

### **Tailored gamification: A review of literature**

Gamification is increasingly becoming a pertinent aspect of any UI and UX design. However, a canonical dearth in research and application of gamification has been related to the role of individual differences in susceptibility to gamification and its varied designs. To address this gap, this study reviews the extant corpus of research on tailored gamification (42 studies). The findings of the review indicate that most studies on the field are mostly focused on user modeling for a future personalization, adaptation, or recommendation of game elements. This user model usually contains the users' preferences of play (i.e., player types), and is mostly applied in educational settings. The main contributions of this paper are a standardized terminology of the game elements used in tailored gamification, the discussion on the most suitable game elements for each users' characteristic, and a research agenda including dynamic modeling, exploring multiple characteristics simultaneously, and understanding the effects of other aspects of the interaction on user experience.

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MoE publication type: A2 Review article in a scientific journal

Organisations: Computing Sciences, Tampere University, Federal University of Rio Grande do Sul, State University of Santa Catarina

Contributors: Klock, A. C. T., Gasparini, I., Pimenta, M. S., Hamari, J.

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Keywords: Adaptation, Gamification, Personalization, Recommendation, Systematic review, Tailoring

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Research output: Contribution to journal > Review Article > Scientific > peer-review

### **The effect of challenge-based gamification on learning: An experiment in the context of statistics education**

Gamification is increasingly employed in learning environments as a way to increase student motivation and consequent learning outcomes. However, while the research on the effectiveness of gamification in the context of education has been growing, there are blind spots regarding which types of gamification may be suitable for different educational contexts. This study investigates the effects of the challenge-based gamification on learning in the area of statistics education. We developed a gamification approach, called Horses for Courses, which is composed of main game design patterns related to the challenge-based gamification; points, levels, challenges and a leaderboard. Having conducted a 2 (read: yes vs. no) x 2 (gamification: yes vs. no) between-subject experiment, we present a quantitative analysis of the performance of 365 students from two different academic majors: Electrical and Computer Engineering (n=279), and Business Administration (n=86). The results of our experiments show that the challenge-based gamification had a positive impact on student learning compared to traditional teaching methods (compared to having no treatment and treatment involving reading exercises). The effect was larger for females or for students at the School of Electrical and Computer Engineering.

#### **General information**

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Organisations: Computing Sciences, National Technical University of Athens, Tampere University, Gamification Group

Contributors: Legaki, N. Z., Xi, N., Hamari, J., Karpouzis, K., Assimakopoulos, V.

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Keywords: Applications in education, Gamification, Human-Computer interface, Statistics education, Teaching forecasting

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Research output: Contribution to journal > Article > Scientific > peer-review

### **Some SonarQube issues have a significant but small effect on faults and changes. A large-scale empirical study**

**Context:** Companies frequently invest effort to remove technical issues believed to impact software qualities, such as removing anti-patterns or coding styles violations. **Objective:** We aim to analyze the diffuseness of SonarQube issues in software systems and to assess their impact on code changes and fault-proneness, considering also their different types and severities. **Methods:** We conducted a case study among 33 Java projects from the Apache Software Foundation repository. **Results:** We analyzed 726 commits containing 27K faults and 12M changes in Java files. The projects violated 173 SonarQube rules generating more than 95K SonarQube issues in more than 200K classes. Classes not affected by SonarQube issues are less change-prone than affected ones, but the difference between the groups is small. Non-affected classes are slightly more change-prone than classes affected by SonarQube issues of type Code Smell or Security Vulnerability. As for fault-proneness, there is no difference between non-affected and affected classes. Moreover, we found incongruities in the type and severity assigned by SonarQube. **Conclusion:** Our result can be useful for practitioners to understand which SonarQube issues should be refactored and for researchers to bridge the missing gaps. Moreover, results can also support companies and tool vendors in identifying SonarQube issues as accurately as possible.

#### **General information**

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Organisations: Computing Sciences, LUT University

Contributors: Lenarduzzi, V., Saarimäki, N., Taibi, D.

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ISSN (Print): 0164-1212

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ASJC Scopus subject areas: Software, Information Systems, Hardware and Architecture

Keywords: Change-proneness, Empirical study, Fault-proneness, SonarQube

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#### **Bibliographical note**

EXT="Lenarduzzi, Valentina"

Source: Scopus

Source ID: 85087390369

Research output: Contribution to journal > Article > Scientific > peer-review

### **Necessary and sufficient conditions for the existence of solution of generalized fuzzy relation equations $A \Leftrightarrow X = B$**

In 2013 Li and Jin studied a particular type of fuzzy relational equations on finite sets, where the introduced min-bi-implication composition is based on Łukasiewicz equivalence. In this paper such fuzzy relation equations are studied on a more general level, namely complete residuated lattice valued fuzzy relation equations of type  $\bigwedge_{y \in Y} (A(x,y) \leftrightarrow X(y)) = B(x)$  are analyzed, and the existence of solutions  $S$  is studied. First a necessary condition for the existence of solution is established, then conditions for lower and upper limits of solutions are given, and finally sufficient conditions for the existence of the smallest and largest solutions, respectively, are characterized. If such general or global solutions do not exist, there might still be partial or point wise solutions; this is a novel way to study fuzzy relation equations. Such point wise solutions are studied on Łukasiewicz, Product and Gödel t-norm based residuated lattices on the real unit interval.

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Organisations: Computing Sciences, Research group: Computer Science and Applied Logics  
Contributors: Turunen, E.  
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Keywords: Fuzzy relation equation, Residuated lattice, T-norm  
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Source ID: 85085840362  
Research output: Contribution to journal > Article > Scientific > peer-review

### Using Deep Learning for price prediction by exploiting stationary limit order book features

The recent surge in Deep Learning (DL) research of the past decade has successfully provided solution to many difficult problems. The field of Quantitative analysis has been slowly adapting the new methods to its problems, but due to problems such as the non-stationary nature of financial data, significant challenges must be overcome before DL is fully utilized. In this work a new method to construct stationary features is proposed such that allows DL models to be applied effectively. These features are thoroughly tested on the task of predicting mid price movements of the Limit Order Book. Several DL models are evaluated such as recurrent Long Short Term Memory (LSTM) networks and Convolutional Neural Networks (CNN). Finally a novel model that combines the ability of the CNN to extract useful features and the ability of LSTMs' to analyse time series, is proposed and evaluated. The combined model is able to outperform the individual LSTM and CNN models in the prediction horizons that are tested.

### General information

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Organisations: Computing Sciences, Aristotle University of Thessaloniki, University of Milan Bicocca, Department of Informatics, Aarhus Universitet  
Contributors: Tsantekidis, A., Passalis, N., Tefas, A., Kannianen, J., Gabbouj, M., Iosifidis, A.  
Publication date: 1 Aug 2020  
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### Bibliographical note

EXT="Tefas, Anastasios"  
EXT="Iosifidis, Alexandros"  
Source: Scopus  
Source ID: 85084845392  
Research output: Contribution to journal > Article > Scientific > peer-review

### **Flow-bounded trajectory-scaling algorithm for hydraulic robotic manipulators**

On-line methods for trajectory scaling have focused on torque or acceleration bounded minimum time trajectories, while other system constraints have received little attention. For hydraulic systems, volumetric flow rate of the supply unit establishes a critical constraint, that has been neglected in control design. Consequently, commercial solutions for robotic control of hydraulic manipulators are typically limited to a compromise of a slower constant endpoint velocity, that can be achieved in any operating point without violating the constrained flow rate. However, with real-time analysis of the required volumetric flow rate, the desired trajectories can be executed much faster without violating the flow rate constraint or losing control accuracy. This study proposes an on-line method for trajectory scaling to perform predetermined trajectories in minimum time. Essentially, the method scales velocity along the trajectory to maintain achievable velocity at all times. The proposed method is capable of enforcing a global volumetric flow limit, whether it is constant or time-varying. The method is validated with simulations and experiments with a real hydraulic robotic manipulator. Experimental results show a very significant improvement in the trajectory tracking control, where the tracking error is reduced from 461 mm to 73 mm on a square trajectory.

#### **General information**

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MoE publication type: A4 Article in a conference publication

Organisations: Automation Technology and Mechanical Engineering, Rambooms Oy

Contributors: Lampinen, S., Niemi, J., Mattila, J.

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ASJC Scopus subject areas: Electrical and Electronic Engineering, Control and Systems Engineering, Computer Science Applications, Software

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Source: Scopus

Source ID: 85090380825

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **On the zeros of the partial Hosoya polynomial of graphs**

The partial Hosoya polynomial (or briefly the partial H-polynomial) can be used to construct the well-known Hosoya polynomial. The  $i$ th coefficient of this polynomial, defined for an arbitrary vertex  $u$  of a graph  $G$ , is the number of vertices at distance  $i$  from  $u$ . The aim of this paper is to determine the partial H-polynomial of several well-known graphs and, then, to investigate the location of their zeros. To pursue, we characterize the structure of graphs with the minimum and the maximum modulus of the zeros of partial H-polynomial. Finally, we define another graph polynomial of the partial H-polynomial, see [9]. Also, we determine the unique positive root of this polynomial for particular graphs.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Shahid Rajaei Teacher Training University, Swiss Distance University of Applied Sciences, Institute for Bioinformatics and Translational Research, Nankai University, Tianjin Polytechnic University, Central South University China, Aalto University, Peking University, Mathematics Faculty of Information Technology and Communication Sciences

Contributors: Ghorbani, M., Dehmer, M., Cao, S., Feng, L., Tao, J., Emmert-Streib, F.

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Peer-reviewed: Yes

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ASJC Scopus subject areas: Software, Control and Systems Engineering, Theoretical Computer Science, Computer Science Applications, Information Systems and Management, Artificial Intelligence

Keywords: Cut-vertex, Distance, Hosoya polynomial, Polynomial roots

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Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Kvazaar 2.0: Fast and efficient open-source HEVC inter encoder

High Efficiency Video Coding (HEVC) is the key to economic video transmission and storage in the current multimedia applications but tackling its inherent computational complexity requires powerful video codec implementations. This paper presents Kvazaar 2.0 HEVC encoder that is the new release of our academic open-source software ([github.com/ultravideo/kvazaar](https://github.com/ultravideo/kvazaar)). Kvazaar 2.0 introduces novel inter coding functionality that is built on advanced rate-distortion optimization (RDO) scheme and speeded up with several early termination mechanisms, SIMD-optimized coding tools, and parallelization strategies. Our experimental results show that the proposed coding scheme makes Kvazaar 125 times as fast as the HEVC reference software HM on the Intel Xeon E5-2699 v4 22-core processor at the additional coding cost of only 2.4% on average. In constant quantization parameter (QP) coding, Kvazaar is also 3 times as fast as the respective preset of the well-known practical x265 HEVC encoder and is still able to attain 10.7% lower average bit rate than x265 for the same objective visual quality. These results indicate that Kvazaar has become one of the leading open-source HEVC encoders in practical high-efficiency video coding.

### General information

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MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research area: Computer engineering

Contributors: Lemmetti, A., Viitanen, M., Mercat, A., Vanne, J.

Number of pages: 6

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ISBN (Electronic): 9781450368452

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Human-Computer Interaction, Software

Keywords: high efficiency video coding (HEVC), inter coding, Kvazaar HEVC encoder, open-source, rate-distortion optimization (RDO)

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Source: Scopus

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Research output: [Chapter in Book/Report/Conference proceeding](#) › [Conference contribution](#) › [Scientific](#) › [peer-review](#)

### Adaptive Normalization for Forecasting Limit Order Book Data Using Convolutional Neural Networks

Deep learning models are capable of achieving state-of-the-art performance on a wide range of time series analysis tasks. However, their performance crucially depends on the employed normalization scheme, while they are usually unable to efficiently handle non-stationary features without first appropriately pre-processing them. These limitations impact the performance of deep learning models, especially when used for forecasting financial time series, due to their non-stationary and multimodal nature. In this paper we propose a data-driven adaptive normalization layer which is capable of learning the most appropriate normalization scheme that should be applied on the data. To this end, the proposed method first identifies the distribution from which the data were generated and then it dynamically shifts and scales them in order to facilitate the task at hand. The proposed normalization scheme is fully differentiable and it is trained in an end-to-end fashion along with the rest of the parameters of the model. The proposed method leads to significant performance improvements over several competitive normalization approaches, as demonstrated using a large-scale limit order book dataset.

### General information

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MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research group: Multimedia Research Group - MRG, Aristotle University of Thessaloniki, Aarhus Universitet

Contributors: Passalis, N., Tefas, A., Kannianen, J., Gabbouj, M., Iosifidis, A.

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ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering

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### Bibliographical note

EXT="Tefas, Anastasios"

EXT="Iosifidis, Alexandros"

Source: Scopus

Source ID: 85089240342

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Peer to Peer Offloading with Delayed Feedback: An Adversary Bandit Approach

Fog computing brings computation and services to the edge of networks enabling real time applications. In order to provide satisfactory quality of experience, the latency of fog networks needs to be minimized. In this paper, we consider a peer computation offloading problem for a fog network with unknown dynamics. Peer competition occurs when different fog nodes offload tasks to the same peer FN. In this paper, the computation offloading problem is modeled as a sequential FN selection problem with delayed feedback. We construct an online learning policy based on the adversary multi-arm bandit framework to deal with peer competition and delayed feedback. Simulation results validate the effectiveness of the proposed policy.

### General information

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Organisations: Electrical Engineering, Research group: Wireless Communications and Positioning, Shanghai Advanced Research Institute, Chinese Academy of Sciences, ShanghaiTech University, Shanghai Institute of Microsystem and Information Technology Chinese Academy of Sciences, Peoples' Friendship University of Russia

Contributors: Yang, M., Zhu, H., Wang, H., Koucheryavy, Y., Samouylov, K., Qian, H.

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Keywords: adversary multi-arm bandit, delayed feed-back, Fog computing, reinforcement learning, task offloading

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### **SeCon-NG: Implementing a lightweight cryptographic library based on ECDH and ECDSA for the development of secure and privacy-preserving protocols in contiki-NG**

There is no doubt that the Internet of Things (IoT) has the power to change our world and drive us to a complete social evolution. In business and industry, there are thousands of IoT use cases and real-life IoT deployments across a variety of sectors (e.g. industry 4.0 and smart factories, smart cities, etc.). However, due to the vastly resource constrained nature of the devices used in IoT, implementing secure and privacy-preserving services, using for example standard asymmetric cryptographic algorithms, has been a real challenge. The majority of IoT devices on the market currently employ the use of various forms of symmetric cryptography such as key pre-distribution. The overall efficiency of such implementations correlate directly to the size of the IoT environment and the deployment method. In this paper, we implement a lightweight cryptographic library that can be used to secure communication protocols between multiple communicating nodes without the need for external trusted entities or a server. Our implementation is based on modifying the Elliptic-Curve Diffie-Hellman (ECDH) and Elliptic Curve Digital Signature Algorithm (ECDSA) components of the Tincrypt cryptographic library. This work focuses on extending the functionalities of the User Datagram Protocol (UDP) broadcast application on the Contiki-NG Operating System (OS) platform.

#### **General information**

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Organisations: Computing Sciences

Contributors: Frimpong, E., Michalas, A.

Number of pages: 3

Pages: 767-769

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ISBN (Electronic): 9781450368667

ASJC Scopus subject areas: Software

Keywords: Contiki-NG, Elliptic curve cryptography, Key distribution, Lightweight cryptography, Privacy, Wireless sensor networks

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Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Gaussian mixture models for signal mapping and positioning**

Maps of RSS from a wireless transmitter can be used for positioning or for planning wireless infrastructure. The RSS values measured at a single point are not always the same, but follow some distribution, which vary from point to point. In existing approaches in the literature this variation is neglected or its mapping requires making many measurements at every point, which makes the measurement collection very laborious. We propose to use GMs for modeling joint distributions of the position and the RSS value. The proposed model is more versatile than methods found in the literature as it models the joint distribution of RSS measurements and the location space. This allows us to model the distributions of RSS values in every point of space without making many measurement in every point. In addition, GMs allow us to compute conditional probabilities and posteriors of position in closed form. The proposed models can model any RSS attenuation pattern, which is useful for positioning in multifloor buildings. Our tests with WLAN signals show that positioning with the proposed algorithm provides accurate position estimates. We conclude that the proposed algorithm can provide useful information about distributions of RSS values for different applications.

#### **General information**

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Organisations: Computing Sciences, Research group: Automation and Systems Theory, Aalto University, University of Liverpool, Universidad Antonio de Nebrija, Uppsala University

Contributors: Raitoharju, M., García-Fernández, F., Hostettler, R., Piché, R., Särkkä, S.

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Keywords: Gaussian mixtures, Indoor positioning, RSS, Signal mapping, Statistical modeling  
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Source ID: 85073693932  
Research output: Contribution to journal › Article › Scientific › peer-review

### **Serverless: What it Is, What to Do and What Not to Do**

Serverless, the new buzzword, has been gaining a lot of attention from the developers and industry. Cloud vendors such as AWS and Microsoft have hyped the architecture almost everywhere, from practitioners' conferences to local events, to blog posts. In this work, we introduce serverless functions (also known as Function-as-a-Service or FaaS), together with on bad practices experienced by practitioners, members of the Tampere Serverless Meetup group.

#### **General information**

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Organisations: Computing Sciences, Gofore Plc  
Contributors: Nupponen, J., Taibi, D.  
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ASJC Scopus subject areas: Computer Science Applications, Hardware and Architecture, Software, Information Systems and Management  
Keywords: FaaS, Function-as-a-service, Serverless  
DOIs:  
10.1109/ICSA-C50368.2020.00016  
Source: Scopus  
Source ID: 85085749334  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **A custom processor for protocol-independent packet parsing**

Networking devices such as switches and routers have traditionally had fixed functionality. They have the logic for the union of network protocols matching the application and market segment for which they have been designed. Possibility of adding new functionality is limited. One of the aims of Software Defined Networking is to make packet processing devices programmable. This provides for innovation and rapid deployment of novel networking protocols. The first step in processing of packets is packet parsing. In this paper, we present a custom processor for packet parsing. The parser is protocol-independent and can be programmed to parse any sequence of headers. It does so without the use of a Ternary Content Addressable Memory. As a result, the area and power consumption are noticeably smaller than in the state of the art. Moreover, its output is the same as that of the parser used in the Reconfigurable Match Tables (RMT). With an area no more than that of parsers in the RMT architecture, it sustains aggregate throughput of 3.4 Tbps in the worst case which is an improvement by a factor of 5.

#### **General information**

Publication status: Published  
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Organisations: Electrical Engineering, Research area: Computer engineering, University of Bologna  
Contributors: Zolfaghari, H., Rossi, D., Nurmi, J.  
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Research output: Contribution to journal › Article › Scientific › peer-review

### Are SonarQube Rules Inducing Bugs?

The popularity of tools for analyzing Technical Debt, and particularly the popularity of SonarQube, is increasing rapidly. SonarQube proposes a set of coding rules, which represent something wrong in the code that will soon be reflected in a fault or will increase maintenance effort. However, our local companies were not confident in the usefulness of the rules proposed by SonarQube and contracted us to investigate the fault-proneness of these rules. In this work we aim at understanding which SonarQube rules are actually fault-prone and to understand which machine learning models can be adopted to accurately identify fault-prone rules. We designed and conducted an empirical study on 21 well-known mature open-source projects. We applied the SZZ algorithm to label the fault-inducing commits. We analyzed the fault-proneness by comparing the classification power of seven machine learning models. Among the 202 rules defined for Java by SonarQube, only 25 can be considered to have relatively low fault-proneness. Moreover, violations considered as 'bugs' by SonarQube were generally not fault-prone and, consequently, the fault-prediction power of the model proposed by SonarQube is extremely low. The rules applied by SonarQube for calculating technical debt should be thoroughly investigated and their harmfulness needs to be further confirmed. Therefore, companies should carefully consider which rules they really need to apply, especially if their goal is to reduce fault-proneness.

### General information

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Organisations: Computing Sciences, Lappeenranta University of Technology

Contributors: Lenarduzzi, V., Lomio, F., Huttunen, H., Taibi, D.

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ASJC Scopus subject areas: Organizational Behavior and Human Resource Management, Hardware and Architecture, Software, Safety, Risk, Reliability and Quality, Computer Networks and Communications

Keywords: architectural smells, code smells, coding style, machine learning, SonarQube, static analysis, Technical Debt

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EXT="Lenarduzzi, Valentina"

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Source ID: 85083565109

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### A preliminary network analysis on steam game tags: Another way of understanding game genres

Video game genre classification has long been a focusing perspective in game studies domain. Despite the commonly acknowledged usefulness of genre classification, scholars in the game studies domain are yet to reach consensus on the

game genre classification. On the other hand, Steam, a popular video game distribution platform, adopts the user-generated tag feature enabling players to describe and annotate video games based on their own understanding of genres. Despite the concern of the quality, the user-generated tags (game tags) provide an opportunity towards an alternative way of understanding video game genres based on the players' collective intelligence. Hence, in this study, we construct a network of game tags based on the co-occurrence of tags in games on Steam platform and analyze the structure of the network via centrality analysis and community detection. Such analysis shall provide an intuitive presentation on the distribution and connections of the game tags, which furthermore suggests a potential way of understanding the important tags that are commonly adopted and the main genres of video games.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Communication Sciences  
Contributors: Li, X., Zhang, B.  
Number of pages: 9  
Pages: 65-73  
Publication date: 29 Jan 2020

#### **Host publication information**

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ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Vision and Pattern Recognition, Computer Networks and Communications  
Keywords: centrality, community detection, game tag, genre, modularity, network, steam, video game  
DOIs:  
10.1145/3377290.3377300

#### **Bibliographical note**

INT=coms,"Li, Xiaozhou"  
Source: Scopus  
Source ID: 85080924784  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Color game: A collaborative social robotic game for icebreaking; Towards the design of robotic ambiances as part of smart building services**

Social robots are entering our workplaces, homes, medical and educational systems in assistive and collaborative roles. In our research, we have investigated the use of a social robot Pepper as an interactive icebreaker host to create a positive atmosphere at events. This paper presents two user studies (total n=43) in which we evaluated two interactive prototypes of playful applications on Pepper, with the overall aim of providing a personal and entertaining service for event attendees. Data about users' experiences and attitudes were collected with semi-structured interviews, surveys, and observations. The results of the studies suggest that the majority of the participants had pleasurable and positive experiences with the robot and its applications. Moreover, their positive encounters led them to accept social robots as icebreaker hosts to connect with strangers. Based on our findings, we present a list of design implications to help the future design of social robots used to facilitate social connectedness, and to aid in the development of social robots as intelligent agents performing tasks as integrated parts of smart spaces.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Civil Engineering, Research group: Digitalization in the real estate and construction sector  
Contributors: Beheshtian, N., Kaipainen, K., Kähkönen, K., Ahtinen, A.  
Number of pages: 10  
Pages: 10-19  
Publication date: 29 Jan 2020

#### **Host publication information**

Title of host publication: AcademicMindtrek 2020 - Proceedings of the 23rd International Academic Mindtrek Conference : January 2020, Tampere  
Publisher: ACM  
ISBN (Electronic): 9781450377744  
ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Vision and Pattern Recognition, Computer Networks and Communications  
Keywords: human robot interaction, ice breaking, smart building, social connectedness, social robots, user experience

DOIs:

10.1145/3377290.3377292

Source: Scopus

Source ID: 85080911326

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Demographic differences in accumulated types of capital in massively multiplayer online role-playing games**

This paper examines how the demographic attributes and extra-game habits of players of a Massively Multiplayer Online Role-Playing Game (MMORPG) predict the accumulated capital of their avatars. An online survey (N=905) was conducted amidst the players of Final Fantasy XIV (FFXIV). Four types of capital were measured to map out the concrete and intangible resources of the avatars; social, economic, cultural and symbolic. The results show that weekly time spent playing the game is the strongest predictor of avatar capital and was associated with all types of capital. Time subscribed to the game was associated with cultural, economic, symbolic and bonding social capital. Social capital was found to be highest amongst both young and female players. Forum activity was associated with symbolic capital.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Communication Sciences, Research group: TUT Game Lab, Computing Sciences, Turun yliopisto

Contributors: Korkeila, H., Koivisto, J., Hamari, J.

Number of pages: 9

Pages: 74-82

Publication date: 29 Jan 2020

#### **Host publication information**

Title of host publication: AcademicMindtrek 2020 - Proceedings of the 23rd International Academic Mindtrek Conference : January 2020, Tampere

Publisher: ACM

ISBN (Electronic): 9781450377744

ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Vision and Pattern Recognition, Computer Networks and Communications

Keywords: avatar, capital, demographics, MMORPG

DOIs:

10.1145/3377290.3377302

Source: Scopus

Source ID: 85080910780

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Innovation challenges as a novel multidisciplinary learning platform**

Innovation Challenges is a new course offered for the whole Tampere university community by Y-kampus entrepreneurship and innovation services, for the first time in fall 2019. Innovation Challenges offers practice-based cases that allow students to develop their creativity and problem-solving skills in a team. Learning is anchored in team coaching pedagogy, learning-by-doing attitude and entrepreneurial mindset. In this paper, we first describe the evolution that created a course called Innovation Challenges. Then, we describe course organization and the six challenges that student teams are currently solving.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Information and Knowledge Management, Research group: Business Data Research Group, Tampere Uni. of Applied Sci., Tampere University

Contributors: Jokiniemi, S., Myllärniemi, J., Poranen, T., Vuorenmaa, M.

Number of pages: 4

Pages: 145-148

Publication date: 29 Jan 2020

#### **Host publication information**

Title of host publication: AcademicMindtrek 2020 - Proceedings of the 23rd International Academic Mindtrek Conference : January 2020, Tampere

Publisher: ACM

ISBN (Electronic): 9781450377744

ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Vision and Pattern Recognition, Computer Networks and Communications

Keywords: innovation, learning platform, multidisciplinary projects

DOIs:

10.1145/3377290.3377311

### **Bibliographical note**

INT=comp,"Poranen, Timo"

Source: Scopus

Source ID: 85080863203

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Satisfaction and willingness to consume immersive journalism: Experiment of differences between VR, 360 video, and article**

Immersive journalism has been touted to revolutionize journalism due to its ability to afford a multi-modal engrossing experience. However, hardly any experiments have been conducted whether consumers' satisfaction and consequent intentions to use immersive journalistic media may differ from traditional forms of journalistic content. Therefore, in this study, we investigate the differences in satisfaction and continued use intentions between article, 360 video and VR-based interaction with content. The data was collected via a randomized controlled laboratory experiment with between-subjects design (N = 87). Participants were randomly assigned to reading a written article based on the video (article) and watching the video on a computer screen (2D 360) or in mobile VR (VR 360). The collected data consisted of demographics (age and gender) and reported satisfaction and intention to continue use. Results suggest that those who were assigned to VR 360 had higher intentions to continue use, but not greater satisfaction than those in the other two conditions. However, the intention was predicted to an extent by satisfaction as suggested by previous literature. Finally, age and gender did not predict continued use. These findings imply that users prefer the new media technology for consuming journalism content and support previous findings of the relationship between satisfaction and intention to continue use. Finally, avenues for further research are presented.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research group: TUT Game Lab

Contributors: Bujic, M., Hamari, J.

Number of pages: 6

Pages: 120-125

Publication date: 29 Jan 2020

### **Host publication information**

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Publisher: ACM

ISBN (Electronic): 9781450377744

ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Vision and Pattern Recognition, Computer Networks and Communications

Keywords: 360-degree video, age, gender, immersive journalism, intention to continue use, satisfaction, virtual reality

DOIs:

10.1145/3377290.3377310

Source: Scopus

Source ID: 85080895604

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Social human-robot interaction in the wild: A workshop proposal for academic mindtrek 2020**

This workshop will collect experts and stakeholders from all fields of human-robot interaction: both social and industrial applications and uses of robotics are of interest as far as they have human in the loop. The workshop will present recent and fully new research work in social HRI, including first results of a 3.5 month field trial and mixed-method study of a social robot Pepper in a shopping mall in Finland.

### **General information**

Publication status: Published

MoE publication type: B3 Non-refereed article in conference proceedings

Organisations: Computing Sciences, Tampere University, VTT Technical Research Centre of Finland

Contributors: Niemelä, M., Ahtinen, A., Turunen, M.

Number of pages: 2

Pages: 168-169

Publication date: 29 Jan 2020

### **Host publication information**

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ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Vision and Pattern Recognition, Computer Networks and Communications

Keywords: collaborative robots, human-robot interaction, social robots

DOIs:

10.1145/3377290.3377320

### **Bibliographical note**

INT=comp,"Turunen, Markku"

Source: Scopus

Source ID: 85080870105

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific

### **"The superhero of the university": Experience-driven design and field study of the university guidance robot**

Robots have recently gained popularity in customer service. Especially social robots are nowadays utilized in healthcare, elderly homes and schools. Although it is crucial to design social robots according to well-defined user experience goals, research related to experience-driven design of social robots is still scarce. Experience-Driven Design (EDD) is a framework to design interaction for technology based on certain goals, known as experience goals. In this paper, we present the design and evaluation of the university guidance robot based on the user experience goals defined in previous research. The experience goals are nurture, fellowship and recreation. We designed applications, interaction, and robot's behavior to support the fulfillment of the experience goals. The social robot Pepper served as a platform for the university guidance robot. The evaluation was conducted as a field study in a university campus with 32 university students during the orientation week. According to our findings, the university guide robot successfully evoked nurture, fellowship and recreation among participants.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences

Contributors: Chowdhury, A., Ahtinen, A., Kaipainen, K.

Number of pages: 9

Pages: 1-9

Publication date: 29 Jan 2020

### **Host publication information**

Title of host publication: AcademicMindtrek 2020 - Proceedings of the 23rd International Academic Mindtrek Conference : January 2020, Tampere

Publisher: ACM

ISBN (Electronic): 9781450377744

ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Vision and Pattern Recognition, Computer Networks and Communications

Keywords: experience-driven design, social robots, user experience

DOIs:

10.1145/3377290.3377304

URLs:

<http://www.scopus.com/inward/record.url?scp=85080943314&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85080943314

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Anthropometric clothing measurements from 3D body scans**

We propose a full processing pipeline to acquire anthropometric measurements from 3D measurements. The first stage of our pipeline is a commercial point cloud scanner. In the second stage, a pre-defined body model is fitted to the captured point cloud. We have generated one male and one female model from the SMPL library. The fitting process is based on non-rigid iterative closest point algorithm that minimizes overall energy of point distance and local stiffness energy terms. In the third stage, we measure multiple circumference paths on the fitted model surface and use a nonlinear regressor to provide the final estimates of anthropometric measurements. We scanned 194 male and 181 female subjects, and the proposed pipeline provides mean absolute errors from 2.5 to 16.0 mm depending on the anthropometric measurement.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Vision, NOMO Technologies Ltd

Contributors: Yan, S., Wirta, J., Kämäräinen, J.  
Number of pages: 11  
Publication date: 2020  
Peer-reviewed: Yes

#### Publication information

Journal: Machine Vision and Applications  
Volume: 31  
Issue number: 1-2  
Article number: 7  
ISSN (Print): 0932-8092  
Original language: English  
ASJC Scopus subject areas: Software, Hardware and Architecture, Computer Vision and Pattern Recognition, Computer Science Applications  
Keywords: 3D body model, Anthropometric measurement, Non-rigid ICP  
Electronic versions:  
Anthropometric clothing measurements 2020  
DOIs:  
10.1007/s00138-019-01054-4  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202006116044>  
Source: Scopus  
Source ID: 85078296322  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Censor-Based Cooperative Multi-Antenna Spectrum Sensing with Imperfect Reporting Channels

The present contribution proposes a spectrally efficient censor-based cooperative spectrum sensing (C-CSS) approach in a sustainable cognitive radio network that consists of multiple antenna nodes and experiences imperfect sensing and reporting channels. In this context, exact analytic expressions are first derived for the corresponding probability of detection, probability of false alarm, and secondary throughput, assuming that each secondary user (SU) sends its detection outcome to a fusion center only when it has detected a primary signal. Capitalizing on the findings of the analysis, the effects of critical measures, such as the detection threshold, the number of SUs, and the number of employed antennas, on the overall system performance are also quantified. In addition, the optimal detection threshold for each antenna based on the Neyman-Pearson criterion is derived and useful insights are developed on how to maximize the system throughput with a reduced number of SUs. It is shown that the C-CSS approach provides two distinct benefits compared with the conventional sensing approach, i.e., without censoring: i) the sensing tail problem, which exists in imperfect sensing environments, can be mitigated; and ii) less SUs are ultimately required to obtain higher secondary throughput, rendering the system more sustainable.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Research group: Wireless Communications and Positioning, Electrical Engineering, Taiyuan University of Science and Technology, University of Waterloo, Khalifa University, University of Surrey, University of London, Simon Fraser University  
Contributors: Li, M., Alhussein, O., Sofotasios, P. C., Muhaidat, S., Yoo, P. D., Liang, J., Wang, A.  
Number of pages: 13  
Pages: 48-60  
Publication date: 2020  
Peer-reviewed: Yes

#### Publication information

Journal: IEEE Transactions on Sustainable Computing  
Volume: 5  
Issue number: 1  
ISSN (Print): 2377-3782  
Original language: English  
ASJC Scopus subject areas: Computational Theory and Mathematics, Hardware and Architecture, Software, Renewable Energy, Sustainability and the Environment, Control and Optimization  
Keywords: censoring, cooperative spectrum sensing, energy detection, energy efficiency, imperfect reporting channels, multi-antenna systems, Sustainable computing  
DOIs:  
10.1109/TSUSC.2019.2896667  
Source: Scopus  
Source ID: 85081759371

### **Compressive sensed video recovery via iterative thresholding with random transforms**

The authors consider the problem of compressive sensed video recovery via iterative thresholding algorithm. Traditionally, it is assumed that some fixed sparsifying transform is applied at each iteration of the algorithm. In order to improve the recovery performance, at each iteration the thresholding could be applied for different transforms in order to obtain several estimates for each pixel. Then the resulting pixel value is computed based on obtained estimates using simple averaging. However, calculation of the estimates leads to significant increase in reconstruction complexity. Therefore, the authors propose a heuristic approach, where at each iteration only one transform is randomly selected from some set of transforms. First, they present simple examples, when block-based 2D discrete cosine transform is used as the sparsifying transform, and show that the random selection of the block size at each iteration significantly outperforms the case when fixed block size is used. Second, building on these simple examples, they apply the proposed approach when video block-matching and 3D filtering (VBM3D) is used for the thresholding and show that the random transform selection within VBM3D allows to improve the recovery performance as compared with the recovery based on VBM3D with fixed transform.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Computational Imaging-CI, ITMO University, Linköping University, University of Oulu

Contributors: Belyaev, E., Codreanu, M., Juntti, M., Egiazarian, K.

Number of pages: 14

Pages: 1187-1200

Publication date: 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: IET Image Processing

Volume: 14

Issue number: 6

ISSN (Print): 1751-9659

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Electrical and Electronic Engineering

DOIs:

10.1049/iet-ipr.2019.0661

#### **Bibliographical note**

EXT="Belyaev, Evgeny"

Source: Scopus

Source ID: 85084175769

Research output: Contribution to journal › Article › Scientific › peer-review

### **Does code quality affect pull request acceptance? An empirical study**

Background: Pull requests are a common practice for making contributions and reviewing them in both open-source and industrial contexts.

Objective: Our goal is to understand whether quality flaws such as code smells, anti-patterns, security vulnerabilities, and coding style violations in a pull request's code affect the chance of its acceptance when reviewed by a maintainer of the project.

Method: We conducted a case study among 28 Java open-source projects, analyzing the presence of 4.7 M code quality flaws in 36 K pull requests. We analyzed further correlations by applying logistic regression and six machine learning techniques. Moreover, we manually validated 10% of the pull requests to get further qualitative insights on the importance of quality issues in cases of acceptance and rejection.

Results: Unexpectedly, quality flaws measured by PMD turned out not to affect the acceptance of a pull request at all. As suggested by other works, other factors such as the reputation of the maintainer and the importance of the delivered feature might be more important than other qualities in terms of pull request acceptance.

Conclusions: Researchers have already investigated the influence of the developers' reputation and the pull request acceptance. This is the first work investigating code style violations and specifically PMD rules. We recommend that researchers further investigate this topic to understand if different measures or different tools could provide some useful measures.

#### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, LUT University  
Contributors: Lenarduzzi, V., Nikkola, V., Saarimäki, N., Taibi, D.  
Number of pages: 14  
Publication date: 2020  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Systems and Software  
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ISSN (Print): 0164-1212  
Original language: English  
ASJC Scopus subject areas: Software, Information Systems, Hardware and Architecture  
Keywords: Machine learning, PMD rules, Pull requests  
Electronic versions:  
Does code quality affect pull request 2020  
DOIs:  
10.1016/j.jss.2020.110806  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202009187047>

#### Bibliographical note

EXT="Lenarduzzi, Valentina"  
INT=comp,"Nikkola, Vili"  
Source: Scopus  
Source ID: 85090024069  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Does migrating a monolithic system to microservices decrease the technical debt?

Background: The migration from a monolithic system to microservices requires a deep refactoring of the system. Therefore, such a migration usually has a big economic impact and companies tend to postpone several activities during this process, mainly to speed up the migration itself, but also because of the demand for releasing new features.  
Objective: We monitored the technical debt of an SME while it migrated from a legacy monolithic system to an ecosystem of microservices. Our goal was to analyze changes in the code technical debt before and after the migration to microservices.  
Method: We conducted a case study analyzing more than four years of the history of a twelve-year-old project (280K Lines of Code) where two teams extracted five business processes from the monolithic system as microservices. For the study, we first analyzed the technical debt with SonarQube and then performed a qualitative study with company members to understand the perceived quality of the system and the motivation for possibly postponed activities.  
Results: The migration to microservices helped to reduce the technical debt in the long run. Despite an initial spike in the technical debt due to the development of the new microservice, after a relatively short period of time the technical debt tended to grow slower than in the monolithic system.

#### General information

Publication status: Published  
MoE publication type: A2 Review article in a scientific journal  
Organisations: Computing Sciences, LUT University  
Contributors: Lenarduzzi, V., Lomio, F., Saarimäki, N., Taibi, D.  
Number of pages: 16  
Publication date: 2020  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Systems and Software  
Volume: 169  
Article number: 110710  
ISSN (Print): 0164-1212  
Original language: English  
ASJC Scopus subject areas: Software, Information Systems, Hardware and Architecture  
Keywords: Architectural debt, Code quality, Microservices, Refactoring, Technical debt  
DOIs:  
10.1016/j.jss.2020.110710

#### Bibliographical note

EXT="Lenarduzzi, Valentina"



Source: Scopus

Source ID: 85087383887

Research output: Contribution to journal › Review Article › Scientific › peer-review

### **Exploration and exploitation of sensorimotor contingencies for a cognitive embodied agent**

The modelling of cognition is playing a major role in robotics. Indeed, robots need to learn, adapt and plan their actions in order to interact with their environment. To do so, approaches like embodiment and enactivism propose to ground sensorimotor experience in the robot's body to shape the development of cognition. In this work, we focus on the role of memory during learning in a closed loop. As sensorimotor contingencies, we consider a robot arm that moves a baby mobile toy to get visual reward. First, the robot explores the continuous sensorimotor space by associating visual stimuli to motor actions through motor babbling. After exploration, the robot uses the experience from its memory and exploits it, thus optimizing its motion to perceive more visual stimuli. The proposed approach uses Dynamic Field Theory and is integrated in the GummiArm, a 3D printed humanoid robot arm. The results indicate a higher visual neural activation after motion learning and show the benefits of an embodied babbling strategy.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Automation Technology and Mechanical Engineering, Research group: Robotics and Automation

Contributors: Houbre, Q., Angleraud, A., Pieters, R.

Number of pages: 9

Pages: 546-554

Publication date: 2020

#### **Host publication information**

Title of host publication: ICAART 2020 - Proceedings of the 12th International Conference on Agents and Artificial Intelligence

Volume: 2

Publisher: SCITEPRESS

Editors: Rocha, A., Steels, L., van den Herik, J.

ISBN (Electronic): 9789897583957

ASJC Scopus subject areas: Artificial Intelligence, Software

Keywords: Cognitive Robotics, Dynamic Neural Fields, Embodiment, Sensorimotor Contingencies

Electronic versions:

Exploration and Exploitation of Sensorimotor 2020

DOIs:

10.5220/0008951205460554

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202006166105>

URLs:

<http://www.icaart.org/?y=2020>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **FinnForest dataset: A forest landscape for visual SLAM**

This paper presents a novel challenging dataset that offers a new landscape of testing material for mobile robotics, autonomous driving research, and forestry operation. In contrast to common urban structures, we explore an unregulated natural environment to exemplify sub-urban and forest environment. The sequences provide two-natured data where each place is visited in summer and winter conditions. The vehicle used for recording is equipped with a sensor rig that constitutes four RGB cameras, an Inertial Measurement Unit, and a Global Navigation Satellite System receiver. The sensors are synchronized based on non-drifting timestamps. The dataset provides trajectories of varying complexity both for the state of the art visual odometry approaches and visual simultaneous localization and mapping algorithms. The full dataset and toolkits are available for download at: <http://urn.fi/urn:nbn:fi:att:9b8157a7-1e0f-47c2-bd4e-a19a7e952c0d>. As an alternative, you can browse for the dataset using the article title at: <http://etsin.fairdata.fi>.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: 3D MEDIA, JC Inertial Oy

Contributors: Ali, I., Durmush, A., Suominen, O., Yli-Hietanen, J., Peltonen, S., Collin, J., Gotchev, A.

Number of pages: 13

Publication date: 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: ROBOTICS AND AUTONOMOUS SYSTEMS

Volume: 132

Article number: 103610

ISSN (Print): 0921-8890

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Software, Mathematics(all), Computer Science Applications

Keywords: Autonomous driving, Computer vision, Dataset, Field robotics, Forest, Localization, Mapping, Mobile robotics, Navigation, SLAM, Stereo, Visual odometry

Electronic versions:

FinnForest dataset 2020

DOIs:

10.1016/j.robot.2020.103610

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009016823>

Source: Scopus

Source ID: 85089744434

Research output: Contribution to journal > Article > Scientific > peer-review

### **IoT-CryptoDiet: Implementing a lightweight cryptographic library based on ecdh and ecdsa for the development of secure and privacy-preserving protocols in contiki-ng**

Even though the idea of transforming basic objects to smart objects with the aid sensors is not new, it is only now that we have started seeing the incredible impact of this digital transformation in our societies. There is no doubt that the Internet of Things (IoT) has the power to change our world and drive us to a complete social evolution. This is something that has been well understood by the research and industrial communities that have been investing significant resources in the field of IoT. In business and industry, there are thousands of IoT use cases and real-life IoT deployments across a variety of sectors (e.g. industry 4.0 and smart factories, smart cities, etc.). However, due to the vastly resource-constrained nature of the devices used in IoT, implementing secure and privacy-preserving services, using, for example, standard asymmetric cryptographic algorithms, has been a real challenge. The majority of IoT devices on the market currently employ the use of various forms of symmetric cryptography such as key pre-distribution. The overall efficiency of such implementations correlates directly to the size of the IoT environment and the deployment method. In this paper, we implement a lightweight cryptographic library that can be used to secure communication protocols between multiple communicating nodes without the need for external trusted entities or a server. Our work focuses on extending the functionalities of the User Datagram Protocol (UDP) broadcast application on the Contiki-NG Operating System (OS) platform.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences

Contributors: Frimpong, E., Michalas, A.

Number of pages: 11

Pages: 101-111

Publication date: 2020

#### **Host publication information**

Title of host publication: IoTBDS 2020 - Proceedings of the 5th International Conference on Internet of Things, Big Data and Security

Publisher: SCITEPRESS

Editors: Wills, G., Kacsuk, P., Chang, V.

ISBN (Electronic): 9789897584268

ASJC Scopus subject areas: Software, Computer Networks and Communications

Keywords: Contiki-NG, Elliptic Curve Cryptography, Key Distribution, Privacy, Wireless Sensor Networks.

Electronic versions:

IoT-CryptoDiet 2020

DOIs:

10.5220/0009405401010111

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009016824>

Source: Scopus

Source ID: 85089469229

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Multimodal subspace support vector data description**

In this paper, we propose a novel method for projecting data from multiple modalities to a new subspace optimized for one-class classification. The proposed method iteratively transforms the data from the original feature space of each modality to a new common feature space along with finding a joint compact description of data coming from all the modalities. For data in each modality, we define a separate transformation to map the data from the corresponding feature space to the new optimized subspace by exploiting the available information from the class of interest only. We also propose different regularization strategies for the proposed method and provide both linear and non-linear formulations. The proposed Multimodal Subspace Support Vector Data Description outperforms all the competing methods using data from a single modality or fusing data from all modalities in four out of five datasets.

### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Multimedia Research Group - MRG, Finnish Environment Institute, Aarhus Universitet

Contributors: Sohrab, F., Raitoharju, J., Iosifidis, A., Gabbouj, M.

Number of pages: 13

Publication date: 2020

Peer-reviewed: Yes

### **Publication information**

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Volume: 110

Article number: 107648

ISSN (Print): 0031-3203

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Artificial Intelligence

Keywords: Feature transformation, Multimodal data, One-class classification, Subspace learning, Support vector data description

Electronic versions:

Multimodal subspace support vector 2020

DOIs:

10.1016/j.patcog.2020.107648

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009297162>

### **Bibliographical note**

EXT="Iosifidis, Alexandros"

Source: Scopus

Source ID: 85090954677

Research output: Contribution to journal > Article > Scientific > peer-review

### **On the diffuseness of technical debt items and accuracy of remediation time when using SonarQube**

Context. Among the static analysis tools available, SonarQube is one of the most used. SonarQube detects Technical Debt (TD) items—i.e., violations of coding rules—and then estimates TD as the time needed to remedy TD items. However, practitioners are still skeptical about the accuracy of remediation time estimated by the tool. Objective. In this paper, we analyze both diffuseness of TD items and accuracy of remediation time, estimated by SonarQube, to fix TD items on a set of 21 open-source Java projects. Method. We designed and conducted a case study where we asked 81 junior developers to fix TD items and reduce the TD of 21 projects. Results. We observed that TD items are diffused in the analyzed projects and most items are code smells. Moreover, the results point out that the remediation time estimated by SonarQube is inaccurate and, as compared to the actual time spent to fix TD items, is in most cases overestimated. Conclusions. The results of our study are promising for practitioners and researchers. The former can make more aware decisions during project execution and resource management, the latter can use this study as a starting point for improving TD estimation models.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Università degli Studi di Bari, LUT University

Contributors: Baldassarre, M. T., Lenarduzzi, V., Romano, S., Saarimäki, N.

Number of pages: 18

Publication date: 2020

Peer-reviewed: Yes

### **Publication information**

Journal: Information and Software Technology  
Volume: 128  
Article number: 106377  
ISSN (Print): 0950-5849  
Original language: English  
ASJC Scopus subject areas: Software, Information Systems, Computer Science Applications  
Keywords: Case study, Effort estimation, Remediation time, Sonarqube, Technical debt  
DOIs:  
10.1016/j.infsof.2020.106377

#### **Bibliographical note**

EXT="Lenarduzzi, Valentina"

Source: Scopus

Source ID: 85088664918

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Patterns for serverless functions (Function-as-a-Service): A multivocal literature review**

[Context] Serverless is a recent technology that enables companies to reduce the overhead for provisioning, scaling and in general managing the infrastructure. Companies are increasingly adopting Serverless, by migrating existing applications to this new paradigm. Different practitioners proposed patterns for composing and managing serverless functions. However, some of these patterns offer different solutions to solve the same problem, which makes it hard to select the most suitable solution for each problem. [Goal] In this work, we aim at supporting practitioners in understanding the different patterns, by classifying them and reporting possible benefits and issues. [Method] We adopted a multivocal literature review process, surveying peer-reviewed and grey literature and classifying patterns (common solutions to solve common problems), together with benefits and issues. [Results] Among 24 selected works, we identified 32 patterns that we classified as orchestration, aggregation, event-management, availability, communication, and authorization. [Conclusion] Practitioners proposed a list of fairly consistent patterns, even if a small number of patterns proposed different solutions to similar problems. Some patterns emerged to circumvent some serverless limitations, while others for some classical technical problems (e.g. publisher/subscriber).

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Free University of Bolzano-Bozen

Contributors: Taibi, D., El Ioini, N., Pahl, C., Niederkofler, J. R. S.

Number of pages: 12

Pages: 181-192

Publication date: 2020

#### **Host publication information**

Title of host publication: CLOSER 2020 - Proceedings of the 10th International Conference on Cloud Computing and Services Science

Volume: 1

Publisher: SCITEPRESS

Editors: Ferguson, D., Helfert, M., Pahl, C.

ISBN (Electronic): 9789897584244

ASJC Scopus subject areas: Computer Science (miscellaneous), Computer Science Applications, Software

Keywords: Cloud, Function as a Service, Serverless, Serverless Functions

Electronic versions:

Patterns for serverless functions 2020

DOIs:

10.5220/0009578501810192

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008286730>

Source: Scopus

Source ID: 85088373702

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Redundancy-based visual tool center point pose estimation for long-reach manipulators**

In this paper, we study a visual sensing scheme for 6 degree-of-freedom (DOF) tool center point (TCP) pose estimation of large-scale, long-reach manipulators. A sensor system is proposed, designed especially for mining manipulators, comprising a stereo camera running a simultaneous localization and mapping (SLAM) algorithm near the TCP and multiple cameras that track a fiducial marker attached near the stereo camera. In essence, the TCP pose is formulated using two different routes in a co-operative (eye-in-hand/eye-to-hand) manner using data fusion, with the goal of increasing the system's fault tolerance and robustness via sensor redundancy. The system is studied in offline data

analysis based on real-world measurements recorded using a hydraulic 6 DOF robotic manipulator with a 5 m reach. The SLAM pose trajectory is obtained using the open source ORB-SLAM2 Stereo algorithm, whereas marker-based tracking is realized with a high-end motion capture system. For reference measurements, the pose trajectory is also formulated using joint encoders and a kinematic model of the manipulator. Results of the 6 DOF pose estimation using the proposed sensor system are presented, with future work and key challenges also highlighted.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Automation Technology and Mechanical Engineering, Research group: Innovative Hydraulic Automation, Sandvik Mining and Construction Oy

Contributors: Mäkinen, P., Mustalahti, P., Launis, S., Mattila, J.

Number of pages: 7

Pages: 1387-1393

Publication date: 2020

#### Host publication information

Title of host publication: 2020 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, AIM 2020

Publisher: IEEE

ISBN (Print): 978-1-7281-6795-4

ISBN (Electronic): 9781728167947

#### Publication series

Name: IEEE/ASME International Conference on Advanced Intelligent Mechatronics

ISSN (Print): 2159-6247

ISSN (Electronic): 2159-6255

ASJC Scopus subject areas: Electrical and Electronic Engineering, Control and Systems Engineering, Computer Science Applications, Software

Electronic versions:

Redundancy-Based Visual Tool Center Point Pose Estimation for Long-Reach Manipulators

DOIs:

10.1109/AIM43001.2020.9159022

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009177032>

#### Bibliographical note

EXT="Launis, Sirpa"

JUF0ID=73592

Source: Scopus

Source ID: 85090392663

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Shearlet Transform-Based Light Field Compression under Low Bitrates

Light field (LF) acquisition devices capture spatial and angular information of a scene. In contrast with traditional cameras, the additional angular information enables novel post-processing applications, such as 3D scene reconstruction, the ability to refocus at different depth planes, and synthetic aperture. In this paper, we present a novel compression scheme for LF data captured using multiple traditional cameras. The input LF views were divided into two groups: key views and decimated views. The key views were compressed using the multi-view extension of high-efficiency video coding (MV-HEVC) scheme, and decimated views were predicted using the shearlet-transform-based prediction (STBP) scheme. Additionally, the residual information of predicted views was also encoded and sent along with the coded stream of key views. The proposed scheme was evaluated over a benchmark multi-camera based LF datasets, demonstrating that incorporating the residual information into the compression scheme increased the overall peak signal to noise ratio (PSNR) by 2 dB. The proposed compression scheme performed significantly better at low bit rates compared to anchor schemes, which have a better level of compression efficiency in high bit-rate scenarios. The sensitivity of the human vision system towards compression artifacts, specifically at low bit rates, favors the proposed compression scheme over anchor schemes.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: 3D MEDIA, Computing Sciences, Mid Sweden University, Sundsvall

Contributors: Ahmad, W., Vagharshakyan, S., Sjoström, M., Gotchev, A., Bregovic, R., Olsson, R.

Number of pages: 12

Pages: 4269-4280

Publication date: 2020

Peer-reviewed: Yes

### Publication information

Journal: IEEE Transactions on Image Processing

Volume: 29

ISSN (Print): 1057-7149

Original language: English

ASJC Scopus subject areas: Software, Computer Graphics and Computer-Aided Design

Keywords: Light field (LF) coding, multi-view extension of high-efficiency video coding (MV-HEVC), multiple camera system (MCS) coding, shearlet

DOIs:

10.1109/TIP.2020.2969087

Source: Scopus

Source ID: 85079506505

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### User experience of stereo and spatial audio in 360° live music videos

360° music videos are becoming prevalent in music entertainment. Still, academic studies of the 360° live music experience covering both audio and visual experience are scarce. In this paper, we present a study of user experience of stereo and spatial audio in a 360° live music video setting with two different display types. The research was conducted in the form of a laboratory experiment, in which 20 participants watched and evaluated stereo and spatial audio versions of the same music video using a flat computer display and a head-mounted display (HMD). Based on the results, spatial audio combined with HMD scored highest in the quantitative metrics of perceived audio quality, presence, and overall listening experience. However, qualitative findings reveal that this combination does not fit well with users' listening habits. While nine participants preferred to use headphones to listen to music, thirteen participants viewed music listening as a secondary task-making the use of HMDs less suitable.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Tampere University, Tampere University of Applied Sciences

Contributors: Holm, J., Väänänen, K., Battah, A.

Number of pages: 8

Pages: 134-141

Publication date: 2020

### Host publication information

Title of host publication: AcademicMindtrek 2020 - Proceedings of the 23rd International Academic Mindtrek Conference : January 2020, Tampere

Publisher: ACM

ISBN (Electronic): 9781450377744

ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Vision and Pattern Recognition, Computer Networks and Communications

Keywords: 360° video, ambisonics, head-mounted display, music video, spatial audio, stereo, user experience, virtual reality

DOIs:

10.1145/3377290.3377291

### Bibliographical note

EXT="Holm, Jukka"

INT=comp,"Battah, Anas"

Source: Scopus

Source ID: 85080964162

Research output: [Chapter in Book/Report/Conference proceeding](#) › [Conference contribution](#) › [Scientific](#) › [peer-review](#)

### Validating effectiveness of safety requirements' compliance evaluation in process assessments

Safety is the primary concern when developing systems containing software in the nuclear power domain. Process assessments are used to ensure quality of the development processes for safety-critical systems. Regulators of the nuclear power industry have increased requirements concerning the systems development processes. Now, process assessments are integrated in the qualification of the systems and are expected to provide information not only based on the assessment model but also about the domain-specific requirements. Therefore, a specific activity, compliance evaluation, was inserted into the assessment process to provide detailed information that supports analysis of the compliance to the domain standards. Compliance evaluation utilizes assessment findings to create evidence of the relevant domain-specific requirements. The main purpose of this study is to validate effectiveness of compliance evaluation by analyzing assessment findings and their relation to the requirements of a safety-critical domain. The analysis

is based on representing the data in compliance evaluation reports as binary relations. The results of this analysis indicate that process assessment findings are also relevant when evaluating compliance to other sets of requirements. The results can significantly support the trustworthiness of the process assessment method and ensure effective use of process assessments.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Software Engineering and Intelligent Systems, Research group: Data-analytics and Optimization, Finnish Software Measurement Association

Contributors: Varkoi, T., Mäkinen, T., Cameron, F., Nevalainen, R.

Number of pages: 16

Publication date: 2020

Peer-reviewed: Yes

Early online date: 2019

#### **Publication information**

Journal: Journal of Software: Evolution and Process

Volume: 32

Issue number: 3

Article number: e2177

ISSN (Print): 2047-7473

Original language: English

ASJC Scopus subject areas: Software

Keywords: Nuclear SPICE, process assessment, safety, systems engineering

DOIs:

10.1002/smr.2177

#### **Bibliographical note**

EXT="Varkoi, Timo"

EXT="Nevalainen, Risto"

Source: Scopus

Source ID: 85080987236

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Bayesian receiver operating characteristic metric for linear classifiers**

We propose a novel classifier accuracy metric: the Bayesian Area Under the Receiver Operating Characteristic Curve (CBAUC). The method estimates the area under the ROC curve and is related to the recently proposed Bayesian Error Estimator. The metric can assess the quality of a classifier using only the training dataset without the need for computationally expensive cross-validation. We derive a closed-form solution of the proposed accuracy metric for any linear binary classifier under the Gaussianity assumption, and study the accuracy of the proposed estimator using simulated and real-world data. These experiments confirm that the closed-form CBAUC is both faster and more accurate than conventional AUC estimators.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Computational Systems Biology, Computing Sciences, AI Virtanen Institute for Molecular Sciences, University of Eastern Finland

Contributors: Hassan, S. S., Huttunen, H., Niemi, J., Tohka, J.

Number of pages: 8

Pages: 52-59

Publication date: 1 Dec 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Pattern Recognition Letters

Volume: 128

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2019): CiteScore 6.3 SJR 0.848 SNIP 2.021

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Artificial Intelligence

Keywords: Bayesian error estimation, Classification, Receiver operating characteristic curve

DOIs:

10.1016/j.patrec.2019.07.016

### **Bibliographical note**

EXT="Tohka, Jussi"

Source: Scopus

Source ID: 85071016385

Research output: Contribution to journal › Article › Scientific › peer-review

### **Software architecture design in global software development: An empirical study**

In Global Software Development (GSD), the additional complexity caused by global distance requires processes to ease collaboration difficulties, reduce communication overhead, and improve control. How development tasks are broken down, shared and prioritized is key to project success. While the related literature provides some support for architects involved in GSD, guidelines are far from complete. This paper presents a GSD Architectural Practice Framework reflecting the views of software architects, all of whom are working in a distributed setting. In-depth interviews with architects from seven different GSD organizations revealed a complex set of challenges and practices. We found that designing software for distributed teams requires careful selection of practices that support understanding and adherence to defined architectural plans across sites. Teams used Scrum which aided communication, and Continuous Integration which helped solve synchronization issues. However, teams deviated from the design, causing conflicts. Furthermore, there needs to be a balance between the self-organizing Scrum team methodology and the need to impose architectural design decisions across distributed sites. The research presented provides an enhanced understanding of architectural practices in GSD companies. Our GSD Architectural Practice Framework gives practitioners a cohesive set of warnings, which for the most part, are matched by recommendations.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research area: Software engineering, University of Limerick

Contributors: Sievi-Korte, O., Richardson, I., Beecham, S.

Publication date: 1 Dec 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Journal of Systems and Software

Volume: 158

Article number: 110400

ISSN (Print): 0164-1212

Ratings:

Scopus rating (2019): CiteScore 7.8 SJR 0.772 SNIP 2.387

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Hardware and Architecture

Keywords: Empirical study, Global software development, GSD, GSE, Scrum, Software architecture

DOIs:

10.1016/j.jss.2019.110400

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001151274>. Embargo ends: 18/09/21

Source: Scopus

Source ID: 85072283236

Research output: Contribution to journal › Article › Scientific › peer-review

### **Promoting local culture and enriching airport experiences through interactive storytelling**

Experiences in airports may shape future travel plans and contribute to tourism destination development. However, a chaotic environment and time-consuming procedural routines in airports may result in negative associations towards the host country and its culture. Despite the existence of assistive airport applications, little attention is given to facilitating travelers' engagement with cultural exploration. This paper introduces a concept of interactive personalized storytelling that provides both a cultural learning adventure and connection to local retailing. Our application generates an imaginative Finnish storyline unique to every user to guide them through local shops in the airport. A field evaluation was conducted with 15 travelers of different nationalities. Travelers perceived the interactive storytelling experience as an interesting and unique way to spend waiting time at the airport while increasing cultural exposure. Moreover, we found this method to be effective in persuading travelers to explore local products at the airport. Further, our results give insight to designing storytelling applications for large public places.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication



Organisations: Computing Sciences, Lapland University of Applied Sciences, Tampere University, Tampere University, Tampere University  
Contributors: Burova, A., Kelling, C., Keskinen, T., Hakulinen, J., Kallioniemi, P., Väättäjä, H., Turunen, M.  
Number of pages: 7  
Publication date: 26 Nov 2019

#### Host publication information

Title of host publication: MUM 2019 - 18th International Conference on Mobile and Ubiquitous Multimedia, Proceedings  
Publisher: Association for Computing Machinery  
Editors: Jacucci, G., Paterno, F., Rohs, M., Santoro, C.  
Article number: 3365640  
ISBN (Electronic): 9781450376242

#### Publication series

Name: ACM International Conference Proceeding Series  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Airport experience, Digital storytelling, Field study, Mobile application  
DOIs:  
10.1145/3365610.3365640  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202001101166>

#### Bibliographical note

EXT="Väättäjä, Heli"  
Source: Scopus  
Source ID: 85076809996  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Programming languages for data-intensive HPC applications: A systematic mapping study

A major challenge in modelling and simulation is the need to combine expertise in both software technologies and a given scientific domain. When High-Performance Computing (HPC) is required to solve a scientific problem, software development becomes a problematic issue. Considering the complexity of the software for HPC, it is useful to identify programming languages that can be used to alleviate this issue. Because the existing literature on the topic of HPC is very dispersed, we performed a Systematic Mapping Study (SMS) in the context of the European COST Action cHiPSet. This literature study maps characteristics of various programming languages for data-intensive HPC applications, including category, typical user profiles, effectiveness, and type of articles. We organised the SMS in two phases. In the first phase, relevant articles are identified employing an automated keyword-based search in eight digital libraries. This led to an initial sample of 420 papers, which was then narrowed down in a second phase by human inspection of article abstracts, titles and keywords to 152 relevant articles published in the period 2006–2018. The analysis of these articles enabled us to identify 26 programming languages referred to in 33 of relevant articles. We compared the outcome of the mapping study with results of our questionnaire-based survey that involved 57 HPC experts. The mapping study and the survey revealed that the desired features of programming languages for data-intensive HPC applications are portability, performance and usability. Furthermore, we observed that the majority of the programming languages used in the context of data-intensive HPC applications are text-based general-purpose programming languages. Typically these have a steep learning curve, which makes them difficult to adopt. We believe that the outcome of this study will inspire future research and development in programming languages for data-intensive HPC applications.

#### General information

Publication status: E-pub ahead of print  
MoE publication type: A1 Journal article-refereed  
Organisations: Computing Sciences, Research group: MMDM, Universidade Nova de Lisboa, University of Torino, Der Technischen Universität Wien Fakultät für Elektrotechnik und Informationstechnik, University of Stirling, Universidade de Lisboa, University of Latvia, NOVA University of Lisbon, University of Amsterdam, Aristotle University of Thessaloniki, Linköping University, Queen's University, Belfast, Northern Ireland, Linnaeus University, Kalmar, Instituto Superior de Engenharia de Lisboa  
Contributors: Amaral, V., Norberto, B., Goulão, M., Aldinucci, M., Benkner, S., Bracciali, A., Carreira, P., Celms, E., Correia, L., Grelck, C., Karatza, H., Kessler, C., Kilpatrick, P., Martiniano, H., Mavridis, I., Pillana, S., Respício, A., Simão, J., Veiga, L., Visa, A.  
Number of pages: 17  
Publication date: 8 Nov 2019  
Peer-reviewed: Yes

#### Publication information

Journal: Parallel Computing

Volume: 91  
Article number: 102584  
ISSN (Print): 0167-8191  
Ratings:

Scopus rating (2019): CiteScore 2.9 SJR 0.346 SNIP 1.104

Original language: English

ASJC Scopus subject areas: Software, Theoretical Computer Science, Hardware and Architecture, Computer Networks and Communications, Computer Graphics and Computer-Aided Design, Artificial Intelligence

Keywords: Big data, Data-intensive applications, Domain-Specific language (DSL), General-Purpose language (GPL), High performance computing (HPC), Programming languages, Systematic mapping study (SMS)

DOIs:

10.1016/j.parco.2019.102584

Source: Scopus

Source ID: 85076201522

Research output: Contribution to journal › Article › Scientific › peer-review

### **Action-Oriented Programming Model: Collective Executions and Interactions in the Fog**

Today's dominant design for the Internet of Things (IoT) is a Cloud-based system, where devices transfer their data to a back-end and in return receive instructions on how to act. This view is challenged when delays caused by communication with the back-end become an obstacle for IoT applications with, for example, stringent timing constraints. In contrast, Fog Computing approaches, where devices communicate and orchestrate their operations collectively and closer to the origin of data, lack adequate tools for programming secure interactions between humans and their proximate devices at the network edge. This paper fills the gap by applying Action-Oriented Programming (AcOP) model for this task. While originally the AcOP model was proposed for Cloud-based infrastructures, presently it is re-designed around the notion of coalescence and disintegration, which enable the devices to collectively and autonomously execute their operations in the Fog by serving humans in a peer-to-peer fashion. The Cloud's role has been minimized—it is being leveraged as a development and deployment platform.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Electrical Engineering, Department of Computer Science, University of Helsinki, National Research University Higher School of Economics

Contributors: Mäkitalo, N., Aaltonen, T., Raatikainen, M., Ometov, A., Andreev, S., Koucheryavy, Y., Mikkonen, T.

Publication date: 1 Nov 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Journal of Systems and Software

Volume: 157

Article number: 110391

ISSN (Print): 0164-1212

Ratings:

Scopus rating (2019): CiteScore 7.8 SJR 0.772 SNIP 2.387

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Hardware and Architecture

Keywords: Edge computing, Fog Computing, Programming model, Proximity-based computing, Socio-technical systems

Electronic versions:

1-s2.0-S0164121219301669-main

DOIs:

10.1016/j.jss.2019.110391

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201909173345>

### **Bibliographical note**

EXT="Mäkitalo, Niko"

EXT="Mikkonen, Tommi"

Source: Scopus

Source ID: 85070882337

Research output: Contribution to journal › Article › Scientific › peer-review

### **Feasibility of FPGA accelerated IPsec on cloud**

Hardware acceleration for famous VPN solution, IPsec, has been widely researched already. Still it is not fully covered and the increasing latency, throughput, and feature requirements need further evaluation. We propose an IPsec accelerator

architecture in an FPGA and explain the details that need to be considered for a production ready design. This research considers the IPsec packet processing without IKE to be offloaded on an FPGA in an SDN network. Related work performance rates in 64 byte packet size for throughput is 1–2 Gbps with 0.2 ms latency in software, and 1–4 Gbps with unknown latencies for hardware solutions. Our proposed architecture is capable to host 1000 concurrent tunnels and have 10 Gbps throughput with only 10  $\mu$ s latency in our test network. Therefore the proposed design is efficient even with voice or video encryption. The architecture is especially designed for data centers and locations with vast number of concurrent IPsec tunnels. The research confirms that FPGA based hardware acceleration increases performance and is feasible to integrate with the other server infrastructure.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research area: Information security, Baseband ASIC R&D, Nokia Siemens Networks

Contributors: Vajaranta, M., Oinonen, A., Hämäläinen, T. D., Viitamäki, V., Markunmäki, J., Kulmala, A.

Publication date: 1 Nov 2019

Peer-reviewed: Yes

### Publication information

Journal: Microprocessors and Microsystems

Volume: 71

Article number: 102861

ISSN (Print): 0141-9331

Ratings:

Scopus rating (2019): CiteScore 3 SJR 0.303 SNIP 0.879

Original language: English

ASJC Scopus subject areas: Software, Hardware and Architecture, Computer Networks and Communications, Artificial Intelligence

Keywords: Accelerator, IPsec, Offloading, SDN

DOIs:

10.1016/j.micpro.2019.102861

### Bibliographical note

EXT="Viitamäki, Vili"

EXT="Kulmala, Ari"

Source: Scopus

Source ID: 85070320729

Research output: Contribution to journal › Article › Scientific › peer-review

### An icon that everyone wants to click: How perceived aesthetic qualities predict app icon successfulness

Mobile app markets have been touted as fastest growing marketplaces in the world. Every day thousands of apps are published to join millions of others on app stores. The competition for top grossing apps and market visibility is fierce. The way an app is visually represented can greatly contribute to the amount of attention an icon receives and to its consequent commercial performance. Therefore, the icon of the app is of crucial importance as it is the first point of contact with the potential user/customer amidst the flood of information. Those apps that fail to arouse attention through their icons danger their commercial performance in the market where consumers browse past hundreds of icons daily. Using semantic differential scale (22 adjective pairs), we investigate the relationship between consumer perceptions of app icons and icon successfulness, measured by 1)overall evaluation of the icon, 2)willingness to click the icon, 3)willingness to download the imagined app and, 4)willingness to purchase the app. The study design was a vignette study with random participant (n = 569)assignment to evaluate 4 icons (n = 2276)from a total of pre-selected 68 game app icons across 4 categories (concrete, abstract, character and text). Results show that consumers are more likely to interact with app icons that are aesthetically pleasing and convey good quality. Particularly, app icons that are perceived unique, realistic and stimulating lead to more clicks, downloads and purchases.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Gamification Group, Tampere University, University of Turku

Contributors: Jylhä, H., Hamari, J.

Number of pages: 13

Pages: 73-85

Publication date: 1 Oct 2019

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Human Computer Studies

Volume: 130

ISSN (Print): 1071-5819

Ratings:

Scopus rating (2019): CiteScore 5.8 SJR 0.756 SNIP 2.163

Original language: English

ASJC Scopus subject areas: Software, Human Factors and Ergonomics, Education, Engineering(all), Human-Computer Interaction, Hardware and Architecture

Keywords: Aesthetics, Digital marketing, Graphical user interfaces, Iconography, Mobile apps, Semantic differential

Electronic versions:

1-s2.0-S1071581918301794-main

DOIs:

10.1016/j.ijhcs.2019.04.004

URLs:

<http://urn.fi/URN:NBN:fi:tty-201907081945>

Source: Scopus

Source ID: 85067993498

Research output: Contribution to journal › Article › Scientific › peer-review

### **Automatic word count estimation from daylong child-centered recordings in various language environments using language-independent syllabification of speech**

Automatic word count estimation (WCE) from audio recordings can be used to quantify the amount of verbal communication in a recording environment. One key application of WCE is to measure language input heard by infants and toddlers in their natural environments, as captured by daylong recordings from microphones worn by the infants. Although WCE is nearly trivial for high-quality signals in high-resource languages, daylong recordings are substantially more challenging due to the unconstrained acoustic environments and the presence of near- and far-field speech. Moreover, many use cases of interest involve languages for which reliable ASR systems or even well-defined lexicons are not available. A good WCE system should also perform similarly for low- and high-resource languages in order to enable unbiased comparisons across different cultures and environments. Unfortunately, the current state-of-the-art solution, the LENA system, is based on proprietary software and has only been optimized for American English, limiting its applicability. In this paper, we build on existing work on WCE and present the steps we have taken towards a freely available system for WCE that can be adapted to different languages or dialects with a limited amount of orthographically transcribed speech data. Our system is based on language-independent syllabification of speech, followed by a language-dependent mapping from syllable counts (and a number of other acoustic features) to the corresponding word count estimates. We evaluate our system on samples from daylong infant recordings from six different corpora consisting of several languages and socioeconomic environments, all manually annotated with the same protocol to allow direct comparison. We compare a number of alternative techniques for the two key components in our system: speech activity detection and automatic syllabification of speech. As a result, we show that our system can reach relatively consistent WCE accuracy across multiple corpora and languages (with some limitations). In addition, the system outperforms LENA on three of the four corpora consisting of different varieties of English. We also demonstrate how an automatic neural network-based syllabifier, when trained on multiple languages, generalizes well to novel languages beyond the training data, outperforming two previously proposed unsupervised syllabifiers as a feature extractor for WCE.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Aalto University, Laboratoire de Sciences Cognitives et Psycholinguistique, Carnegie Mellon University, University of Manitoba, Max Planck Institute for Psycholinguistics, CONICET, Duke University  
Contributors: Räsänen, O., Seshadri, S., Karadayi, J., Riebling, E., Bunce, J., Cristia, A., Metze, F., Casillas, M., Rosemberg, C., Bergelson, E., Soderstrom, M.

Number of pages: 18

Pages: 63-80

Publication date: 1 Oct 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Speech Communication

Volume: 113

ISSN (Print): 0167-6393

Ratings:

Scopus rating (2019): CiteScore 4.2 SJR 0.554 SNIP 1.297

Original language: English

ASJC Scopus subject areas: Software, Modelling and Simulation, Communication, Language and Linguistics, Linguistics and Language, Computer Vision and Pattern Recognition, Computer Science Applications

Keywords: Automatic syllabification, Daylong recordings, Language acquisition, Noise robustness, Word count estimation

Electronic versions:

1-s2.0-S0167639318304205-main

DOIs:

10.1016/j.specom.2019.08.005

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201909173346>

Source: Scopus

Source ID: 85070952723

Research output: Contribution to journal > Article > Scientific > peer-review

### **DevOps in practice: A multiple case study of five companies**

**Context:** DevOps is considered important in the ability to frequently and reliably update a system in operational state. DevOps presumes cross-functional collaboration and automation between software development and operations. DevOps adoption and implementation in companies is non-trivial due to required changes in technical, organisational and cultural aspects. **Objectives:** This exploratory study presents detailed descriptions of how DevOps is implemented in practice. The context of our empirical investigation is web application and service development in small and medium sized companies. **Method:** A multiple-case study was conducted in five different development contexts with successful DevOps implementations since its benefits, such as quick releases and minimum deployment errors, were achieved. Data was mainly collected through interviews with 26 practitioners and observations made at the companies. Data was analysed by first coding each case individually using a set of predefined themes and thereafter perform a cross-case synthesis. **Results:** Our analysis yielded some of the following results: (i) software development team attaining ownership and responsibility to deploy software changes in production is crucial in DevOps. (ii) toolchain usage and support in deployment pipeline activities accelerates the delivery of software changes, bug fixes and handling of production incidents. (iii) the delivery speed to production is affected by context factors, such as manual approvals by the product owner (iii) steep learning curve for new skills is experienced by both software developers and operations staff, who also have to cope with working under pressure. **Conclusion:** Our findings contributes to the overall understanding of DevOps concept, practices and its perceived impacts, particularly in small and medium sized companies. We discuss two practical implications of the results.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, University of Oulu, Aalto University, University of Helsinki

Contributors: Lwakatare, L. E., Kilamo, T., Karvonen, T., Sauvola, T., Heikkilä, V., Itkonen, J., Kuvaja, P., Mikkonen, T., Oivo, M., Lassenius, C.

Number of pages: 14

Pages: 217-230

Publication date: 1 Oct 2019

Peer-reviewed: Yes

### **Publication information**

Journal: Information and Software Technology

Volume: 114

ISSN (Print): 0950-5849

Ratings:

Scopus rating (2019): CiteScore 7.6 SJR 0.781 SNIP 2.555

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Computer Science Applications

Keywords: Agile, Continuous deployment, Development, DevOps, Operations

DOIs:

10.1016/j.infsof.2019.06.010

### **Bibliographical note**

EXT="Mikkonen, Tommi"

Source: Scopus

Source ID: 85068546035

Research output: Contribution to journal > Article > Scientific > peer-review

### **The Double Shadowed $\kappa$ - $\mu$ Fading Model**

In this paper, we introduce a new fading model which is capable of characterizing both the shadowing of the dominant component and composite shadowing which may exist in wireless channels. More precisely, this new model assumes a  $\kappa$ - $\mu$  envelope where the dominant component is fluctuated by a Nakagami-m random variable (RV) which is preceded (or succeeded) by a secondary round of shadowing brought about by an inverse Nakagami-m RV. We conveniently refer to this as the double shadowed  $\kappa$ - $\mu$  fading model. In this context, novel closed-form and analytical expressions are developed for a range of channel related statistics, such as the probability density function, cumulative distribution function, and

moments. All of the derived expressions have been validated through Monte-Carlo simulations and reduction to a number of well-known special cases. It is worth highlighting that the proposed fading model offers remarkable flexibility as it includes the  $\kappa$ - $\mu$ ,  $\eta$ - $\mu$ , Rician shadowed, double shadowed Rician,  $\kappa$ - $\mu$  shadowed,  $\kappa$ - $\mu$ /inverse gamma and  $\eta$ - $\mu$ /inverse gamma distributions as special cases.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Wireless Communications and Positioning, Electrical Engineering, Queen's University, Belfast, Northern Ireland, Universidade Estadual de Campinas, Center on Cyber-Physical Systems, Khalifa University, Tampere University of Applied Sciences

Contributors: Simmons, N., Nogueira Da Silva, C. R., Cotton, S. L., Sofotasios, P. C., Ki Yoo, S., Yacoub, M. D.

Publication date: 1 Oct 2019

#### Host publication information

Title of host publication: 2019 International Conference on Wireless and Mobile Computing, Networking and Communications, WiMob 2019

Publisher: IEEE

ISBN (Electronic): 9781728133164

#### Publication series

Name: International Conference on Wireless and Mobile Computing, Networking and Communications

ISSN (Print): 2161-9646

ISSN (Electronic): 2161-9654

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software

DOIs:

10.1109/WiMOB.2019.8923336

Source: Scopus

Source ID: 85077583520

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Tunable VVC Frame Partitioning based on Lightweight Machine Learning

Block partition structure is a critical module in video coding scheme to achieve significant gap of compression performance. Under the exploration of the future video coding standard, named Versatile Video Coding (VVC), a new Quad Tree Binary Tree (QTBT) block partition structure has been introduced. In addition to the QT block partitioning defined in High Efficiency Video Coding (HEVC) standard, new horizontal and vertical BT partitions are enabled, which drastically increases the encoding time compared to HEVC. In this paper, we propose a lightweight and tunable QTBT partitioning scheme based on a Machine Learning (ML) approach. The proposed solution uses Random Forest classifiers to determine for each coding block the most probable partition modes. To minimize the encoding loss induced by misclassification, risk intervals for classifier decisions are introduced in the proposed solution. By varying the size of risk intervals, tunable trade-off between encoding complexity reduction and coding loss is achieved. The proposed solution implemented in the JEM-7.0 software offers encoding complexity reductions ranging from 30% average for only 0.7% BD-BR increase; to 3.0% BD-BR increase in Random Access (RA) coding configuration, with very slight overhead induced by Random Forest. The proposed solution based on Random Forest classifiers is also efficient to reduce the complexity of the Multi-Type Tree (MTT) partitioning scheme under the VTM-5.0 software, with complexity reductions ranging from 25% to 61% in average for only 0.4% to 2.2% BD-BR increase.

#### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, UBL, HTE/STR/MMP Gennevilliers

Contributors: Amestoy, T., Mercat, A., Hamidouche, W., Menard, D., Bergeron, C.

Publication date: 6 Sep 2019

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Transactions on Image Processing

ISSN (Print): 1057-7149

Ratings:

Scopus rating (2019): CiteScore 15.6 SJR 2.893 SNIP 4.182

Original language: English

ASJC Scopus subject areas: Software, Computer Graphics and Computer-Aided Design

Keywords: Complexity Reduction, JEM, Machine Learning, QTBT, Random Forest, Video Compression, VTM, VVC

DOIs:

10.1109/TIP.2019.2938670

Source: Scopus

Source ID: 85072159338

Research output: Contribution to journal › Article › Scientific › peer-review

### **Model checking and validity in propositional and modal inclusion logics**

Propositional and modal inclusion logic are formalisms that belong to the family of logics based on team semantics. This article investigates the model checking and validity problems of these logics. We identify complexity bounds for both problems, covering both lax and strict team semantics. By doing so, we come close to finalizing the programme that aims to completely classify the complexities of the basic reasoning problems for modal and propositional dependence, independence and inclusion logics.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Tampere University, Leibniz Universität Hannover, University of Helsinki, Hasselt University

Contributors: Hella, L., Kuusisto, A., Meier, A., Virtema, J.

Number of pages: 26

Pages: 605-630

Publication date: 1 Sep 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: JOURNAL OF LOGIC AND COMPUTATION

Volume: 29

Issue number: 5

ISSN (Print): 0955-792X

Ratings:

Scopus rating (2019): CiteScore 2.8 SJR 0.786 SNIP 1.481

Original language: English

ASJC Scopus subject areas: Software, Theoretical Computer Science, Arts and Humanities (miscellaneous), Hardware and Architecture, Logic

Keywords: complexity, Inclusion logic, model checking, team semantics, validity problem

DOIs:

10.1093/logcom/exz008

Source: Scopus

Source ID: 85080893187

Research output: Contribution to journal › Article › Scientific › peer-review

### **Performance analysis of single-query 6-DoF camera pose estimation in self-driving setups**

In this work, we consider the problem of single-query 6-DoF camera pose estimation, i.e. estimating the position and orientation of a camera by using reference images and a point cloud. We perform a systematic comparison of three state-of-the-art strategies for 6-DoF camera pose estimation: feature-based, photometric-based and mutual-information-based approaches. Two standard datasets with self-driving setups are used for experiments, and the performance of the studied methods is evaluated in terms of success rate, translation error and maximum orientation error. Building on the analysis of the results, we evaluate a hybrid approach that combines feature-based and mutual-information-based pose estimation methods to benefit from their complementary properties for pose estimation. Experiments show that (1) in cases with large appearance change between query and reference, the hybrid approach outperforms feature-based and mutual-information-based approaches by an average increment of 9.4% and 8.7% in the success rate, respectively; (2) in cases where query and reference images are captured at similar imaging conditions, the hybrid approach performs similarly as the feature-based approach, but outperforms both photometric-based and mutual-information-based approaches with a clear margin; (3) the feature-based approach is consistently more accurate than mutual-information-based and photometric-based approaches when at least 4 consistent matching points are found between the query and reference images.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Universidad Industrial de Santander, Czech Technical University in Prague

Contributors: Fu, J., Pertuz, S., Matas, J., Kämäräinen, J.

Pages: 58-73

Publication date: Sep 2019

Peer-reviewed: Yes

### Publication information

Journal: Computer Vision and Image Understanding

Volume: 186

ISSN (Print): 1077-3142

Ratings:

Scopus rating (2019): CiteScore 8.7 SJR 1.453 SNIP 2.255

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition

Keywords: 3D point cloud, Camera pose estimation, Hybrid method, Mutual information, Photometric matching, Self driving car

DOIs:

10.1016/j.cviu.2019.04.009

### Bibliographical note

EXT="Matas, Jiri"

Source: Scopus

Source ID: 85067195521

Research output: Contribution to journal > Article > Scientific > peer-review

### Game postmortems vs. developer Reddit AMAs: Computational analysis of developer communication

Postmortems and Reddit Ask Me Anything (AMA) threads represent communications of game developers through two different channels about their game development experiences, culture, processes, and practices. We carry out a quantitative text mining based comprehensive analysis of online available postmortems and AMA threads from game developers over multiple years. We find and analyze underlying topics from the postmortems and AMAs as well as their variation among the data sources and over time. The analysis is done based on structural topic modeling, a probabilistic modeling technique for text mining. The extracted topics reveal differing and common interests as well as their evolution of prevalence over time in the two text sources. We have found that postmortems put more emphasis on detail-oriented development aspects as well as technically-oriented game design problems whereas AMAs feature a wider variety of discussion topics that are related to a more general game development process, game-play and game-play experience related game design. The prevalences of the topics also evolve differently over time in postmortems versus AMAs.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Tampere University

Contributors: Lu, C., Peltonen, J., Nummenmaa, T.

Publication date: 26 Aug 2019

### Host publication information

Title of host publication: Proceedings of the 14th International Conference on the Foundations of Digital Games, FDG 2019

Publisher: ACM

Editors: Khosmood, F., Pirker, J., Apperley, T., Deterding, S.

Article number: 22

ISBN (Electronic): 9781450372176

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Game development, Literature analysis, Postmortem analysis, Reddit, Text mining

DOIs:

10.1145/3337722.3337727

### Bibliographical note

INT=comp,"Peltonen, Jaakko"

INT=comp,"Lu, Chien"

Source: Scopus

Source ID: 85072819939

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Social features in hybrid board game marketing material

This paper identifies 7 key social features which appear in the marketing and promotional material of hybrid board games. The features are identified by exploring sources such as game websites and game boxes of 13 hybrid board game products. The material is analyzed in order to determine how social features related to hybrid game features are presented. As a result of the analysis, it became apparent that there are certain key social features which are presented as being important to players. The knowledge generated in this work acts as a view to how the industry sees hybridity in games as a tool for supporting social interaction, and how the industry wants to message it to consumers when they



explore promotional material. The identified key social features can also be used as design knowledge for developing new games, as they give insight into popular social features in hybrid board games.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Tampere University  
Contributors: Nummenmaa, T., Kankainen, V.  
Publication date: 26 Aug 2019

#### Host publication information

Title of host publication: Proceedings of the 14th International Conference on the Foundations of Digital Games, FDG 2019  
Publisher: ACM  
Editors: Khosmood, F., Pirker, J., Apperley, T., Deterding, S.  
Article number: 67  
ISBN (Electronic): 9781450372176  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Board games, Design, Hybrid games, Marketing  
DOIs:  
10.1145/3337722.3341864

#### Bibliographical note

INT=comp,"Kankainen, Vill"  
Source: Scopus  
Source ID: 85072820010  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Are architectural smells independent from code smells? An empirical study

Background. Architectural smells and code smells are symptoms of bad code or design that can cause different quality problems, such as faults, technical debt, or difficulties with maintenance and evolution. Some studies show that code smells and architectural smells often appear together in the same file. The correlation between code smells and architectural smells, however, is not clear yet; some studies on a limited set of projects have claimed that architectural smells can be derived from code smells, while other studies claim the opposite. Objective. The goal of this work is to understand whether architectural smells are independent from code smells or can be derived from a code smell or from one category of them. Method. We conducted a case study analyzing the correlations among 19 code smells, six categories of code smells, and four architectural smells. Results. The results show that architectural smells are correlated with code smells only in a very low number of occurrences and therefore cannot be derived from code smells. Conclusion. Architectural smells are independent from code smells, and therefore deserve special attention by researchers, who should investigate their actual harmfulness, and practitioners, who should consider whether and when to remove them.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Computing Sciences, University Milano-Bicocca, Alten Italia  
Contributors: Arcelli Fontana, F., Lenarduzzi, V., Roveda, R., Taibi, D.  
Number of pages: 18  
Pages: 139-156  
Publication date: 1 Aug 2019  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Systems and Software  
Volume: 154  
ISSN (Print): 0164-1212  
Ratings:  
Scopus rating (2019): CiteScore 7.8 SJR 0.772 SNIP 2.387  
Original language: English  
ASJC Scopus subject areas: Software, Information Systems, Hardware and Architecture  
Keywords: Architectural smells, Code smells, Empirical analysis, Technical debt  
DOIs:  
10.1016/j.jss.2019.04.066  
Source: Scopus  
Source ID: 85064869442

### Enabling cybersecurity incident reporting and coordinated handling for maritime sector

The maritime industry is experiencing a new era of digital transformation. At the same time as the number of cyberattacks and cybersecurity incidents are increasing, cybersecurity awareness and incident reporting in this sector remains low. In this paper, we describe a cybersecurity incident reporting system for the maritime industry that aims to address this issue. The work focuses on autonomous and unmanned vessels, but can be equally applied to other areas of the maritime industry. The proposed approach has been evaluated experimentally and the results demonstrate its applicability and feasibility.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research area: Information security

Contributors: Silverajan, B., Vistiaho, P.

Number of pages: 8

Pages: 88-95

Publication date: 1 Aug 2019

#### Host publication information

Title of host publication: 2019 14th Asia Joint Conference on Information Security, AsiaJCIS 2019

Publisher: IEEE

ISBN (Electronic): 9781728125565

ASJC Scopus subject areas: Software, Information Systems and Management, Computer Networks and Communications, Safety, Risk, Reliability and Quality

Keywords: Cybersecurity incident exchange, Maritime cybersecurity, Smart ports, Smart ships

DOIs:

10.1109/AsiaJCIS.2019.000-1

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Hermitian normalized Laplacian matrix for directed networks

In this paper, we extend and generalize the spectral theory of undirected networks towards directed networks by introducing the Hermitian normalized Laplacian matrix for directed networks. In order to start, we discuss the Courant–Fischer theorem for the eigenvalues of Hermitian normalized Laplacian matrix. Based on the Courant–Fischer theorem, we obtain a similar result towards the normalized Laplacian matrix of undirected networks: for each  $i \in \{1, 2, \dots, n\}$ , any eigenvalue of Hermitian normalized Laplacian matrix  $\lambda_i \in [0, 2]$ . Moreover, we prove some special conditions if 0, or 2 is an eigenvalue of the Hermitian normalized Laplacian matrix  $L(X)$ . On top of that, we investigate the symmetry of the eigenvalues of  $L(X)$  and the edge-version for the eigenvalue interlacing result. Finally we present two expressions for the coefficients of the characteristic polynomial of the Hermitian normalized Laplacian matrix. As an outlook, we sketch some novel and intriguing problems to which our apparatus could generally be applied.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Predictive Society and Data Analytics (PSDA), Guizhou University of Finance and Economics, University of Applied Sciences Upper Austria, Nankai University, Hall in Tyrol, Institute of Biosciences and Medical Technology

Contributors: Yu, G., Dehmer, M., Emmert-Streib, F., Jodlbauer, H.

Number of pages: 10

Pages: 175-184

Publication date: 1 Aug 2019

Peer-reviewed: Yes

#### Publication information

Journal: Information Sciences

Volume: 495

ISSN (Print): 0020-0255

Ratings:

Scopus rating (2019): CiteScore 11.3 SJR 1.723 SNIP 2.688

Original language: English

ASJC Scopus subject areas: Software, Control and Systems Engineering, Theoretical Computer Science, Computer Science Applications, Information Systems and Management, Artificial Intelligence

Keywords: Characteristic polynomial, Courant–Fischer theorem, Directed networks, Eigenvalue interlacing inequality, Hermitian normalized Laplacian matrix

DOIs:

10.1016/j.ins.2019.04.049

Source: Scopus

Source ID: 85065248406

Research output: Contribution to journal › Article › Scientific › peer-review

### **Real-time online drilling vibration analysis using data mining**

While the data mining intermediaries play a critical role in the rock drilling industry, they also tend to provide an optimized real-time model for the drilling systems. In addition, proper online tool condition monitoring (OTOM) methods can improve the drilling performance by accessing real-time data. Hence, OTOM methods assist depreciating error and detect unspecified faults at early stages. In this study, we proposed appropriate OTOM algorithms to develop and enhance the quality of real-time systems and provide a solution to detect and categorize various stages of drilling operation with the aid of vibration signals (especially in terms of acceleration or velocity). In particular, the proposed methods in this article perform based on statistical approaches. Therefore, in order to recognize the drilling stages, we measured the Root Mean Square (RMS) values corresponding to the acceleration signals. In the meantime, we also succeeded to distinguish the drilling stages by employing estimated power spectral density (PSD) in the frequency domain. The acquired results in this publication confirm the real-time prediction and classification potential of the proposed methods for the different drilling stages and especially for the rock drilling engineering.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Automation Technology and Mechanical Engineering, Research group: Innovative Hydraulic Automation, Research group: MMDM, Tamlink Oy, Sandvik Mining and Construction Oy

Contributors: Zare, M., Huova, M., Visa, A., Launis, S.

Number of pages: 6

Pages: 175-180

Publication date: 19 Jul 2019

### **Host publication information**

Title of host publication: Proceedings of the 2019 2nd International Conference on Data Science and Information Technology, DSIT 2019

Publisher: ACM

ISBN (Electronic): 9781450371414

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Data mining, Drilling stages, Real-time, Statistical analysis

DOIs:

10.1145/3352411.3352439

Source: Scopus

Source ID: 85072810540

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **High-performance SIMD implementation of the lattice-Boltzmann method on the Xeon Phi processor**

We present a high-performance implementation of the lattice-Boltzmann method (LBM) on the Knights Landing generation of Xeon Phi. The Knights Landing architecture includes 16GB of high-speed memory (MCDRAM) with a reported bandwidth of over 400 GB/s, and a subset of the AVX-512 single instruction multiple data (SIMD) instruction set. We explain five critical implementation aspects for high performance on this architecture: (1) the choice of appropriate LBM algorithm, (2) suitable data layout, (3) vectorization of the computation, (4) data prefetching, and (5) running our LBM simulations exclusively from the MCDRAM. The effects of these implementation aspects on the computational performance are demonstrated with the lattice-Boltzmann scheme involving the D3Q19 discrete velocity set and the TRT collision operator. In our benchmark simulations of fluid flow through porous media, using double-precision floating-point arithmetic, the observed performance exceeds 960 million fluid lattice site updates per second.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, CSC - IT center for science, Abo Akad Univ, Abo Akademi University, Dept Phys, Jyväskylän yliopisto

Contributors: Robertsén, F., Mattila, K., Westerholm, J.

Number of pages: 16

Publication date: 10 Jul 2019

Peer-reviewed: Yes

## Publication information

Journal: Concurrency Computation

Volume: 31

Issue number: 13

Article number: e5072

ISSN (Print): 1532-0626

Ratings:

Scopus rating (2019): CiteScore 3.4 SJR 0.341 SNIP 0.944

Original language: English

ASJC Scopus subject areas: Software, Theoretical Computer Science, Computer Science Applications, Computer Networks and Communications, Computational Theory and Mathematics

Keywords: Lattice Boltzmann, prefetching, SIMD, Xeon Phi

DOIs:

10.1002/cpe.5072

Source: Scopus

Source ID: 85056764195

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

## Detection of Typical Pronunciation Errors in Non-native English Speech Using Convolutional Recurrent Neural Networks

A machine learning method for the automatic detection of pronunciation errors made by non-native speakers of English is proposed. It consists of training word-specific binary classifiers on a collected dataset of isolated words with possible pronunciation errors, typical for Finnish native speakers. The classifiers predict whether the typical error is present in the given word utterance. They operate on sequences of acoustic features, extracted from consecutive frames of an audio recording of a word utterance. The proposed architecture includes a convolutional neural network, a recurrent neural network, or a combination of the two. The optimal topology and hyperparameters are obtained in a Bayesian optimisation setting using a tree-structured Parzen estimator. A dataset of 80 words uttered naturally by 120 speakers is collected. The performance of the proposed system, evaluated on a well-represented subset of the dataset, shows that it is capable of detecting pronunciation errors in most of the words (46/49) with high accuracy (mean accuracy gain over the zero rule 12.21 percent points).

## General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Language Centre

Contributors: Diment, A., Fagerlund, E., Benfield, A., Virtanen, T.

Publication date: 1 Jul 2019

## Host publication information

Title of host publication: 2019 International Joint Conference on Neural Networks, IJCNN 2019

Publisher: IEEE

ISBN (Electronic): 9781728119854

ASJC Scopus subject areas: Software, Artificial Intelligence

Keywords: Computer-assisted language learning, computer-assisted pronunciation training CNN, CRNN, GRU, pronunciation learning

DOIs:

10.1109/IJCNN.2019.8851963

## Bibliographical note

jufoid=58177

Source: Scopus

Source ID: 85073198799

Research output: [Chapter in Book/Report/Conference proceeding](#) > [Conference contribution](#) > [Scientific](#) > [peer-review](#)

## User Experience Study of 360° Music Videos on Computer Monitor and Virtual Reality Goggles

360° videos are increasingly used for media and entertainment, but the best practices for editing them are not yet well established. In this paper, we present a study in which we investigated the user experience of 360° music videos viewed on computer monitor and VR goggles. The research was conducted in the form of a laboratory experiment with 20 test participants. During the within-subject study, participants watched and evaluated four versions of the same 360° music video with a different cutting rate. Based on the results, an average cutting rate of 26 seconds delivered the highest-quality user experience both for computer monitor and VR goggles. The cutting rate matched with participants' mental models, and there was enough time to explore the environment without getting bored. Faster cutting rates made the users nervous, and a video consisting of a single shot was considered to be too static and boring.

## General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Tampere University, Tampere University of Applied Sciences  
Contributors: Holm, J., Väänänen, K., Remans, M. M. R.  
Number of pages: 7  
Pages: 81-87  
Publication date: 1 Jul 2019

#### Host publication information

Title of host publication: Information Visualization - Biomedical Visualization and Geometric Modelling and Imaging, IV 2019  
Publisher: IEEE  
Editors: Banissi, E., Ursyn, A., McK. Bannatyne, M. W., Datia, N., Pires, J. M., Francese, R., Sarfraz, M., Wyeld, T. G., Bouali, F., Venturin, G., Azzag, H., Lebbah, M., Trutschl, M., Cvek, U., Muller, H., Nakayama, M., Kernbach, S., Caruccio, L., Risi, M., Erra, U., Vitiello, A., Rossano, V.  
ISBN (Electronic): 9781728128382

#### Publication series

Name: Proceedings of the International Conference on Information Visualisation  
ISSN (Print): 1093-9547  
ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition  
Keywords: 360° video, cutting rate, hmd, music video, virtual reality, virtual reality goggles  
DOIs:  
10.1109/IV.2019.00023

#### Bibliographical note

jufoid=58079  
EXT="Holm, Jukka"  
INT=comp,"Remans, Mohammad Mushfiqur Rahman"  
Source: Scopus  
Source ID: 85072286445  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Public and open HEVC encoding service in the cloud

The ability to record vast amounts of video content requires convenient and efficient video coding services with which users can tackle the limited storage and transmission capacities. This paper presents an open-source cloud service for encoding raw video formats and transcoding compressed videos to the latest HEVC/H.265 format. Respective commercial transcoding services are available on the Internet but they are behind a paywall. On the other hand, using command-line interfaces of existing open-source software solutions requires in-depth knowledge of the coding process to attain the best coding gain and speed. The proposed service is available online, it is free to use without any registration, and its easy-to-use web interface makes it feasible for non-technical users. It is built on the FFmpeg multimedia framework whose built-in decoders accept various input video formats that are then compressed to HEVC with a full-fledged Kvazaar open-source encoder.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Tampere University  
Contributors: Altonen, A., Viitanen, M., Räsänen, J., Mercat, A., Vanne, J.  
Number of pages: 4  
Pages: 300-303  
Publication date: 18 Jun 2019

#### Host publication information

Title of host publication: Proceedings of the 10th ACM Multimedia Systems Conference, MMSys 2019  
Publisher: ACM  
ISBN (Electronic): 9781450362979  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Human-Computer Interaction, Software  
Keywords: Cloud en/transcoding, FFmpeg, High efficiency video coding (HEVC), Kvazaar HEVC encoder, Software as a service (SaaS)  
Electronic versions:  
MMSys2019\_Cloud\_Encoder\_Camera\_Ready  
DOIs:  
10.1145/3304109.3323834  
URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910013616>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Investigation of egocentric social structures for diversity-enhancing followee recommendations**

The increasing amount of data in social media enables new advanced user modeling approaches. This paper focuses on user profiling for diversity-enhancing recommender systems for finding new followees on Twitter. By combining social network analysis with Latent Dirichlet Allocation based content analysis, we defined three egocentric structural positions on the network extracted from Twitter data: Mentions of Mentions, Community Cluster, Dormant Ties (and the rest as a baseline condition). In addition to describing the data analysis procedure, we report preliminary empirical findings on a user-centered evaluation study of recommendations based on the proposed matching strategy and the presented structural positions. The investigation of the possible overlaps of the groups and the participants' evaluations of perceived relevance of the recommendation imply that the three positions are sufficiently mutually exclusive and thus could serve as new diversity-enhancing mechanisms in various people recommender systems.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Information and Knowledge Management, Computing Sciences, Tampere University

Contributors: Skenderi, E., Olshannikova, E., Olsson, T., Huhtamäki, J., Koivunen, S., Yao, P., Huttunen, H.

Number of pages: 5

Pages: 257-261

Publication date: 6 Jun 2019

#### **Host publication information**

Title of host publication: ACM UMAP 2019 Adjunct - Adjunct Publication of the 27th Conference on User Modeling, Adaptation and Personalization

Publisher: ACM

ISBN (Electronic): 9781450367110

ASJC Scopus subject areas: Software

Keywords: Hybrid recommendation system, People recommender system, Social network analysis, Social recommender system, Twitter analytics, User modeling for social matching

DOIs:

10.1145/3314183.3323460

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Facilitating the first move: Exploring inspirational design patterns for aiding initiation of social encounters**

Actualizing positive social encounters remains both a key ends and means in many activities to foster a sense of community. Initiating encounters between strangers typically requires facilitative activities or artefacts, such as icebreakers or tickets-to-talk. However, there is little understanding of which designs are effective and why, and the broad design space remains largely underexplored. We address this challenge by presenting five candidates for inspirational design patterns on signaling social intentions and identifying impediments that deter commencement of encounters. The principles result from an extensive review of design cases and public art installations. Through focus groups and expert interviews, we assessed the perceived applicability and social acceptance of the proposed patterns. Three new design principles relating to the risks of initiating an encounter emerged through analyzing participant responses. These articulations of possible approaches and pitfalls for increasing conviviality may broaden the repertoire of, and support discussion between designers and others concerned with collocated social interaction.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, University of Southern Denmark

Contributors: Mitchell, R., Olsson, T.

Number of pages: 12

Pages: 283-294

Publication date: 3 Jun 2019

#### **Host publication information**

Title of host publication: C&T 2019 - 9th International Conference on Communities and Technologies, Conference Proceedings

Publisher: ACM

Editors: Tellioglu, H., Cech, F.

ISBN (Electronic): 9781450371629

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Collocated interaction, Design patterns, Social encounters, Social encouragement, Social interaction design, Ticket-to-talk

DOIs:

10.1145/3328320.3328396

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201908142894>

Source: Scopus

Source ID: 85067884637

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Towards Efficient Code Generation for Exposed Datapath Architectures**

Coarse-grained reconfigurable architectures and other exposed datapath architectures such as transport-triggered architectures come with a high energy efficiency promise for accelerating data oriented workloads. Their main drawback results from the push of complexity from the architecture to the programmer; compiler techniques that allow starting from a higher-level programming language and generate code efficiently to such architectures robustly is still an open research area. In this article we survey the known main sources of challenges and outline a generic processor architecture template that covers the most common architecture variations along with a proposal for a common code generation framework for such challenging architectures.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Eindhoven University of Technology

Contributors: Vadivel, K., Jordans, R., Stuijk, S., Corporaal, H., Jääskeläinen, P., Kultala, H.

Number of pages: 4

Pages: 86-89

Publication date: 27 May 2019

#### **Host publication information**

Title of host publication: Proceedings of the 22nd International Workshop on Software and Compilers for Embedded Systems, SCOPES 2019

Publisher: ACM

Editor: Stuijk, S.

ISBN (Electronic): 9781450367622

ASJC Scopus subject areas: Hardware and Architecture, Software

Keywords: CGRA, code generation, energy efficiency, reconfigurable architectures, scheduling, TTA

DOIs:

10.1145/3323439.3323990

Source: Scopus

Source ID: 85066039585

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **1-D Convolutional Neural Networks for Signal Processing Applications**

1D Convolutional Neural Networks (CNNs) have recently become the state-of-the-art technique for crucial signal processing applications such as patient-specific ECG classification, structural health monitoring, anomaly detection in power electronics circuitry and motor-fault detection. This is an expected outcome as there are numerous advantages of using an adaptive and compact 1D CNN instead of a conventional (2D) deep counterparts. First of all, compact 1D CNNs can be efficiently trained with a limited dataset of 1D signals while the 2D deep CNNs, besides requiring 1D to 2D data transformation, usually need datasets with massive size, e.g., in the »Big Data» scale in order to prevent the well-known »overfitting» problem. 1D CNNs can directly be applied to the raw signal (e.g., current, voltage, vibration, etc.) without requiring any pre- or post-processing such as feature extraction, selection, dimension reduction, denoising, etc. Furthermore, due to the simple and compact configuration of such adaptive 1D CNNs that perform only linear 1D convolutions (scalar multiplications and additions), a real-time and low-cost hardware implementation is feasible. This paper reviews the major signal processing applications of compact 1D CNNs with a brief theoretical background. We will present their state-of-the-art performances and conclude with focusing on some major properties. Keywords - 1-D CNNs, Biomedical Signal Processing, SHM.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research group: Multimedia Research Group - MRG, Qatar University, Electrical and Electronics Engineering Department, Izmir University of Economics

Contributors: Kiranyaz, S., Ince, T., Abdeljaber, O., Avci, O., Gabbouj, M.

Number of pages: 5

Pages: 8360-8364  
Publication date: 1 May 2019

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ISBN (Electronic): 9781479981311  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
DOIs:  
10.1109/ICASSP.2019.8682194

#### Bibliographical note

EXT="Kiranyaz, Serkan"  
EXT="Ince, Turker"  
Source: Scopus  
Source ID: 85068995333  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Convex Energy Optimization of Streaming Applications for MPSoCs

The energy efficiency of modern MPSoCs is enhanced by complex hardware features such as Dynamic Voltage and Frequency Scaling (DVFS) and Dynamic Power Management (DPM). This paper introduces a new method, based on convex problem solving, that determines the most energy efficient operating point in terms of frequency and number of active cores in an MPSoC. The solution can challenge the popular approaches based on never-idle (or As-Slow-As-Possible (ASAP)) and race-to-idle (or As-Fast-As-Possible (AFAP)) principles. Experimental data are reported using a Samsung Exynos 5410 MPSoC and show a reduction in energy of up to 27 % when compared to ASAP and AFAP.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Universite de Rennes  
Contributors: Nogues, E., Mercat, A., Arrestier, F., Pelcat, M., Menard, D.  
Number of pages: 5  
Pages: 1557-1561  
Publication date: 1 May 2019

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Title of host publication: 2019 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2019 - Proceedings  
Publisher: IEEE  
ISBN (Electronic): 9781479981311  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
DOIs:  
10.1109/ICASSP.2019.8682317  
Source: Scopus  
Source ID: 85068997223  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Deep Reinforcement Learning for Financial Trading Using Price Trailing

Developing accurate financial analysis tools can be useful both for speculative trading, as well as for analyzing the behavior of markets and promptly responding to unstable conditions ensuring the smooth operation of the financial markets. This led to the development of various methods for analyzing and forecasting the behaviour of financial assets, ranging from traditional quantitative finance to more modern machine learning approaches. However, the volatile and unstable behavior of financial markets forbids the accurate prediction of future prices, reducing the performance of these approaches. In contrast, in this paper we propose a novel price trailing method that goes beyond traditional price forecasting by reformulating trading as a control problem, effectively overcoming the aforementioned limitations. The proposed method leads to developing robust agents that can withstand large amounts of noise, while still capturing the price trends and allowing for taking profitable decisions.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Aristotle University of Thessaloniki, School of Informatics  
Contributors: Zarkias, K. S., Passalis, N., Tsantekidis, A., Tefas, A.  
Number of pages: 5



Pages: 3067-3071  
Publication date: 1 May 2019

#### Host publication information

Title of host publication: 2019 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2019 - Proceedings  
Publisher: IEEE  
ISBN (Electronic): 9781479981311  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Deep Reinforcement Learning, Financial Markets, Price Forecasting, Trading  
DOIs:  
10.1109/ICASSP.2019.8683161

#### Bibliographical note

EXT="Tefas, Anastasios"  
Source: Scopus  
Source ID: 85068989312  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Deep Temporal Logistic Bag-of-features for Forecasting High Frequency Limit Order Book Time Series

Forecasting time series has several applications in various domains. The vast amount of data that are available nowadays provide the opportunity to use powerful deep learning approaches, but at the same time pose significant challenges of high-dimensionality, velocity and variety. In this paper, a novel logistic formulation of the well-known Bag-of-Features model is proposed to tackle these challenges. The proposed method is combined with deep convolutional feature extractors and is capable of accurately modeling the temporal behavior of time series, forming powerful forecasting models that can be trained in an end-to-end fashion. The proposed method was extensively evaluated using a large-scale financial time series dataset, that consists of more than 4 million limit orders, outperforming other competitive methods.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, School of Informatics, Aristotle University of Thessaloniki, Aarhus Universitet  
Contributors: Passalis, N., Tefas, A., Kannianen, J., Gabbouj, M., Iosifidis, A.  
Number of pages: 5  
Pages: 7545-7549  
Publication date: 1 May 2019

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Publisher: IEEE  
ISBN (Electronic): 9781479981311  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Limit Order Book, Temporal Bag-of-Features, Time series forecasting  
DOIs:  
10.1109/ICASSP.2019.8682297

#### Bibliographical note

EXT="Tefas, Anastasios"  
EXT="Iosifidis, Alexandros"  
Source: Scopus  
Source ID: 85069000578  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Low-latency Deep Clustering for Speech Separation

This paper proposes a low algorithmic latency adaptation of the deep clustering approach to speaker-independent speech separation. It consists of three parts: a) the usage of long-short-term-memory (LSTM) networks instead of their bidirectional variant used in the original work, b) using a short synthesis window (here 8 ms) required for low-latency operation, and, c) using a buffer in the beginning of audio mixture to estimate cluster centres corresponding to constituent speakers which are then utilized to separate speakers within the rest of the signal. The buffer duration would serve as an initialization phase after which the system is capable of operating with 8 ms algorithmic latency. We evaluate our proposed approach on two-speaker mixtures from Wall Street Journal (WSJ0) corpus. We observe that the use of LSTM yields around one dB lower SDR as compared to the baseline bidirectional LSTM in terms of source to distortion ratio (SDR). Moreover, using an 8 ms synthesis window instead of 32 ms degrades the separation performance by around 2.1 dB as compared to the baseline. Finally, we also report separation performance with different buffer durations noting that separation can be achieved even for buffer duration as low as 300 ms.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Research group: Audio research group - ARG  
Contributors: Wang, S., Naithani, G., Virtanen, T.  
Number of pages: 5  
Pages: 76-80  
Publication date: 1 May 2019

### Host publication information

Title of host publication: 2019 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2019 - Proceedings  
Publisher: IEEE  
ISBN (Electronic): 9781479981311  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Deep clustering, Low latency, Monaural speech separation  
DOIs:  
10.1109/ICASSP.2019.8683437

### Bibliographical note

int=comp,"Wang, Shanshan"  
Source: Scopus  
Source ID: 85068960960  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Random Forest Oriented Fast QTBT Frame Partitioning

Block partition structure is a critical module in video coding scheme to achieve significant gap of compression performance. Under the exploration of future video coding standard by the Joint Video Exploration Team (JVET), named Versatile Video Coding (VVC), a new Quad Tree Binary Tree (QTBT) block partition structure has been introduced. In addition to the QT block partitioning defined by High Efficiency Video Coding (HEVC) standard, new horizontal and vertical BT partitions are enabled, which drastically increases the encoding time compared to HEVC. In this paper, we propose a fast QTBT partitioning scheme based on a Machine Learning approach. Complementary to techniques proposed in literature to reduce the complexity of HEVC Quad Tree (QT) partitioning, the proposed solution uses Random Forest classifiers to determine for each block which partition modes between QT and BT is more likely to be selected. Using uncertainty zones of classifier decisions, the proposed complexity reduction technique is able to reduce in average by 30% the encoding time of JEM-v7.0 software in Random Access configuration with only 0.57% Bjontegaard Delta Rate (BD-BR) increase.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Universite de Rennes, MMP  
Contributors: Amestoy, T., Mercat, A., Hamidouche, W., Bergeron, C., Menard, D.  
Number of pages: 5  
Pages: 1837-1841  
Publication date: 1 May 2019

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Title of host publication: 2019 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2019 - Proceedings  
Publisher: IEEE  
ISBN (Electronic): 9781479981311  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Complexity Reduction, JEM, Machine Learning, QTBT, Random Forest, Video Compression, VVC  
DOIs:  
10.1109/ICASSP.2019.8683413  
Source: Scopus  
Source ID: 85068966990  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Time Difference of Arrival Estimation of Speech Signals Using Deep Neural Networks with Integrated Time-frequency Masking

The Time Difference of Arrival (TDoA) of a sound wavefront impinging on a microphone pair carries spatial information about the source. However, captured speech typically contains dynamic non-speech interference sources and noise. Therefore, the TDoA estimates fluctuate between speech and interference. Deep Neural Networks (DNNs) have been

applied for Time-Frequency (TF) masking for Acoustic Source Localization (ASL) to filter out non-speech components from a speaker location likelihood function. However, the type of TF mask for this task is not obvious. Secondly, the DNN should estimate the TDoA values, but existing solutions estimate the TF mask instead. To overcome these issues, a direct formulation of the TF masking as a part of a DNN-based ASL structure is proposed. Furthermore, the proposed network operates in an online manner, i.e., producing estimates frame-by-frame. Combined with the use of recurrent layers it exploits the sequential progression of speaker related TDoAs. Training with different microphone spacings allows model re-use for different microphone pair geometries in inference. Real-data experiments with smartphone recordings of speech in interference demonstrate the network's generalization capability.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences  
Contributors: Pertilä, P., Parviainen, M.  
Number of pages: 5  
Pages: 436-440  
Publication date: 1 May 2019

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Publisher: IEEE  
ISBN (Electronic): 9781479981311  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Acoustic Source Localization, Microphone Arrays, Recurrent Neural Networks, Time-Frequency Masking  
Electronic versions:  
Pertila\_ICASSP\_2019  
DOIs:  
10.1109/ICASSP.2019.8682574  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202002272397>  
Source: Scopus  
Source ID: 85068957469

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Variance Preserving Initialization for Training Deep Neuromorphic Photonic Networks with Sinusoidal Activations

Photonic neuromorphic hardware can provide significant performance benefits for Deep Learning (DL) applications by accelerating and reducing the energy requirements of DL models. However, photonic neuromorphic architectures employ different activation elements than those traditionally used in DL, slowing down the convergence of the training process for such architectures. An initialization scheme that can be used to efficiently train deep photonic networks that employ quadratic sinusoidal activation functions is proposed in this paper. The proposed initialization scheme can overcome these limitations, leading to faster and more stable training of deep photonic neural networks. The ability of the proposed method to improve the convergence of the training process is experimentally demonstrated using two different DL architectures and two datasets.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Aristotle University of Thessaloniki  
Contributors: Passalis, N., Mourgias-Alexandris, G., Tsakyridis, A., Pleros, N., Tefas, A.  
Number of pages: 5  
Pages: 1483-1487  
Publication date: 1 May 2019

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ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Neuromorphic Hardware, Photonic Neural Networks, Sinusoidal Activations  
DOIs:  
10.1109/ICASSP.2019.8682218

#### Bibliographical note

EXT="Tefas, Anastasios"

Source: Scopus

Source ID: 85064389224

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **The FitOptiVis ECSEL Project: Highly Efficient Distributed Embedded Image/Video Processing in Cyber-Physical Systems Invited Paper**

Cyber-Physical Systems (CPS) are systems that are in feedback with their environment, possibly with humans in the loop. They are often distributed with sensors and actuators, smart, adaptive and predictive and react in real-time. Image- and video-processing pipelines are a prime source for environmental information improving the possibilities of active, relevant feedback. In such a context, FitOptiVis aims to provide end-to-end multi-objective optimization for imaging and video pipelines of CPS, with emphasis on energy and performance, leveraging on a reference architecture, supported by low-power, high-performance, smart devices, and by methods and tools for combined design-time and run-time multi-objective optimization within system and environment constraints.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Delft University of Technology, Eindhoven University of Technology, Royal Philips, Institute of Information Theory and Automation of the Academy of Sciences of the Czech Republic, Thales Alenia Space Italia, PolComIng - Information Engineering Unit, Università dell'Aquila, Nokia Technologies, Turku University of Applied Science, Dept. of Electrical and Electronic Engineering, Abinsula

Contributors: Al-Ars, Z., Basten, T., Beer, A., Geilen, M., Goswami, D., Jääskeläinen, P., Kadlec, J., Alejandro, M. M., Palumbo, F., Peeren, G., Pomante, L., Linden, F. V., Saarinen, J., Säntti, T., Sau, C., Zedda, M. K.

Number of pages: 6

Pages: 333-338

Publication date: 30 Apr 2019

#### **Host publication information**

Title of host publication: ACM International Conference on Computing Frontiers 2019, CF 2019 - Proceedings

Publisher: ACM

ISBN (Electronic): 9781450366854

ASJC Scopus subject areas: Software

Keywords: Distributed systems, Energy and performance optimization, Heterogeneous system, Image-video processing

DOIs:

10.1145/3310273.3323437

Source: Scopus

Source ID: 85066051362

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **How do academics experience use of recorded audio feedback in higher education? A thematic analysis**

Our Work in Progress Paper in Research to Practice Category focuses on use of recorded audio feedback (RAF) in higher education. RAF is one method for providing feedback that is becoming increasingly popular, especially in e-education. According to previous studies, most learners have an overall positive attitude towards RAF. However, many of the studies have been carried out from learners' point of view. To complement RAF research, we study how academics experience use of RAF as a feedback method. We adopted a qualitative content analysis approach, applying thematic network analysis to the data received from four case academics. This approach proposes graphical networks as an aid for analyzing and synthesizing qualitative data into basic, organizing and global themes. The thematic network analysis produced two global, nine organizational and 45 basic themes. The two global themes were named 'Dialogue diversification' and 'Load reduction'. Based on our analysis, academics can, by using RAF, provide learners more relaxed and dialogic feedback and reduce their own workload both mentally and physically.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Jyväskylän yliopisto

Contributors: Heimbirger, A., Isomottonen, V., Nieminen, P., Keto, H.

Publication date: 4 Mar 2019

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Publisher: IEEE

Article number: 8658635

ISBN (Electronic): 9781538611739

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ISSN (Print): 1539-4565

ASJC Scopus subject areas: Software, Education, Computer Science Applications

Keywords: Academics, Distance learning, E-education, Higher education, RAF, Recorded audio feedback, Thematic network analysis, Work in Progress

DOIs:

10.1109/FIE.2018.8658635

### Bibliographical note

jufoid=70484

Source: Scopus

Source ID: 85063507477

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Challenges of Multi-Factor Authentication for Securing Advanced IoT Applications

The unprecedented proliferation of smart devices together with novel communication, computing, and control technologies have paved the way for A-IoT. This development involves new categories of capable devices, such as high-end wearables, smart vehicles, and consumer drones aiming to enable efficient and collaborative utilization within the smart city paradigm. While massive deployments of these objects may enrich people's lives, unauthorized access to said equipment is potentially dangerous. Hence, highly secure human authentication mechanisms have to be designed. At the same time, human beings desire comfortable interaction with the devices they own on a daily basis, thus demanding authentication procedures to be seamless and user-friendly, mindful of contemporary urban dynamics. In response to these unique challenges, this work advocates for the adoption of multi-factor authentication for A-IoT, such that multiple heterogeneous methods - both well established and emerging - are combined intelligently to grant or deny access reliably. We thus discuss the pros and cons of various solutions as well as introduce tools to combine the authentication factors, with an emphasis on challenging smart city environments. We finally outline the open questions to shape future research efforts in this emerging field.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, National Research University Higher School of Economics, ITMO University, Electrical Engineering Department, University of California, Los Angeles (UCLA)

Contributors: Ometov, A., Petrov, V., Bezzateev, S., Andreev, S., Koucheryavy, Y., Gerla, M.

Number of pages: 7

Pages: 82-88

Publication date: 1 Mar 2019

Peer-reviewed: Yes

### Publication information

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Volume: 33

Issue number: 2

ISSN (Print): 0890-8044

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Electronic versions:

Challenges of Multi-Factor Authentication for Securing Advanced IoT (A-IoT) Applications

DOIs:

10.1109/MNET.2019.1800240

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001151303>

Source: Scopus

Source ID: 85063775257

Research output: Contribution to journal > Article > Scientific > peer-review

### Analysis of an efficient parallel implementation of active-set Newton algorithm

This paper presents an analysis of an efficient parallel implementation of the active-set Newton algorithm (ASNA), which is used to estimate the nonnegative weights of linear combinations of the atoms in a large-scale dictionary to approximate an observation vector by minimizing the Kullback–Leibler divergence between the observation vector and the approximation. The performance of ASNA has been proved in previous works against other state-of-the-art methods. The

implementations analysed in this paper have been developed in C, using parallel programming techniques to obtain a better performance in multicore architectures than the original MATLAB implementation. Also a hardware analysis is performed to check the influence of CPU frequency and number of CPU cores in the different implementations proposed. The new implementations allow ASNA algorithm to tackle real-time problems due to the execution time reduction obtained.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Audio research group - ARG, Universitat Politècnica de València

Contributors: San Juan Sebastián, P., Virtanen, T., Garcia-Molla, V. M., Vidal, A. M.

Number of pages: 12

Pages: 1298-1309

Publication date: Mar 2019

Peer-reviewed: Yes

Early online date: 19 May 2018

#### Publication information

Journal: Journal of Supercomputing

Volume: 75

Issue number: 3

ISSN (Print): 0920-8542

Ratings:

Scopus rating (2019): CiteScore 3.9 SJR 0.432 SNIP 1.181

Original language: English

ASJC Scopus subject areas: Software, Theoretical Computer Science, Information Systems, Hardware and Architecture

Keywords: Convex optimization, Multicore, Newton algorithm, Parallel computing, Sparse representation

DOIs:

10.1007/s11227-018-2423-5

Source: Scopus

Source ID: 85047129085

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

#### Convolutional low-resolution fine-grained classification

Successful fine-grained image classification methods learn subtle details between visually similar (sub-)classes, but the problem becomes significantly more challenging if the details are missing due to low resolution. Encouraged by the recent success of Convolutional Neural Network (CNN) architectures in image classification, we propose a novel resolution-aware deep model which combines convolutional image super-resolution and convolutional fine-grained classification into a single model in an end-to-end manner. Extensive experiments on multiple benchmarks demonstrate that the proposed model consistently performs better than conventional convolutional networks on classifying fine-grained object classes in low-resolution images.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Vision

Contributors: Cai, D., Chen, K., Qian, Y., Kämäräinen, J.

Pages: 166-171

Publication date: Mar 2019

Peer-reviewed: Yes

Early online date: 2017

#### Publication information

Journal: Pattern Recognition Letters

Volume: 119

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2019): CiteScore 6.3 SJR 0.848 SNIP 2.021

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Artificial Intelligence

Keywords: Deep learning, Fine-grained image classification, Super resolution convolutional neural networks

DOIs:

10.1016/j.patrec.2017.10.020

Source: Scopus

Source ID: 85032974725

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### **Challenges and recommended practices for software architecting in global software development**

Context: Global software development (GSD), although now a norm in the software industry, carries with it enormous challenges mostly regarding communication and coordination. Aforementioned challenges are highlighted when there is a need to transfer knowledge between sites, particularly when software artifacts assigned to different sites depend on each other. The design of the software architecture and associated task dependencies play a major role in reducing some of these challenges. Objective: The current literature does not provide a cohesive picture of how the distributed nature of software development is taken into account during the design phase: what to avoid, and what works in practice. The objective of this paper is to gain an understanding of software architecting in the context of GSD, in order to develop a framework of challenges and solutions that can be applied in both research and practice. Method: We conducted a systematic literature review (SLR) that synthesises (i) challenges which GSD imposes on software architecture design, and (ii) recommended practices to alleviate these challenges. Results: We produced a comprehensive set of guidelines for performing software architecture design in GSD based on 55 selected studies. Our framework comprises nine key challenges with 28 related concerns, and nine recommended practices, with 22 related concerns for software architecture design in GSD. These challenges and practices were mapped to a thematic conceptual model with the following concepts: Organization (Structure and Resources), Ways of Working (Architecture Knowledge Management, Change Management and Quality Management), Design Practices, Modularity and Task Allocation. Conclusion: The synthesis of findings resulted in a thematic conceptual model of the problem area, a mapping of the key challenges to practices, and a concern framework providing concrete questions to aid the design process in a distributed setting. This is a first step in creating more concrete architecture design practices and guidelines.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Pervasive Computing, Research area: Software engineering, University of Limerick

Contributors: Sievi-Korte, O., Beecham, S., Richardson, I.

Number of pages: 20

Pages: 234-253

Publication date: 1 Feb 2019

Peer-reviewed: Yes

Early online date: 2018

#### **Publication information**

Journal: Information and Software Technology

Volume: 106

ISSN (Print): 0950-5849

Ratings:

Scopus rating (2019): CiteScore 7.6 SJR 0.781 SNIP 2.555

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Computer Science Applications

Keywords: Design practice, Global software development, Software architecture, Software design, Systematic literature review

Electronic versions:

Challenges and Recommended practices. Embargo ended: 29/11/20

DOIs:

10.1016/j.infsof.2018.10.008

URLs:

<http://urn.fi/URN:NBN:fi:tty-201908232006>. Embargo ended: 29/11/20

Source: Scopus

Source ID: 85055646041

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Additional lossless compression of JPEG images based on BPG**

The task of additional lossless compression of JPEG images is considered. We propose to decode JPEG image and recompress it using lossy BPG (Better Portable Graphics) codec based on a subset of the HEVC open video compression standard. Then the decompressed and smoothed BPG image is used for calculation and quantization of DCT coefficients in 8x8 image blocks using quantization tables of the source JPEG image. A difference between obtained quantized DCT coefficients and quantized DCT coefficients of the source JPEG image (prediction error) is calculated. The difference is lossless compressed by a proposed context modeling and arithmetical coding. In this way the source JPEG image is replaced by two files: compressed BPG image and the compressed difference which needed for lossless restoration of the source JPEG image. It is shown that the proposed approach provides compression ratios comparable with state of the art PAQ8, WinZip and STUFFIT file archivers. At the same time BPG images may be used for fast preview of compressed JPEG images.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Kharkiv National Aerospace University

Contributors: Ponomarenko, M., Miroschnichenko, O., Lukin, V., Egiazarian, K.

Publication date: 13 Jan 2019

### Host publication information

Title of host publication: Image Processing: Algorithms and Systems XVII

### Publication series

Name: IS and T International Symposium on Electronic Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Context modelling, Discrete cosine transform, JPEG, JPEG additional compression

DOIs:

10.2352/ISSN.2470-1173.2019.11.IPAS-263

Source: Scopus

Source ID: 85080092000

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Combined no-reference IQA metric and its performance analysis

The problem of increasing efficiency of blind image quality assessment is considered. No-reference image quality metrics both independently and as components of complex image processing systems are employed in various application areas where images are the main carriers of information. Meanwhile, existing no-reference metrics have a significant drawback characterized by a low adequacy to image perception by human visual system (HVS). Many well-known no-reference metrics are analyzed in our paper for several image databases. A method of combining several no-reference metrics based on artificial neural networks is proposed based on multi-database verification approach. The effectiveness of the proposed approach is confirmed by extensive experiments.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Kharkiv National Aerospace University

Contributors: Ieremeiev, O., Lukin, V., Ponomarenko, N., Egiazarian, K.

Publication date: 13 Jan 2019

### Host publication information

Title of host publication: Image Processing: Algorithms and Systems XVII

### Publication series

Name: IS and T International Symposium on Electronic Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Combined metrics, Full-reference metrics, Image visual quality assessment, Robust metrics

DOIs:

10.2352/ISSN.2470-1173.2019.11.IPAS-260

Source: Scopus

Source ID: 85080028392

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Phase masks optimization for broadband diffractive imaging

The task of optimization of phase masks for broadband diffractive imaging to minimize chromatic aberrations and to provide given value of Depth of Focus (DoF) is considered. Different schemes of multilevel phase mask (MPM) forming by combining pixels of two Fresnel lenses are analyzed. The Fresnel lenses are calculated for the same focal distance but for very different wavelengths. A possibility of adding to the optimized mask a cubic component is taking into account as well as usage of discrete phase masks with optimized number of levels. It is shown that the proposed approach in the combination with inverse imaging allows to significantly increase image quality for a focus distance in comparison to refractive lens-based optical systems. Moreover, it is shown that by changing of aforementioned parameters it is possible to increase or decrease DoF value depending from a given goal of optimization. It is demonstrated by numerical analysis that the proposed approach significantly increases robustness of designed MPM to Gaussian additive noise in MPM introduced due to fabrication errors.

### General information

Publication status: Published



MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Research group: Computational Imaging-CI  
Contributors: Ponomarenko, M., Katkovnik, V., Egiazarian, K.  
Publication date: 13 Jan 2019

#### Host publication information

Title of host publication: Image Processing: Algorithms and Systems XVII

#### Publication series

Name: IS and T International Symposium on Electronic Imaging Science and Technology  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
Keywords: Diffractive optical elements, Inverse imaging, Lensless imaging, Multilevel phase mask design  
DOIs:  
10.2352/ISSN.2470-1173.2019.11.IPAS-258  
Source: Scopus  
Source ID: 85080039777  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Thin form-factor super multiview head-up display system

We propose a virtual-image head-up display (HUD) based on the super multiview (SMV) display technology. Implementation-wise, the HUD provides a compact solution, consisting of a thin form-factor SMV display and a combiner placed on the windshield of the vehicle. Since the utilized display is at most few centimeters thick, it does not need extra installation space that is usually required by most of the existing virtual image HUDs. We analyze the capabilities of the proposed system in terms of several HUD related quality factors such as resolution, eyebox width, and target image depth. Subsequently, we verify the analysis results through experiments carried out using our SMV-HUD demonstrator. We show that the proposed system is capable of visualizing images at the typical virtual image HUD depths of 2 – 3m, in a reasonably large eyebox, which is slightly over 30cm in our demonstrator. For an image at the target virtual image depth of 2.5m, the field of view of the developed system is  $11^\circ \times 16^\circ$  and the spatial resolution is around 240x60 pixels in vertical and horizontal directions, respectively. There is, however, plenty of room for improvement regarding the resolution, as we actually utilize an LCD at moderate resolution (216 ppi) and off-the-shelf lenticular sheet in our demonstrator.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences  
Contributors: Akpınar, U., Sahin, E., Suominen, O., Gotchev, A.  
Publication date: 13 Jan 2019

#### Host publication information

Title of host publication: Stereoscopic Displays and Applications XXX

#### Publication series

Name: IS&T International Symposium on Electronic Imaging  
ISSN (Electronic): 2470-1173  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
DOIs:  
10.2352/ISSN.2470-1173.2019.3.SDA-631

#### Bibliographical note

jufoid=84313  
Source: Scopus  
Source ID: 85081086336  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Performance evaluation of bandwidth reservation for mmWave 5G NR systems

Introduction: In 3GPP New Radio (NR) systems, frequent radio propagation path blockages can lead to the disconnection of ongoing sessions already accepted into the system, reducing the quality of service in the network. Controlling access to system resource by prioritizing for the ongoing sessions can increase the session continuity. In this paper, we propose resource allocation with a reservation mechanism. Purpose: Development of a mathematical model for analyzing the effect of this mechanism on other system performance indicators - dropping probabilities for new and ongoing sessions and system utilization. The model takes into account the key features of the 3GPP NR technology, including the height of the interacting objects, the spatial distribution and mobility of the blockers, as well as the line-of-sight propagation properties between the transceivers for mmWave NR technology. Results: We analyzed the reservation mechanism with the help of a developed model in the form of a resource queueing system with signals, where the base station bandwidth corresponds

to the resource, and the signals model a change in the line-of-sight conditions between the receiving and transmitting devices. Creating a priority for ongoing sessions whose service has not yet been completed provides a considerable flexibility for balancing the session continuity and dropping of a new session, with a slight decrease in the efficiency of the radio resource utility. With the developed model, we showed that reserving even a small bandwidth (less than 10% of the total resources) to maintain the ongoing sessions has a positive effect on their continuity, as it increases the probability of their successful completion. Practical relevance: The proposed mechanism works more efficiently in overload conditions and with sessions which have a high data transfer rate requirements. This increases the demand for the proposed mechanism in 5G NR communication systems.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, Peoples' Friendship University of Russia, Federal Research Center Computer Science and Control of the Russian Academy of Sciences

Contributors: Begishev, V. O., Sopin, E. S., Molchanov, D. A., Samouylov, A. K., Gaidamaka, Y. V., Samouylov, K. E.

Number of pages: 13

Pages: 51-63

Publication date: 1 Jan 2019

Peer-reviewed: Yes

### Publication information

Journal: Informatsionno-Upravliaiushchie Sistemy

Issue number: 5

ISSN (Print): 1684-8853

Ratings:

Scopus rating (2019): CiteScore 0.5 SJR 0.201 SNIP 0.507

Original language: English

ASJC Scopus subject areas: Software, Control and Systems Engineering, Information Systems, Human-Computer Interaction, Computer Science Applications, Control and Optimization

Keywords: 5G networks, Bandwidth reservation, Millimeter wave, New Radio, New session drop probability, Ongoing session drop probability, Session continuity, System resource utilization

DOIs:

10.31799/1684-8853-2019-5-51-63

Source: Scopus

Source ID: 85082424315

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### Towards detecting structural branching and cyclicity in graphs: A polynomial-based approach

Structural properties of graphs and networks have been investigated across scientific disciplines ranging from mathematics to structural chemistry. Structural branching, cyclicity and, more generally, connectedness are well-known examples of such properties. In particular, various graph measures for detecting structural branching and cyclicity have been investigated. These measures are of limited applicability since their interpretation relies heavily on a certain definition of structural branching. In this paper we define a related measure, taking an approach to measurement similar to that of Lovász and Pelikán (On the eigenvalues of trees, *Periodica Mathematica Hungarica*, Vol. 3 (1–2), 1973, 175–182). We define a complex valued polynomial which also has a unique positive root. Analytical and numerical results demonstrate that this measure can be interpreted as a structural branching and cyclicity measure for graphs. Our results generalize the work of Lovász and Pelikán since the measure we introduce is not restricted to trees.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Medicine and Statistical Learning Laboratory (CMSL), Research group: Predictive Society and Data Analytics (PSDA), University of Applied Sciences Upper Austria, Nankai University, Hall in Tyrol, The City College of New York (CUNY), Shandong University at Weihai

Contributors: Dehmer, M., Chen, Z., Emmert-Streib, F., Mowshowitz, A., Shi, Y., Tripathi, S., Zhang, Y.

Number of pages: 10

Pages: 19-28

Publication date: 1 Jan 2019

Peer-reviewed: Yes

Early online date: 29 Aug 2018

### Publication information

Journal: Information Sciences

Volume: 471  
ISSN (Print): 0020-0255  
Ratings:

Scopus rating (2019): CiteScore 11.3 SJR 1.723 SNIP 2.688

Original language: English

ASJC Scopus subject areas: Software, Control and Systems Engineering, Theoretical Computer Science, Computer Science Applications, Information Systems and Management, Artificial Intelligence

Keywords: Data science, Graphs, Networks, Quantitative graph theory, Structural branching

DOIs:

10.1016/j.ins.2018.08.043

Source: Scopus

Source ID: 85052883508

Research output: Contribution to journal › Article › Scientific › peer-review

### **Business intelligence process model revisited**

Today many organizations have come to value knowledge as a production factor. Thus, there is a constant need for getting the information in and sorted. Business intelligence (BI) is a process for systematic acquiring, analyzing, and disseminating data and information from various sources to gain understanding about the business's environment. This is required for supporting decisions for achieving organization's business objectives. Literature has introduced models for planning and executing BI. However, as business environments and technologies evolve in a rapid pace, are the models still applicable? Not all recent issues are taken into consideration in the previous models. BI is considered to be integrated into business processes, so the similar evolution is expected to take place. There are two studies investigating BI instigating this study, but there are still questions to be answered. Literature on different models and findings of these studies were combined to form a vision to better match reality. Various issues like users' active involvement, real-time analysis and presentation, and social media resources were brought up. Practitioners can use the approach to assess their current state of BI activities or planning the organization of BI program.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Information and Knowledge Management

Contributors: Hellsten, P., Myllärniemi, J.

Number of pages: 8

Pages: 341-348

Publication date: 2019

### **Host publication information**

Title of host publication: IC3K 2019 - Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management

Publisher: SCITEPRESS

Editors: Bernardino, J., Salgado, A., Filipe, J.

ISBN (Electronic): 9789897583827

### **Publication series**

Name: IC3K 2019 - Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management

Volume: 3

ASJC Scopus subject areas: Software

Keywords: Business Intelligence, Business Intelligence Process Model, Decision-Making, Organizational Development

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Challenges in developing data-based value creation**

Understanding data-based value creation helps organizations to enhance its decision-making and to renew their business operations. However, organizations aiming to use modern data analytics face several severe challenges that are not usually so evident or visible beforehand. In this paper we study a Finnish manufacturing company's data empowerment and information and knowledge management practices in order to identify the potential challenges related to modern data-based value creation within industrial context. The empirical data is consisted of group discussions, relevant data sets acquired from the case company's information systems, and lastly, 12 thematic interviews of the key actors in the company in relation to service development. The study provides valuable insights for managing service development and decision-making and creates understanding on data-based value creation. Achieved understanding provides meaningful knowledge for organizations utilizing or having plans to utilize, for example, data analytic methods in their businesses.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication  
Organisations: Information and Knowledge Management  
Contributors: Myllärniemi, J., Helander, N., Pekkola, S.  
Number of pages: 7  
Pages: 370-376  
Publication date: 2019

#### Host publication information

Title of host publication: IC3K 2019 - Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management  
Publisher: SCITEPRESS  
Editors: Bernardino, J., Salgado, A., Filipe, J.  
ISBN (Electronic): 9789897583827

#### Publication series

Name: IC3K 2019 - Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management  
Volume: 3  
ASJC Scopus subject areas: Software  
Keywords: Case Study, Data-based Value Creation, Information Management Process, Knowledge Management  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Co-creating digital services for citizens: Activity theory analysis

Smart city development relies heavily on creation of digital services that are available for the citizens and for the city authorities. At best, these services are co-created by the authorities, citizens and the digital solution supplier companies. Digital service co-creation is, however, a complex process and includes several contradictions due to presence of several stakeholders. In this paper, we present a case study of smart city initiated digital service co-creation process through the analytical lenses of activity theory.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Information and Knowledge Management, HAMK Design Factory, HAMK University of Applied Sciences, HAMK Smart Research Unit  
Contributors: Jussila, J., Kukkamäki, J., Helander, N.  
Number of pages: 6  
Pages: 285-290  
Publication date: 2019

#### Host publication information

Title of host publication: IC3K 2019 - Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management  
Publisher: SCITEPRESS  
Editors: Bernardino, J., Salgado, A., Filipe, J.  
ISBN (Electronic): 9789897583827

#### Publication series

Name: IC3K 2019 - Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management  
Volume: 3  
ASJC Scopus subject areas: Software  
Keywords: Activity Theory, Co-creation, Digital Service, Empirical Study  
DOIs:  
10.5220/0008349002850290

#### Bibliographical note

EXT="Jussila, Jari"  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Compatible natural gradient policy search

Trust-region methods have yielded state-of-the-art results in policy search. A common approach is to use KL-divergence to bound the region of trust resulting in a natural gradient policy update. We show that the natural gradient and trust region optimization are equivalent if we use the natural parameterization of a standard exponential policy distribution in combination with compatible value function approximation. Moreover, we show that standard natural gradient updates may reduce the entropy of the policy according to a wrong schedule leading to premature convergence. To control entropy reduction we introduce a new policy search method called compatible policy search (COPOS) which bounds entropy loss.

The experimental results show that COPOS yields state-of-the-art results in challenging continuous control tasks and in discrete partially observable tasks.

#### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Intelligent Autonomous Systems, Technical University Darmstadt, MPI for Intelligent Systems, University of Lincoln

Contributors: Pajarinen, J., Thai, H. L., Akrou, R., Peters, J., Neumann, G.

Publication date: 2019

Peer-reviewed: Yes

#### Publication information

Journal: Machine Learning

ISSN (Print): 0885-6125

Ratings:

Scopus rating (2019): CiteScore 5 SJR 1.034 SNIP 1.941

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence

Keywords: Policy search, Reinforcement learning

Electronic versions:

Manuscript\_MAGMA\_Final\_preprint

DOIs:

10.1007/s10994-019-05807-0

URLs:

<http://urn.fi/URN:NBN:fi:tty-201906101846>

Source: Scopus

Source ID: 85066145275

Research output: Contribution to journal > Article > Scientific > peer-review

#### Continuum approach to high-cycle fatigue. The finite life-time case with stochastic stress history

In this paper, we consider continuum approach for high-cycle fatigue in the case where life-time is finite. The method is based on differential equations and all basic concepts are explained. A stress history is assumed to be a stochastic process and this leads us to the theory of stochastic differential equations. The life-time is a quantity, which tells us when the breakdown of the material happens. In this method, it is naturally a random variable. The basic assumption is, that the distribution of the life-time is log-normal or Weibull. We give a numerical basic example to demonstrate the method.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences

Contributors: Orelma, H.

Number of pages: 12

Pages: 452-463

Publication date: 2019

Peer-reviewed: Yes

#### Publication information

Journal: Vestnik Samarskogo Gosudarstvennogo Tekhnicheskogo Universiteta, Seriya Fiziko-Matematicheskie Nauki

Volume: 23

Issue number: 3

ISSN (Print): 1991-8615

Ratings:

Scopus rating (2019): CiteScore 0

Original language: English

ASJC Scopus subject areas: Mechanics of Materials, Condensed Matter Physics, Mathematical Physics, Modelling and Simulation, Analysis, Applied Mathematics, Software

Keywords: Evolution equation, High-cycle fatigue, Life-time

DOIs:

10.14498/vsgtu1705

Source: Scopus

Source ID: 85079143163

Research output: Contribution to journal > Article > Scientific > peer-review

## **Farm detection based on deep convolutional neural nets and semi-supervised green texture detection using VIS-NIR satellite image**

Farm detection using low resolution satellite images is an important topic in digital agriculture. However, it has not received enough attention compared to high-resolution images. Although high resolution images are more efficient for detection of land cover components, the analysis of low-resolution images are yet important due to the low-resolution repositories of the past satellite images used for timeseries analysis, free availability and economic concerns. The current paper addresses the problem of farm detection using low resolution satellite images. In digital agriculture, farm detection has significant role for key applications such as crop yield monitoring. Two main categories of object detection strategies are studied and compared in this paper; First, a two-step semi-supervised methodology is developed using traditional manual feature extraction and modelling techniques; the developed methodology uses the Normalized Difference Moisture Index (NDMI), Grey Level Co-occurrence Matrix (GLCM), 2-D Discrete Cosine Transform (DCT) and morphological features and Support Vector Machine (SVM) for classifier modelling. In the second strategy, high-level features learnt from the massive filter banks of deep Convolutional Neural Networks (CNNs) are utilised. Transfer learning strategies are employed for pretrained Visual Geometry Group Network (VGG-16) networks. Results show the superiority of the high-level features for classification of farm regions.

### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Electrical Engineering, Coventry University  
Contributors: Sharifzadeh, S., Tata, J., Tan, B.  
Number of pages: 9  
Pages: 100-108  
Publication date: 2019

### **Host publication information**

Title of host publication: DATA 2019 - Proceedings of the 8th International Conference on Data Science, Technology and Applications  
Publisher: SCITEPRESS  
Editors: Hammoudi, S., Quix, C., Bernardino, J.  
ISBN (Electronic): 9789897583773  
ASJC Scopus subject areas: Hardware and Architecture, Information Systems, Software, Computer Networks and Communications  
Keywords: Classification, Convolutional Neural Nets (CNNs), Digital Agriculture, Satellite Image, Supervised Feature Extraction  
Electronic versions:  
DATA\_2019\_68  
DOIs:  
10.5220/0007954901000108  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-201910234035>  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

## **Institutional Perspectives on the Process of Enterprise Architecture Adoption**

Organizations often adopt enterprise architecture (EA) when planning how best to develop their information technology (IT) or businesses, for strategic management, or generally for managing change initiatives. This variety of different uses affects many stakeholders within and between organizations. Because stakeholders have dissimilar backgrounds, positions, assumptions, and activities, they respond differently to changes and the potential problems that emerge from those changes. This situation creates contradictions and conflicts between stakeholders that may further influence project activities and ultimately determine how EA is adopted. In this paper, we examine how institutional pressures influence EA adoption. Based on a qualitative case study of two cases, we show how regulative, normative, and cognitive pressures influence stakeholders' activities and behaviors during the process of EA adoption. Our contribution thus lies in identifying roles of institutional pressures in different phases during the process of EA adoption and how it changes overtime. The results provide insights into EA adoption and the process of institutionalization, which help to explain emergent challenges in EA adoption.

### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Information and Knowledge Management, Research group: Business Data Research Group, University of Vaasa (UVA)  
Contributors: Dang, D., Pekkola, S.  
Publication date: 2019

Peer-reviewed: Yes

### Publication information

Journal: Information Systems Frontiers

ISSN (Print): 1387-3326

Ratings:

Scopus rating (2019): CiteScore 6.7 SJR 1.02 SNIP 1.926

Original language: English

ASJC Scopus subject areas: Software, Theoretical Computer Science, Information Systems, Computer Networks and Communications

Keywords: EA adoption, Enterprise architecture, Institutional theory, Institutionalization process

Electronic versions:

Dang-Pekkola2019\_Article\_InstitutionalPerspectivesOnThe

DOIs:

10.1007/s10796-019-09944-8

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201909052073>

### Bibliographical note

EXT="Dang, Duong"

Source: Scopus

Source ID: 85069739091

Research output: Contribution to journal › Article › Scientific › peer-review

### Log analysis of 360-degree video users via MQTT

Analyzing 360-degree video users is beneficial for 360-degree video application development. The analysis can be done with logged user data. In this paper, we argue that MQTT is a conventional technology for distributed logging of mobile 360-degree video users. MQTT not only saves resources also allows communication from the logging server to mobile clients in various networking conditions relatively easy. We constructed a proof of concept to show the feasibility of the approach. As log analysis examples, the proof of concept visualizes results of the most popular region of interest analysis and k-means clustering. The used research method is design science.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences

Contributors: Luoto, A.

Number of pages: 8

Pages: 130-137

Publication date: 2019

### Host publication information

Title of host publication: ICGDA 2019 : Proceedings of the 2019 2nd International Conference on Geoinformatics and Data Analysis

Publisher: ACM

ISBN (Electronic): 978-1-4503-6245-0

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: 360-degree video, Component, Log Analysis, MQTT

Electronic versions:

ICSSE\_2019\_paper\_5

DOIs:

10.1145/3318236.3318248

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009116968>

Source: Scopus

Source ID: 85066837109

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### PyGOP: A Python library for Generalized Operational Perceptron algorithms

PyGOP provides a reference implementation of existing algorithms using Generalized Operational Perceptron (GOP), a recently proposed artificial neuron model. The implementation adopts a user-friendly interface while allowing a high level of customization including user-defined operators, custom loss function, custom metric functions that requires full batch evaluation such as Precision, Recall or F1. Besides, PyGOP supports different computation environments (CPU/GPU) on

both single machine and cluster using SLURM job scheduler. In addition, since training GOP-based algorithms might take days, PyGOP automatically saves checkpoints during computation and allows resuming to the last checkpoint in case the script got interfered in the middle during the progression.

#### General information

Publication status: Accepted/In press

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Qatar University, Aarhus Universitet

Contributors: Tran, D. T., Kiranyaz, S., Gabbouj, M., Iosifidis, A.

Publication date: 2019

Peer-reviewed: Yes

#### Publication information

Journal: Knowledge-Based Systems

ISSN (Print): 0950-7051

Ratings:

Scopus rating (2019): CiteScore 11.7 SJR 1.754 SNIP 2.902

Original language: English

ASJC Scopus subject areas: Software, Management Information Systems, Information Systems and Management, Artificial Intelligence

Keywords: Generalized Operational Perceptron (GOP), Heterogeneous Multilayer Generalized Operational Perceptron (HeMLGOP), Progressive Operational Perceptron (POP), Progressive Operational Perceptron with Memory (POPmem)

DOIs:

10.1016/j.knosys.2019.06.009

#### Bibliographical note

EXT="Kiranyaz, Serkan"

EXT="Iosifidis, Alexandros"

Source: Scopus

Source ID: 85066982487

Research output: Contribution to journal > Article > Scientific > peer-review

#### Revisiting continuous deployment maturity: A two-year perspective

Background: Achieving a steady stream of small releases and employing practices such as continuous deployment requires maturity in company processes. Maturity models provide one approach for companies to pinpoint areas of improvement by providing a position and hints to reflect on. Incorporating maturity models with agile software development and continuous deployment has its challenges, though. Aims: The focus of the study is in understanding the evolution of software processes towards continuous deployment in an industry organization over time when a maturity model is used as a yardstick in evaluation. Method: An embedded case study by design, the study utilizes and replicates a survey on the state of software projects in a large Finnish software company, Solita. The survey was initially conducted in 2015 with responses from 35 projects and now replicated in 2017 with responses from 43 projects. Both quantitative and qualitative approaches for survey responses are used in the analysis. Results: Maturity of software processes in the case company show improvement in deployment and in monitoring, albeit short of statistical significance. Technological advances in the application of cloud computing have likely spurred development in these areas. Capability in processes related to test automation and quality has not changed much in two years. Conclusions: Maintaining maturity in software processes requires constant attention as impressions on process quality can gradually diminish. Projects which are built on a compatible technology stack have a greater chance in achieving continuous deployment and thus being more mature. Customer preferences also make a difference in the ability to reach certain maturity levels.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, University of Helsinki, Solita Plc.

Contributors: Mäkinen, S., Puonti, M., Lehtonen, T., Mikkonen, T., Kilamo, T., Männistö, T.

Number of pages: 8

Pages: 1810-1817

Publication date: 2019

#### Host publication information

Title of host publication: Proceedings of the 34th ACM/SIGAPP Symposium on Applied Computing

Publisher: ACM

ISBN (Print): 9781450359337

ASJC Scopus subject areas: Software

DOIs:

10.1145/3297280.3297458



### Bibliographical note

EXT="Mikkonen, Tommi"

EXT="Puonti, Mikko"

Source: Scopus

Source ID: 85065664245

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### The Lord of the shares: Combining attribute-based encryption and searchable encryption for flexible data sharing

Secure cloud storage is considered one of the most important issues that both businesses and end-users are considering before moving their private data to the cloud. Lately, we have seen some interesting approaches that are based either on the promising concept of Symmetric Searchable Encryption (SSE) or on the well-studied field of Attribute-Based Encryption (ABE). In the first case, researchers are trying to design protocols where users' data will be protected from both internal and external attacks without paying the necessary attention to the problem of user revocation. On the other hand, in the second case existing approaches address the problem of revocation. However, the overall efficiency of these systems is compromised since the proposed protocols are solely based on ABE schemes and the size of the produced ciphertexts and the time required to decrypt grows with the complexity of the access formula. In this paper, we propose a protocol that combines both SSE and ABE in a way that the main advantages of each scheme are used. The proposed protocol allows users to directly search over encrypted data by using an SSE scheme while the corresponding symmetric key that is needed for the decryption is protected via a Ciphertext-Policy Attribute-Based Encryption scheme.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences

Contributors: Michalás, A.

Number of pages: 10

Pages: 146-155

Publication date: 2019

### Host publication information

Title of host publication: Proceedings of the 34th ACM/SIGAPP Symposium on Applied Computing

Publisher: ACM

ISBN (Print): 9781450359337

ASJC Scopus subject areas: Software

Keywords: Access Control, Attribute-Based Encryption, Cloud Security, Hybrid Encryption, Policies, Storage Protection, Symmetric Searchable Encryption

DOIs:

10.1145/3297280.3297297

Source: Scopus

Source ID: 85065666090

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Zeffiro User Interface for Electromagnetic Brain Imaging: a GPU Accelerated FEM Tool for Forward and Inverse Computations in Matlab

This article introduces the Zeffiro interface (ZI) version 2.2 for brain imaging. ZI aims to provide a simple, accessible and multimodal open source platform for finite element method (FEM) based and graphics processing unit (GPU) accelerated forward and inverse computations in the Matlab environment. It allows one to (1) generate a given multi-compartment head model, (2) to evaluate a lead field matrix as well as (3) to invert and analyze a given set of measurements. GPU acceleration is applied in each of the processing stages (1)–(3). In its current configuration, ZI includes forward solvers for electro-/magnetoencephalography (EEG) and linearized electrical impedance tomography (EIT) as well as a set of inverse solvers based on the hierarchical Bayesian model (HBM). We report the results of EEG and EIT inversion tests performed with real and synthetic data, respectively, and demonstrate numerically how the inversion parameters affect the EEG inversion outcome in HBM. The GPU acceleration was found to be essential in the generation of the FE mesh and the LF matrix in order to achieve a reasonable computing time. The code package can be extended in the future based on the directions given in this article.

### General information

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Inverse Problems

Contributors: He, Q., Rezaei, A., Pursiainen, S.

Number of pages: 14

Publication date: 2019

Peer-reviewed: Yes

## Publication information

Journal: Neuroinformatics

ISSN (Print): 1539-2791

Ratings:

Scopus rating (2019): CiteScore 8.2 SJR 1.984 SNIP 2.238

Original language: English

ASJC Scopus subject areas: Software, Neuroscience(all), Information Systems

Keywords: Electrical Impedance Tomography (EIT), Electro-/Magnetoencephalography (EEG/MEG), Finite Element Method (FEM), Hierarchical Bayesian Model (HBM), Matlab Interface

Electronic versions:

He2019\_Article\_ZeffiroUserInterfaceForElectro

DOIs:

10.1007/s12021-019-09436-9

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911296442>

Source: Scopus

Source ID: 85074501520

Research output: Contribution to journal > Article > Scientific > peer-review

## On the Secrecy Capacity of Fisher-Snedecor F Fading Channels

The performance of physical-layer security of the classic Wyner's wiretap model over Fisher-Snedecor composite fading channels is considered in this work. Specifically,  $F$  the main channel (i.e., between the source and the legitimate destination) and the eavesdropper's channel (i.e., between the source and the illegitimate destination) are assumed to experience independent quasi-static Fisher-Snedecor fading conditions, which have been shown to be encountered in realistic wireless transmission scenarios in conventional and emerging communication systems. In this context, exact closed-form expressions for the average secrecy capacity (ASC) and the probability of non-zero secrecy capacity (PNSC) are derived. Additionally, an asymptotic analytical expression for the ASC is presented. The impact of shadowing and multipath fading on the secrecy performance is investigated. Our results show that increasing the fading parameter of the main channel and/or the shadowing parameter of the eavesdropper's channel improves the secrecy performance. The analytical results are compared with Monte-Carlo simulations to validate the analysis.

## General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Wireless Communications and Positioning, Electrical Engineering, German Jordanian University, Khalifa University, University of Surrey, Queen's University, Belfast, Northern Ireland, Manchester Metropolitan University, Universidade Federal do Ceara

Contributors: Badarneh, O. S., Sofotasios, P. C., Muhaidat, S., Cotton, S. L., Rabie, K., Al-Dhahir, N.

Number of pages: 6

Pages: 102-107

Publication date: 26 Dec 2018

## Host publication information

Title of host publication: 2018 14th International Conference on Wireless and Mobile Computing, Networking and Communications, WiMob 2018

Publisher: IEEE

ISBN (Electronic): 9781538668764

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software

DOIs:

10.1109/WiMOB.2018.8589137

Source: Scopus

Source ID: 85060830976

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

## The N-Fisher-Snedecor F Cascaded Fading Model

The Fisher-Snedecor  $F$  distribution was recently proposed as an accurate and tractable composite fading model in the context of device-to-device communications. The present work derives the product of the Fisher-Snedecor  $F$  composite fading model, which is useful in characterizing fading effects in numerous realistic communication scenarios. To this end, novel analytic expressions are first derived for the probability density function, the cumulative distribution function and the moment of the product of  $N$  statistically independent, but not necessarily identically distributed, Fisher-Snedecor  $F$  random variables. Capitalizing on these expressions, we derive tractable closed-form expressions for channel quality estimation of the proposed model as well as the corresponding outage probability and average bit error probability for binary modulations. The offered results are corroborated by extensive Monte-Carlo simulation results, which verify the validity of the derived expressions. It is shown that the number of cascaded channels affects considerably the corresponding performance, as a variation of over an order of magnitude is observed across all signal-to-noise ratio regimes.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Wireless Communications and Positioning, Electrical Engineering, German Jordanian University, Khalifa University, University of Surrey, Queen's University, Belfast, Northern Ireland, Manchester Metropolitan University, Universidade Federal do Ceara

Contributors: Badarneh, O. S., Muhaidat, S., Sofotasios, P. C., Cotton, S. L., Rabie, K., Da Costa, D. B.

Publication date: 26 Dec 2018

### Host publication information

Title of host publication: 2018 14th International Conference on Wireless and Mobile Computing, Networking and Communications, WiMob 2018

Publisher: IEEE

ISBN (Electronic): 9781538668764

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software

DOIs:

10.1109/WiMOB.2018.8589124

Source: Scopus

Source ID: 85060794044

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Power mitigation of a heterogeneous multicore architecture on FPGA/ASIC by DFS/DVFS techniques

This article presents an integrated self-aware computing model in a Heterogeneous Multicore Architecture (HMA) to mitigate the power dissipation of an Orthogonal Frequency-Division Multiplexing (OFDM) receiver. The proposed platform consists of template-based Coarse-Grained Reconfigurable Array (CGRA) devices connected through a Network-on-Chip (NoC) around a few Reduced Instruction-Set Computing (RISC) cores. The self-aware computing model exploits Feedback Control System (FCS) which constantly monitors the execution-time of each core and dynamically scales the operating frequency of each node of the NoC depending on the worst execution-time. Therefore, the performance of the overall system is equalized towards a desired level besides mitigating the power dissipation. Measurement results obtained from Field-Programmable Gate Array (FPGA) synthesis show up to 20.2% dynamic power dissipation and 16.8% total power dissipation savings. Since FCS technique can be employed for scaling the frequency and the voltage and on the other hand, voltage supply cannot be scaled on the FPGA-based prototyped platform, the implementation is also estimated in 28nm Ultra-Thin Body and Buried oxide (UTBB) Fully-Depleted Silicon-On-Insulator (FD-SOI) Application-Specific Integrated Circuit (ASIC) technology to scale voltage in addition to frequency and get more benefits in terms of dynamic power dissipation reduction. Subsequent to synthesizing the whole platform on ASIC and scaling the voltage and frequency simultaneously as a Dynamic Voltage and Frequency Scaling (DVFS) method, significant dynamic power dissipation savings by 5.97X against Dynamic Frequency Scaling (DFS) method were obtained.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electronics and Communications Engineering, Research group: System-on-Chip for GNSS, Wireless Communications and Cyber-Physical Embedded Computing, University of Bologna

Contributors: Nouri, S., Rossi, D., Nurmi, J.

Number of pages: 10

Pages: 259-268

Publication date: 1 Nov 2018

Peer-reviewed: Yes

### Publication information

Journal: Microprocessors and Microsystems

Volume: 63

ISSN (Print): 0141-9331

Ratings:

Scopus rating (2018): CiteScore 2.5 SJR 0.264 SNIP 0.941

Original language: English

ASJC Scopus subject areas: Software, Hardware and Architecture, Computer Networks and Communications, Artificial Intelligence

Keywords: Accelerator, ASIC, CGRA, Channel estimation, DVFS, FCS, FFT, FPGA, Frequency offset estimation, Heterogeneous, Multicore, Network-on-Chip, OFDM, Power mitigation, Receiver, Reconfigurable, Time synchronization

Electronic versions:

Power mitigation of a heterogeneous multicore architecture 2018

DOIs:

10.1016/j.micpro.2018.09.010

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002252335>

Source: Scopus

Source ID: 85054428146

Research output: Contribution to journal › Article › Scientific › peer-review

### **End-to-End Polyphonic Sound Event Detection Using Convolutional Recurrent Neural Networks with Learned Time-Frequency Representation Input**

Sound event detection systems typically consist of two stages: Extracting hand-crafted features from the raw audio waveform, and learning a mapping between these features and the target sound events using a classifier. Recently, the focus of sound event detection research has been mostly shifted to the latter stage using standard features such as mel spectrogram as the input for classifiers such as deep neural networks. In this work, we utilize end-to-end approach and propose to combine these two stages in a single deep neural network classifier. The feature extraction over the raw waveform is conducted by a feedforward layer block, whose parameters are initialized to extract the time-frequency representations. The feature extraction parameters are updated during training, resulting with a representation that is optimized for the specific task. This feature extraction block is followed by (and jointly trained with) a convolutional recurrent network, which has recently given state-of-the-art results in many sound recognition tasks. The proposed system does not outperform a convolutional recurrent network with fixed hand-crafted features. The final magnitude spectrum characteristics of the feature extraction block parameters indicate that the most relevant information for the given task is contained in 0 - 3 kHz frequency range, and this is also supported by the empirical results on the SED performance.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Research group: Audio research group - ARG

Contributors: Cakir, E., Virtanen, T.

Publication date: 10 Oct 2018

#### **Host publication information**

Title of host publication: 2018 International Joint Conference on Neural Networks, IJCNN 2018 - Proceedings

Publisher: IEEE

Article number: 8489470

ISBN (Electronic): 9781509060146

ASJC Scopus subject areas: Software, Artificial Intelligence

Keywords: convolutional recurrent neural networks, end-to-end, feature learning, neural networks

DOIs:

10.1109/IJCNN.2018.8489470

#### **Bibliographical note**

jufoid=58177

Source: Scopus

Source ID: 85056548407

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Guidelines for development and evaluation of usage data analytics tools for human-machine interactions with industrial manufacturing systems**

We present the lessons learned during the development and evaluation process for UX-sensors, a visual data analytics tool for inspecting logged usage data from flexible manufacturing systems (FMS). Based on the experiences during a collaborative development process with practitioners from one FMS supplier company, we propose guidelines to support other developers of visual data analytics tools for usage data logging in context of complex industrial systems. For instance, involving stakeholders with different roles can help to identify user requirements and generate valuable development ideas. Tool developers should confirm early access to real usage data from customers' systems and familiarize themselves with the log data structure. We argue that combining expert evaluations with field study methods can provide a more diverse set of usability issues to address. For future research, we encourage studies on insights emerging from usage data analytics and their impact on the viewpoints of the supplier and customer.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: User experience, University of Wisconsin-Stevens Point, Fastems

Contributors: Varsaluoma, J., Väättäjä, H., Heimonen, T., Tiitinen, K., Hakulinen, J., Turunen, M., Nieminen, H.

Number of pages: 10

Pages: 172-181

Publication date: 10 Oct 2018

### Host publication information

Title of host publication: Mindtrek 2018 - Proceedings of the 22nd International Academic Mindtrek Conference

Publisher: ACM

ISBN (Electronic): 9781450365895

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

DOIs:

10.1145/3275116.3275138

### Bibliographical note

EXT="Nieminen, Harri"

Source: Scopus

Source ID: 85056717713

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Implications of audio and narration in the user experience design of virtual reality

Virtual reality (VR) is quickly gaining momentum as an immersive medium; however, there is much to learn about the design elements needed to create a positive experience. In this paper, we present the second wave of user testing of a journalistic and cultural VR experience that tells the story of a well-known artist through his art. The storytelling elements narration and ambient music were added to the initial prototype and tested in the field with 32 participants. Our results showed that the improvements produced a mostly positive user experience and shed light on what could be further improved in the case of our prototype, the field of immersive journalism, and VR used in the cultural context.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: User experience, Sanoma

Contributors: Kelling, C., Karhu, J., Kauhanen, O., Turunen, M., Väättäjä, H., Lindqvist, V.

Number of pages: 4

Pages: 258-261

Publication date: 10 Oct 2018

### Host publication information

Title of host publication: Mindtrek 2018 - Proceedings of the 22nd International Academic Mindtrek Conference

Publisher: ACM

ISBN (Electronic): 9781450365895

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Cultural VR, Immersive Journalism, Museum, Storytelling

DOIs:

10.1145/3275116.3275153

### Bibliographical note

INT="tie,"Kauhanen, Otto"

Source: Scopus

Source ID: 85056721502

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Multichannel Sound Event Detection Using 3D Convolutional Neural Networks for Learning Inter-channel Features

In this paper, we propose a stacked convolutional and recurrent neural network (CRNN) with a 3D convolutional neural network (CNN) in the first layer for the multichannel sound event detection (SED) task. The 3D CNN enables the network to simultaneously learn the inter-and intra-channel features from the input multichannel audio. In order to evaluate the proposed method, multichannel audio datasets with different number of overlapping sound sources are synthesized. Each of this dataset has a four-channel first-order Ambisonic, binaural, and single-channel versions, on which the performance of SED using the proposed method are compared to study the potential of SED using multichannel audio. A similar study is also done with the binaural and single-channel versions of the real-life recording TUT-SED 2017 development dataset. The proposed method learns to recognize overlapping sound events from multichannel features faster and performs better SED with a fewer number of training epochs. The results show that on using multichannel Ambisonic audio in place of single-channel audio we improve the overall F-score by 7.5%, overall error rate by 10% and recognize 15.6% more sound events in time frames with four overlapping sound sources.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Aalto University

Contributors: Adavanne, S., Politis, A., Virtanen, T.  
Publication date: 10 Oct 2018

#### Host publication information

Title of host publication: 2018 International Joint Conference on Neural Networks, IJCNN 2018 - Proceedings  
Publisher: IEEE  
Article number: 8489542  
ISBN (Electronic): 9781509060146  
ASJC Scopus subject areas: Software, Artificial Intelligence  
DOIs:  
10.1109/IJCNN.2018.8489542

#### Bibliographical note

jufoid=58177  
Source: Scopus  
Source ID: 85056497231  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Robotic process automation - Creating value by digitalizing work in the private healthcare?

Organizations are applying digitalization to the constantly increasing amounts of different organizational processes [2]. The healthcare sector is also changing and actively seeking better ways to enhance performance, especially in the private healthcare sector [7]. Automation of workflow processes, e.g., Robotic Process Automation (RPA), in organizations has been emerging as a solution to this demand [3, 4]. To meet this clear demand, automation of workflow processes in organizations has been a rising trend during the past few years [3]. We analyze the value creating functions of the RPA potential in the private healthcare industry sector, using modified Walter et al.'s function-oriented value analysis as our theoretical lens for identifying the potential of RPA.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Industrial and Information Management  
Contributors: Ratia, M., Myllärmiemi, J., Helander, N.  
Number of pages: 6  
Pages: 222-227  
Publication date: 10 Oct 2018

#### Host publication information

Title of host publication: Mindtrek 2018 - Proceedings of the 22nd International Academic Mindtrek Conference  
Publisher: ACM  
ISBN (Electronic): 9781450365895  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Digitalization of knowledge work, Healthcare, Robotic Process Automation, Value creation  
DOIs:  
10.1145/3275116.3275129  
Source: Scopus  
Source ID: 85056714767  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Systematic literature review on user logging in virtual reality

In this systematic literature review, we study the role of user logging in virtual reality research. By categorizing literature according to data collection methods and identifying reasons for data collection, we aim to find out how popular user logging is in virtual reality research. In addition, we identify publications with detailed descriptions about logging solutions. Our results suggest that virtual reality logging solutions are relatively seldom described in detail despite that many studies gather data by body tracking. Most of the papers gather data to witness something about a novel functionality or to compare different technologies without discussing logging details. The results can be used for scoping future virtual reality research.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Pervasive Computing, Research area: Software engineering  
Contributors: Luoto, A.  
Number of pages: 8  
Pages: 110-117

Publication date: 10 Oct 2018

#### Host publication information

Title of host publication: Mindtrek 2018 - Proceedings of the 22nd International Academic Mindtrek Conference

Publisher: ACM

ISBN (Electronic): 9781450365895

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Systematic Literature Review, User Logging

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DOIs:

10.1145/3275116.3275123

Source: Scopus

Source ID: 85056744675

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### The Finnish you – An interactive storytelling application for an airport environment

Traveling should be full of excitement and new experiences. However, a chaotic airport environment and constant waiting often halt these pleasurable feelings. Although passengers can spend their time shopping, they are unlikely to connect personally to the products. Furthermore, airport services seldom highlight the local culture that passengers miss by being confined to the airport. To address these shortcomings, we present a mobile web-application, called "The Finnish You". Utilizing the elements of interactive storytelling and gamification, the application guides users through shops and brands in the airport while teaching about the local culture in a personalized way. The application was tested in a user study with nine participants in a controlled office environment and was seen as a satisfactory way to spend time waiting in the airport. Our findings show how a personalized storytelling approach may convert ordinary shopping activity into a culture-learning adventure. We further suggest implications for the design of storytelling applications regarding the airport context of use.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Faculty of Computing and Electrical Engineering, Pervasive Computing, Research area: User experience, Human-Centered Technology (IHTE)

Contributors: Burova, A., Kelling, C., Hakulinen, J., Kallioniemi, P., Keskinen, T., Turunen, M., Väättäjä, H.

Number of pages: 10

Pages: 182-191

Publication date: 10 Oct 2018

#### Host publication information

Title of host publication: Mindtrek 2018 - Proceedings of the 22nd International Academic Mindtrek Conference

Publisher: ACM

ISBN (Electronic): 9781450365895

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Airport Environment, Digital Storytelling, Gamification, Mobile Web-Application, User Experience

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Source: Scopus

Source ID: 85056694022

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Graph measures with high discrimination power revisited: A random polynomial approach

Finding graph measures with high discrimination power has been triggered by searching for so-called complete graph invariants. In a series of papers, we have already investigated highly discriminating measures to distinguish graphs (networks) based on their topology. In this paper, we propose an approach where the graph measures are based on the roots of random graph polynomials. The polynomial coefficients have been defined by utilizing information functionals which capture structural information of the underlying networks. Our numerical results obtained by employing exhaustively generated graphs reveal that the new approach outperforms earlier results in the literature.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Medicine and Statistical Learning Laboratory (CMSL), Research group: Predictive Society and Data Analytics (PSDA), University of Applied Sciences Upper Austria, School of Management, Nankai University

Contributors: Dehmer, M., Chen, Z., Emmert-Streib, F., Shi, Y., Tripathi, S.  
Number of pages: 8  
Pages: 407-414  
Publication date: 1 Oct 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Information Sciences

Volume: 467

ISSN (Print): 0020-0255

Ratings:

Scopus rating (2018): CiteScore 10.4 SJR 1.62 SNIP 2.744

Original language: English

ASJC Scopus subject areas: Software, Control and Systems Engineering, Theoretical Computer Science, Computer Science Applications, Information Systems and Management, Artificial Intelligence

Keywords: Data science, Graphs, Networks, Quantitative graph theory, Statistics

DOIs:

10.1016/j.ins.2018.07.072

#### Bibliographical note

EXT="Tripathi, Shailesh"

Source: Scopus

Source ID: 85051518614

Research output: Contribution to journal > Article > Scientific > peer-review

#### Reproducible Evaluation of System Efficiency with a Model of Architecture: From Theory to Practice

Current trends in high performance and embedded computing include design of increasingly complex hardware architectures with high parallelism, heterogeneous processing elements and non-uniform communication resources. In order to take hardware and software design decisions, early evaluations of the system non-functional properties are needed. These evaluations of system efficiency require Electronic System-Level (ESL) information on both the algorithms and the architecture. Contrary to algorithm models for which a major body of work has been conducted on defining formal Models of Computation (MoCs), architecture models from the literature are mostly empirical models from which reproducible experimentation requires the accompanying software. In this paper, a precise definition of a Model of Architecture (MoA) is proposed that focuses on reproducibility and abstraction and removes the overlap previously existing between the notions of MoA and MoC. A first MoA, called the Linear System-Level Architecture Model (LSLA), is presented. To demonstrate the generic nature of the proposed new architecture modeling concepts, we show that the LSLA Model can be integrated flexibly with different MoCs. LSLA is then used to model the energy consumption of a State-of-the-Art Multiprocessor System-on-Chip (MPSoC) when running an application described using the Synchronous Dataflow (SDF) MoC. A method to automatically learn LSLA model parameters from platform measurements is introduced. Despite the high complexity of the underlying hardware and software, a simple LSLA model is demonstrated to estimate the energy consumption of the MPSoC with a fidelity of 86%.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Pervasive Computing, UBL, Scuola Superiore sant'Anna, University of Maryland

Contributors: Pelcat, M., Mercat, A., Desnos, K., Maggiani, L., Liu, Y., Heulot, J., Nezan, J. F., Hamidouche, W., Menard, D., Bhattacharyya, S. S.

Pages: 2050-2063

Publication date: Oct 2018

Peer-reviewed: Yes

Early online date: 16 Nov 2017

#### Publication information

Journal: IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems

Volume: 37

Issue number: 10

ISSN (Print): 0278-0070

Ratings:

Scopus rating (2018): CiteScore 4.6 SJR 0.476 SNIP 1.737

Original language: English

ASJC Scopus subject areas: Software, Computer Graphics and Computer-Aided Design, Electrical and Electronic Engineering

Keywords: Algorithm design and analysis, architecture, Complexity theory, Computational modeling, Computer architecture, design space exploration, Energy consumption, Hardware, hardware/software co-design, modeling, multiprocessor SoC, performance optimization, Ports (Computers), power modeling and estimation., system on chip



DOIs:

10.1109/TCAD.2017.2774822

URLs:

<https://hal.archives-ouvertes.fr/hal-01646738>

Source: Scopus

Source ID: 85035150836

Research output: Contribution to journal > Article > Scientific > peer-review

### **Designing for experiences with socially interactive robots**

Socially interactive technologies are emerging as one of the predominant technologies of the future. In this workshop, we aim to discuss the emerging field of Social Robotic technologies with a particular focus on interaction design methodologies used in the design process. The workshop will investigate how researchers have approached designing social robots and what we can learn from the interaction design field for future designs. The main activities of the workshop will encompass two interactive sessions and a discussion panel on approaches to inspire the design of socially interactive robots. In particular, we focus on experience-driven design methods involving rituals and memorable experiences with social robots.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: User experience, Uppsala University, Strate School of Design

Contributors: Obaid, M., Kaipainen, K., Ocnarescu, I., Ahtinen, A.

Number of pages: 4

Pages: 948-951

Publication date: 29 Sep 2018

#### **Host publication information**

Title of host publication: NordiCHI 2018 : Revisiting the Life Cycle - Proceedings of the 10th Nordic Conference on Human-Computer Interaction

Publisher: ACM

ISBN (Electronic): 9781450364379

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Design, Social, Social Robot, Technology, User Experience

Electronic versions:

Obaid-et-al\_NordiCHI2018\_Designing-experiences\_accepted-version (002)

DOIs:

10.1145/3240167.3240257

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910033689>

Source: Scopus

Source ID: 85056571102

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Understanding animals: A critical challenge in ACI**

We present a qualitative content analysis of visual-verbal social media posts, where ordinary dog owners pretend to be their canine, to identify meaningful facets in their dogs' life-worlds, e.g. pleasures of human-dog relation, dog-dog relations, food etc. We use this knowledge to inform design of "quantified pets". The study targets a general problem in Animal-Computer Interaction (ACI), i.e. to understand animals when designing "for" them, although lacking a common language. Several approaches, e.g. ethnography and participatory design, have been appropriated from HCI without exhausting the issue. We argue for a methodological creativity and pluralism by suggesting an additional approach drawing on "kinesthetic empathy". It implies to understand animals by empathizing with their bodily movements over time and decoding the realities of their life-worlds. This, and other related approaches, has inspired animal researchers to conduct more or less radical participant observations during extensive duration to understand the perspective of the other. We suggest that dog owners whom share their lives with their dogs already possess a similar understanding as these experts, and thus uphold important experiences of canine life that could be used to understand individual dogs and inspire design.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: User experience, Stockholm University

Contributors: Aspling, F., Juhlin, O., Väättäjä, H.

Number of pages: 13

Pages: 148-160  
Publication date: 29 Sep 2018

#### **Host publication information**

Title of host publication: NordiCHI 2018 : Revisiting the Life Cycle - Proceedings of the 10th Nordic Conference on Human-Computer Interaction  
Publisher: ACM  
ISBN (Electronic): 9781450364379  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Animal-Computer Interaction, Dog Blogs, Kinesthetic Empathy, Pet Dogs, Quantified Pets, Social Media  
DOIs:  
10.1145/3240167.3240226  
Source: Scopus  
Source ID: 85056568856  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **A joint target localization and classification framework for sensor networks**

In this paper, we propose a joint framework for target localization and classification using a single generalized model for non-imaging based multi-modal sensor data. For target localization, we exploit both sensor data and estimated dynamics within a local neighborhood. We validate the capabilities of our framework by using a multi-modal dataset, which includes ground truth GPS information (e.g., time and position) and data from co-located seismic and acoustic sensors. Experimental results show that our framework achieves better classification accuracy compared to recent fusion algorithms using temporal accumulation and achieves more accurate target localizations than multilateration.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Pervasive Computing, Research area: Computer engineering, U.S. Army Research Laboratory, University of Maryland  
Contributors: Lee, K., Riggan, B. S., Bhattacharyya, S. S.  
Number of pages: 5  
Pages: 3076-3080  
Publication date: 10 Sep 2018

#### **Host publication information**

Title of host publication: 2018 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2018 - Proceedings  
Volume: 2018-April  
Publisher: Institute of Electrical and Electronics Engineers Inc.  
Article number: 8462641  
ISBN (Print): 9781538646588  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Classification, Localization, Sensor fusion, Sensor networks, Tracking  
DOIs:  
10.1109/ICASSP.2018.8462641

#### **Bibliographical note**

JUFOID=57409  
Source: Scopus  
Source ID: 85054211699  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Estimation of time-varying room impulse responses of multiple sound sources from observed mixture and isolated source signals**

This paper proposes a method for online estimation of time-varying room impulse responses (RIR) between multiple isolated sound sources and a far-field mixture. The algorithm is formulated as adaptive convolutive filtering in short-time Fourier transform (STFT) domain. We use the recursive least squares (RLS) algorithm for estimating the filter parameters due to its fast convergence rate, which is required for modeling rapidly changing RIRs of moving sound sources. The proposed method allows separation of reverberated sources from the far-field mixture given that their close-field signals are available. The evaluation is based on measuring unmixing performance (removal of reverberated source) using objective separation criteria calculated between the ground truth recording of the preserved sources and the unmixing result obtained with the proposed algorithm. We compare online and offline formulations for the RIR estimation and also provide evaluation with blind source separation algorithm only operating on the mixture signal.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing, Research group: Audio research group - ARG  
Contributors: Nikunen, J., Virtanen, T.  
Number of pages: 5  
Pages: 421-425  
Publication date: 10 Sep 2018

### Host publication information

Title of host publication: 2018 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2018 - Proceedings  
Volume: 2018-April  
Publisher: Institute of Electrical and Electronics Engineers Inc.  
Article number: 8462535  
ISBN (Print): 9781538646588

### Publication series

Name: Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing  
ISSN (Electronic): 2379-190X  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Adaptive filtering, Informed source separation, Online room impulse response estimation, Source unmixing  
DOIs:  
10.1109/ICASSP.2018.8462535

### Bibliographical note

jufoid=57409  
Source: Scopus  
Source ID: 85054234348  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Low-energy graph fourier basis functions span salient objects

There is an emerging interest aiming at defining principles for signals on general graphs, which are analogous to the basic principles in traditional signal processing. One example is the Graph Fourier Transform which aims at decomposing a graph signal into its components based on a set of basis functions with corresponding graph frequencies. It has been observed that most of the important information of a graph signal is contained inside the low frequency band, which leads to several applications such as denoising, compression, etc. In this paper, we show that the low frequency basis functions span the salient regions in an image, which can also be considered as important regions. Motivated by this, we present a novel simple and unsupervised method to utilize a number of low-energy basis functions and show that it improves the performance of seven state-of-the-art salient object detection methods in five datasets under four different evaluation criteria, with only minor exceptions.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing, Research group: Multimedia Research Group - MRG  
Contributors: Malik, J., Aytakin, C., Gabbouj, M.  
Number of pages: 5  
Pages: 1548-1552  
Publication date: 10 Sep 2018

### Host publication information

Title of host publication: 2018 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2018 - Proceedings  
Volume: 2018-April  
Publisher: Institute of Electrical and Electronics Engineers Inc.  
Article number: 8462672  
ISBN (Print): 9781538646588  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Graph fourier transform, Graph signal processing, Salient object detection  
DOIs:  
10.1109/ICASSP.2018.8462672

### Bibliographical note

jufoid=57409  
Source: Scopus

Source ID: 85054244934

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Statistical Evaluation of Visual Quality Metrics for Image Denoising

This paper studies the problem of full reference visual quality assessment of denoised images with a special emphasis on images with low contrast and noise-like texture. Denoising of such images together with noise removal often results in image details loss or smoothing. A new test image database, FLT, containing 75 noise-free 'reference' images and 300 filtered ('distorted') images is developed. Each reference image, corrupted by an additive white Gaussian noise, is denoised by the BM3D filter with four different values of threshold parameter (four levels of noise suppression). After carrying out a perceptual quality assessment of distorted images, the mean opinion scores (MOS) are obtained and compared with the values of known full reference quality metrics. As a result, the Spearman Rank Order Correlation Coefficient (SROCC) between PSNR values and MOS has a value close to zero, and SROCC between values of known full-reference image visual quality metrics and MOS does not exceed 0.82 (which is reached by a new visual quality metric proposed in this paper). The FLT dataset is more complex than earlier datasets used for assessment of visual quality for image denoising. Thus, it can be effectively used to design new image visual quality metrics for image denoising.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Research group: Computational Imaging-CI, National Aerospace University

Contributors: Egiazarian, K., Ponomarenko, M., Lukin, V., Ieremeiev, O.

Number of pages: 5

Pages: 6752-6756

Publication date: 10 Sep 2018

### Host publication information

Title of host publication: 2018 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2018 - Proceedings

Volume: 2018-April

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 8462294

ISBN (Print): 9781538646588

ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering

Keywords: BM3D, Full-reference metrics, Image denoising, Image visual quality assessment

DOIs:

10.1109/ICASSP.2018.8462294

### Bibliographical note

EXT="Lukin, Vladimir"

JUFOID=57409

Source: Scopus

Source ID: 85054084165

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Low latency edge rendering scheme for interactive 360 degree virtual reality gaming

This paper describes the core functionality and a proof-of-concept demonstration setup for remote 360 degree stereo virtual reality (VR) gaming. In this end-to-end scheme, the execution of a VR game is off-loaded from an end user device to a cloud edge server in which the executed game is rendered based on user's field of view (FoV) and control actions. Headset and controller feedback is transmitted over the network to the server from which the rendered views of the game are streamed to a user in real-time as encoded HEVC video frames. This approach saves energy and computation load of the end terminals by making use of the latest advancements in network connection speed and quality. In the showcased demonstration, a VR game is run in Unity on a laptop powered by i7 7820HK processor and GTX 1070 GPU. The 360 degree spherical view of the game is rendered and converted to a rectangular frame using equirectangular projection (ERP). The ERP video is sliced vertically and only the FoV is encoded with Kvazaar HEVC encoder in real time and sent over the network in UDP packets. Another laptop is used for playback with a HTC Vive VR headset. Our system can reach an end-to-end latency of 30 ms and bit rate of 20 Mbps for stereo 1080p30 format.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Datacenter Infrastructure Modules, Nokia Technologies

Contributors: Viitanen, M., Vanne, J., Hämäläinen, T. D., Kulmala, A.

Number of pages: 4

Pages: 1557-1560

Publication date: 19 Jul 2018

### Host publication information

Title of host publication: Proceedings - 2018 IEEE 38th International Conference on Distributed Computing Systems, ICDCS 2018

Publisher: IEEE

ISBN (Electronic): 9781538668719

ASJC Scopus subject areas: Software, Hardware and Architecture, Computer Networks and Communications

Keywords: 360 degree video, Edge computing, High Efficiency Video Coding (HEVC), Video coding, Virtual reality (VR)

Electronic versions:

Low Latency Edge Rendering Scheme for Interactive 360 Degree Virtual Reality Gaming

DOIs:

10.1109/ICDCS.2018.00168

URLs:

<http://urn.fi/URN:NBN:fi:tty-201908211990>

### Bibliographical note

jufoid=58061e

Source: Scopus

Source ID: 85050973480

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Liking the game: How can spectating motivations influence social media usage at live esports events?

There is no doubt that various social media services shape the ways in which we approach our daily lives. The ubiquitous nature of these services, afforded by mobile devices, means that we can take them with us wherever we go — including when we attend live events. Uncovering why individuals use social media during live events can help improve event organization, marketing, and the experiences of attendees. Our understanding of the motivations for using social media during live events is, however, still lacking in depth, especially in regard to emerging live events such as esports. This study aims to answer the question: what motivates the use of social media during live esports events? Data was gathered via a survey (N=255) at the 'Assembly 2016' LAN-event, a major live esports event. We examine the relationships between using various social media services and the motivations for esports spectating, through the Motivation Scale for Sports Consumption. While the results indicate that using social media services while attending Assembly 2016 was quite popular, it seemed that in many cases social media usage was a distraction from esports spectating, a core activity of the event. The results provide implications as to how marketers of live esports events should encourage or control usage of social media by attendees.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Gamification Group, Gamification Group

Contributors: Sjöblom, M., Hassan, L., Macey, J., Törhönen, M., Hamari, J.

Number of pages: 8

Pages: 160-167

Publication date: 18 Jul 2018

### Host publication information

Title of host publication: Proceedings of the 9th International Conference on Social Media and Society, SMSociety 2018

Publisher: ACM

ISBN (Print): 9781450363341

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Esports, Live events, Motivation, Social media, Sports consumption

Electronic versions:

ACCEPTED\_VERSION\_Liking\_the\_game

DOIs:

10.1145/3217804.3217908

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201912237103>

### Bibliographical note

EXT="Törhönen, Maria"

DUPL=44481582

Source: Scopus

Source ID: 85051509297

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Code notes: Designing a low-cost tangible coding tool for/with children**

Programming has become an essential subject for today's education curriculum and as a result, the importance of creating the right environments to teach is increasing. For such environments, featuring tangible tools enhances creativity and collaboration. However, due to their high prices, current tangible tools are not reachable by most of the students. We developed Code Notes as a low-cost, attainable and tangible tool aimed to motivate children to support programming education. Code Notes is comprised of an Android app and code-cardboards to teach the basic concepts in programming. We continue to develop the platform with insights gained from children. This paper shares the design phases of Code Notes and observations from our two-month programming project. We also presented some future concepts of Code Notes that offer an active and embodied interaction with the teaching material.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Koç University

Contributors: Sabuncuoğlu, A., Erkaya, M., Buruk, O. T., Göksun, T.

Number of pages: 6

Pages: 644-649

Publication date: 19 Jun 2018

#### **Host publication information**

Title of host publication: IDC 2018 - Proceedings of the 2018 ACM Conference on Interaction Design and Children

Publisher: ACM

ISBN (Electronic): 9781450351522

ASJC Scopus subject areas: Developmental and Educational Psychology, Education, Software, Human-Computer Interaction

Keywords: Affordable systems for education, Collaborative learning environments, Mobile learning, Tangible blocks.

DOIs:

10.1145/3202185.3210791

Source: Scopus

Source ID: 85051492885

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Fast and easy live video service setup using lightweight virtualization**

The service broker provides service providers with virtualized services that can be initialized rapidly and scaled up or down on demand. This demonstration paper describes how a service provider can set up a new video distribution service to end users with a diminutive effort. Our proposal makes use of Docker lightweight virtualization technologies that pack services in containers. This makes it possible to implement video coding and content delivery networks that are scalable and consume resources only when needed. The demonstration showcases a scenario where a video service provider sets up a new live video distribution service to end users. After the setup, live 720p30 video camera feed is encoded in real-time, streamed in HEVC MPEG-DASH format over CDN network, and accessed with a HbbTV compatible set-top-box. This end-to-end system illustrates that virtualization causes no significant resource or performance overhead but is a perfect match for online video services.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, VTT Technical Research Centre of Finland, Sofia Digital, VESTEL Elektronik

Contributors: Heikkinen, A., Pääkkönen, P., Viitanen, M., Vanne, J., Riikonen, T., Bakanoglu, K.

Number of pages: 3

Pages: 487-489

Publication date: 12 Jun 2018

#### **Host publication information**

Title of host publication: Proceedings of the 9th ACM Multimedia Systems Conference, MMSys 2018

Publisher: ACM

ISBN (Electronic): 9781450351928

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Software, Human-Computer Interaction

Keywords: Content Delivery Network (CDN), Docker, Dynamic adaptive streaming over HTTP (DASH), High Efficiency Video Coding (HEVC), Hybrid broadcast broadband TV (HbbTV), Virtualization

Electronic versions:

Fast and Easy Live Video Service Setup Using Lightweight Virtualization

DOIs:

10.1145/3204949.3208112

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001171375>

Source: Scopus

Source ID: 85050667891

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Optimized viewport dependent streaming of stereoscopic omnidirectional video**

Streaming the whole omnidirectional video at high quality is less efficient in terms of bandwidth requirements and decoding complexity, since only a small part of the 360-degree horizontal field of view can be seen by a user at a given point in time. In Viewport Dependent Streaming (VDS) only the current user viewport is streamed at high quality, while the remaining parts are streamed at lower quality. This technology may save streaming bandwidth considerably, especially when it is associated to other techniques. Among the others, asymmetric stereoscopic video, has been studied in the past for traditional video and displays. We focused our research on the usage of asymmetric stereoscopic video for omnidirectional streams watched with a Head Mounted Display (HMD) in VDS. We conducted two subjective quality experiments with the main goal of reducing the streaming bandwidth, while keeping the subjective video quality at the highest level. We assessed asymmetric video applied separately to the foreground and background views of omnidirectional VDS sessions. We show that for VDS, applying asymmetric stereoscopic streaming delivery on the foreground view can save up to 41% bit rate, and using the same technique on the background view can save approximately up to 15% bit rate. Furthermore, eye dominance was seen not to be relevant in our experiments.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Nokia Technologies

Contributors: Naik, D., Curcio, I. D., Toukoma, H.

Number of pages: 6

Pages: 37-42

Publication date: 12 Jun 2018

### **Host publication information**

Title of host publication: Proceedings of the 23th ACM Workshop on Packet Video, PV 2018

Publisher: ACM

ISBN (Electronic): 9781450357739

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: 360 degrees video, Asymmetric video, Omnidirectional video, Streaming adaptation, Subjective quality evaluation, Virtual reality streaming

DOIs:

10.1145/3210424.3210437

### **Bibliographical note**

EXT="Curcio, Igor D.D."

Source: Scopus

Source ID: 85050644603

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **A quasi-virtual online analyser based on an artificial neural networks and offline measurements to predict purities of raffinate/extract in simulated moving bed processes**

The quality control and optimization of Simulated Moving Bed processes are still a challenge. Among the main reasons for that, the real time measurement of its main properties can be highlighted. Further developments in this field are necessary in order to allow the development of better control and optimization systems of these units. In the present work, a system composed by two Artificial Neural Networks working concomitantly with an offline measurement system is proposed, named Quasi-Virtual Analyser (Q-VOA) system. The development of the Q-VOA is presented and the system is simulated in order to evaluate its efficiency. The methodology used to select the input variables for the Q-VOA is another contribution of this work. The results show that the Q-VOA is capable of reducing the system errors and keep the prediction closer to the process true responses, when compared with the simple VOA system, which is based solely on model predictions. Furthermore, the results show the efficiency of the measurement system even under the presence of non-measured perturbations.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation and Hydraulic Engineering, Univ Porto, Universidade do Porto, Fac Med, Dept Med Imaging, Federal Univ. of Bahia

Contributors: Nogueira, I. B., Ribeiro, A. M., Requião, R., Pontes, K. V., Koivisto, H., Rodrigues, A. E., Loureiro, J. M.

Number of pages: 19  
Pages: 29-47  
Publication date: 1 Jun 2018  
Peer-reviewed: Yes

#### **Publication information**

Journal: Applied Soft Computing Journal  
Volume: 67  
ISSN (Print): 1568-4946  
Ratings:

Scopus rating (2018): CiteScore 8.9 SJR 1.216 SNIP 2.474

Original language: English

ASJC Scopus subject areas: Software

Keywords: Artificial neural network, Enantiomers separation, Purity measurement, Quasi-virtual analyser system, True moving bed

DOIs:

10.1016/j.asoc.2018.03.001

Source: Scopus

Source ID: 85043383206

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Looking for a five-legged sheep: Identifying enterprise architects' skills and competencies**

Enterprise architecture (EA) is a holistic approach to comprehend the organization's business objectives and processes, data resources, information systems and information technologies. To advance EA activities, organizations need a myriad of different skills and competences both from individual enterprise architects and from architect teams. However, research on these skills and competences is scarce. Not knowing what skills are actually needed might be one of the reasons why public sector EA endeavors have been very problematic. In this paper, we conduct a qualitative survey among enterprise architects themselves to identify which skills they consider essential for EA work. Our results indicate that the range of skills is great, and finding an expert with all appropriate competencies is like looking for a fivelegged sheep.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Industrial and Information Management

Contributors: Ylinen, M., Pekkola, S.

Publication date: 30 May 2018

#### **Host publication information**

Title of host publication: Proceedings of the 19th Annual International Conference on Digital Government Research : Governance in the Data Age, DG.O 2018

Publisher: ACM

Article number: a58

ISBN (Electronic): 9781450365260

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

DOIs:

10.1145/3209281.3209353

Source: Scopus

Source ID: 85049050136

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Toward efficient many-core scheduling of partial expansion graphs**

Transformation of synchronous data flow graphs (SDF) into equivalent homogeneous SDF representations has been extensively applied as a pre-processing stage when mapping signal processing algorithms onto parallel platforms. While this transformation helps fully expose task and data parallelism, it also presents several limitations such as an exponential increase in the number of actors and excessive communication overhead. Partial expansion graphs were introduced to address these limitations for multi-core platforms. However, existing solutions are not well-suited to achieve efficient scheduling on many-core architectures. In this article, we develop a new approach that employs cyclo-static data flow techniques to provide a simple but efficient method of coordinating the data production and consumption in the expanded graphs. We demonstrate the advantage of our approach through experiments on real application models.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication



Organisations: Pervasive Computing, Research area: Computer engineering, Parc Scientifique de la Haute Borne, University of Maryland  
Contributors: Tran, H. N., Bhattacharyya, S. S., Talpin, J. P., Gautier, T.  
Number of pages: 4  
Pages: 100-103  
Publication date: 28 May 2018

#### Host publication information

Title of host publication: Proceedings of the 21st International Workshop on Software and Compilers for Embedded Systems, SCOPES 2018  
Publisher: Association for Computing Machinery, Inc  
ISBN (Print): 9781450357807  
ASJC Scopus subject areas: Hardware and Architecture, Software  
DOIs:  
10.1145/3207719.3207734  
Source: Scopus  
Source ID: 85054140820  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Preface: Special Issue on 'New Hydraulic Components for Tough Robots'

#### General information

Publication status: Published  
MoE publication type: B1 Article in a scientific magazine  
Organisations: Automation and Hydraulic Engineering, Research group: Innovative Hydraulic Automation, Tokyo Institute of Technology, Ritsumeikan University, Italian Institute of Technology, Okayama University  
Contributors: Suzumori, K., Hyon, S. H., Semini, C., Mattila, J., Kanda, T.  
Number of pages: 1  
Publication date: 3 May 2018  
Peer-reviewed: No

#### Publication information

Journal: Advanced Robotics  
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Issue number: 9  
ISSN (Print): 0169-1864  
Ratings:  
Scopus rating (2018): CiteScore 2.7 SJR 0.346 SNIP 0.886  
Original language: English  
ASJC Scopus subject areas: Control and Systems Engineering, Software, Human-Computer Interaction, Hardware and Architecture, Computer Science Applications  
DOIs:  
10.1080/01691864.2018.1466427  
Source: Scopus  
Source ID: 85047515551  
Research output: Contribution to journal › Editorial › Scientific

#### On the Definition of Microservice Bad Smells

Code smells and architectural smells (also called bad smells) are symptoms of poor design that can hinder code understandability and decrease maintainability. Several bad smells have been defined in the literature for both generic architectures and specific architectures. However, cloud-native applications based on microservices can be affected by other types of issues. In order to identify a set of microservice-specific bad smells, researchers collected evidence of bad practices by interviewing 72 developers with experience in developing systems based on microservices. Then, they classified the bad practices into a catalog of 11 microservice-specific bad smells frequently considered harmful by practitioners. The results can be used by practitioners and researchers as a guideline to avoid experiencing the same difficult situations in the systems they develop.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Pervasive Computing  
Contributors: Taibi, D., Lenarduzzi, V.  
Number of pages: 7  
Pages: 56-62

Publication date: 1 May 2018

Peer-reviewed: Yes

### Publication information

Journal: IEEE Software

Volume: 35

Issue number: 3

ISSN (Print): 0740-7459

Ratings:

Scopus rating (2018): CiteScore 5.3 SJR 0.549 SNIP 2.444

Original language: English

ASJC Scopus subject areas: Software

Keywords: anti-pattern, antipattern, architectural smell, bad smell, cloud computing, code smell, microservice, software development, software engineering

DOIs:

10.1109/MS.2018.2141031

Source: Scopus

Source ID: 85046708734

Research output: Contribution to journal › Article › Scientific › peer-review

### Backshoring of production in the context of a small and open Nordic economy

**Purpose** – The purpose of this paper is to investigate the extent, drivers, and conditions underlying backshoring in the Finnish manufacturing industry, comparing the results to the wider ongoing relocation of production in the international context. **Design/methodology/approach** – The survey of 229 Finnish manufacturing firms reveals the background, drivers, and patterns of offshoring and backshoring. **Findings** – Companies that had transferred their production back to Finland were more commonly in industries with relatively higher technology intensity and they were typically larger than the no-movement companies, and with a higher number of plants. They also reported more commonly having a corporate-wide strategy for guiding production location decisions. **Research limitations/implications** – Backshoring activity in the small and open economy of Finland seems to be higher compared to earlier studies in larger countries. The findings suggest that there is a transformation in the manufacturing industries with some gradual replacement of labor-intensive and lower technology-intensive industries toward higher technology-intensive industries. **Practical implications** – Moving production across national borders is one option in the strategies of firms to stay competitive. Companies must carefully consider the relevance of various decision-making drivers when determining strategies for their production networks. **Social implications** – Manufacturing industries have traditionally been important for employment in the relatively small and open economies of the Nordic countries. From the social perspective, it is important to understand the ongoing transformation and its implications. **Originality/value** – There are few empirical studies available of the ongoing backshoring movement, utilizing data from company decision makers instead of macroeconomic factors.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Industrial and Information Management, Research group: Center for Research on Operations Projects and Services

Contributors: Heikkilä, J., Martinsuo, M., Nenonen, S.

Number of pages: 19

Pages: 658-675

Publication date: May 2018

Peer-reviewed: Yes

Early online date: 27 Nov 2017

### Publication information

Journal: Journal of Manufacturing Technology Management

Volume: 29

Issue number: 4

ISSN (Print): 1741-038X

Ratings:

Scopus rating (2018): CiteScore 4.8 SJR 0.954 SNIP 1.393

Original language: English

ASJC Scopus subject areas: Software, Control and Systems Engineering, Computer Science Applications, Strategy and Management, Industrial and Manufacturing Engineering

Keywords: Manufacturing, Manufacturing strategy, Production

DOIs:

10.1108/JMTM-12-2016-0178

URLs:

<http://www.scopus.com/inward/record.url?scp=85039840754&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85039840754

Research output: Contribution to journal › Article › Scientific › peer-review

### **Towards secure cloud orchestration for multi-cloud deployments**

Cloud orchestration frameworks are commonly used to deploy and operate cloud infrastructure. Their role spans both vertically (deployment on infrastructure, platform, application and microservice levels) and horizontally (deployments from many distinct cloud resource providers). However, despite the central role of orchestration, the popular orchestration frameworks lack mechanisms to provide security guarantees for cloud operators. In this work, we analyze the security landscape of cloud orchestration frameworks for multi-cloud infrastructure. We identify a set of attack scenarios, define security enforcement enablers and propose an architecture for a security-enabled cloud orchestration framework for multi-cloud application deployments.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, RISE SICS, University of Westminster

Contributors: Paladi, N., Michalas, A., Dang, H. V.

Publication date: 23 Apr 2018

#### **Host publication information**

Title of host publication: CrossCloud 2018 - 5th Workshop on CrossCloud Infrastructures and Platforms, colocated with EuroSys 2018

Publisher: ACM

Article number: a4

ISBN (Electronic): 9781450356534

ASJC Scopus subject areas: Information Systems, Software, Computer Science Applications

Keywords: Cloud infrastructure, Microservices, Orchestration, Security, Virtualization

DOIs:

10.1145/3195870.3195874

Source: Scopus

Source ID: 85049685222

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Ripple thermostat: Affecting the emotional experience through interactive force feedback and shape change**

Force feedback and shape change are modalities with a growing application potential beyond the more traditional GUIs. We present two studies that explored the effect of these modalities on the emotional experience when interacting with an intelligent thermostat. The first study compared visual feedback, force feedback, and a combination of force feedback and shape change. Results indicate that force feedback correlates to experienced dominance during interaction, while shape change mainly affects experienced arousal. The second study explored how force feedback and shape change could communicate affective meaning during interaction with the thermostat through a co-design study. Participants designed the thermostat behavior for three scenarios supporting energy savings. Results suggest that despite their abstractness, force feedback and shape change convey affective meaning during the user-system dialogue. The findings contribute to the design of intelligible and intuitive feedback.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Aarhus Universitet, Eindhoven University of Technology, Vincit

Contributors: Van Oosterhout, A., Alonso, M. B., Jumisko-Pyykkö, S.

Publication date: 20 Apr 2018

#### **Host publication information**

Title of host publication: Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems

Publisher: ACM

Article number: 655

ISBN (Electronic): 9781450356206

ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software

Keywords: Actuated interfaces, Affective computing, Haptic force feedback, Shape-changing interfaces

DOIs:

10.1145/3173574.3174229

Source: Scopus

Source ID: 85046938728

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **A design tool for high performance image processing on multicore platforms**

Design and implementation of smart vision systems often involve the mapping of complex image processing algorithms into efficient, real-time implementations on multicore platforms. In this paper, we describe a novel design tool that is developed to address this important challenge. A key component of the tool is a new approach to hierarchical dataflow scheduling that integrates a global scheduler and multiple local schedulers. The local schedulers are lightweight modules that work independently. The global scheduler interacts with the local schedulers to optimize overall memory usage and execution time. The proposed design tool is demonstrated through a case study involving an image stitching application for large scale microscopy images.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, University of Maryland, National Institute of Standards and Technology

Contributors: Wu, J., Blattner, T., Keyrouz, W., Bhattacharyya, S. S.

Number of pages: 6

Pages: 1304-1309

Publication date: 19 Apr 2018

#### **Host publication information**

Title of host publication: Proceedings of the 2018 Design, Automation and Test in Europe Conference and Exhibition, DATE 2018

Publisher: IEEE

ISBN (Electronic): 9783981926316

ASJC Scopus subject areas: Safety, Risk, Reliability and Quality, Hardware and Architecture, Software, Information Systems and Management

DOIs:

10.23919/DATE.2018.8342215

Source: Scopus

Source ID: 85048740891

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Deep multiresolution color constancy**

In this paper, a computational color constancy method is proposed via estimating the illuminant chromaticity in a scene by pooling from many local estimates. To this end, first, for each image in a dataset, we form an image pyramid consisting of several scales of the original image. Next, local patches of certain size are extracted from each scale in this image pyramid. Then, a convolutional neural network is trained to estimate the illuminant chromaticity per-patch. Finally, two more consecutive trainings are conducted, where the estimation is made per-image via taking the mean (1<sup>st</sup> training) and median (2<sup>nd</sup> training) of local estimates. The proposed method is shown to outperform the state-of-the-art in a widely used color constancy dataset.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Intel Finland

Contributors: Aytekin, C., Nikkanen, J., Gabbouj, M.

Number of pages: 5

Pages: 3735-3739

Publication date: 20 Feb 2018

#### **Host publication information**

Title of host publication: 2017 IEEE International Conference on Image Processing, ICIP 2017 - Proceedings

Publisher: IEEE COMPUTER SOCIETY PRESS

ISBN (Electronic): 9781509021758

ASJC Scopus subject areas: Software, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Color constancy, Deep learning, Illuminant chromaticity estimation, Local estimation, Multi-resolution

DOIs:

10.1109/ICIP.2017.8296980

#### **Bibliographical note**

jufoid=57423

Source: Scopus

Source ID: 85045299547

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **A multi-agent approach for processing industrial enterprise data**

The C2NET project aims to provide cloud-based platform for the supply chain interactions. The architecture of such platform includes a Data Collection Framework (DCF) for managing the collection of the company's data. The DCF collects, transforms and stores data from both Internet of Things (IoT) devices in the factory shopfloor and company enterprises data via two types of hub; Legacy system hub (LSH) and IoT hub. Since the C2NET, targets the Small and Medium-sized Enterprises (SMEs), the enterprise data, or legacy data as called in the C2NET project, can be provided via excel files. Thus, this research work highlights a technique for processing the excel files in the LSHs. This technique adopts the concept of Multi-Agent Systems for processing the data as table in the excel files in the LSH. The multi-agent approach allows the LSH to process any excel file regardless the complexity in the data structure or in the file table. Furthermore, the presented approach enhances the processing of the excel files in different aspects, such as the size of the excel file or the required processing power.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Automation and Hydraulic Engineering, Research group: Automation and Systems Theory, Universitat Politècnica de València, Instituto de Desenvolvimento de Novas Tecnologias

Contributors: Mohammed, W. M., Ferrer, B. R., Martinez, J. L., Sanchis, R., Andres, B., Agostinho, C.

Number of pages: 7

Pages: 1209-1215

Publication date: 2 Feb 2018

#### **Host publication information**

Title of host publication: 2017 International Conference on Engineering, Technology and Innovation : Engineering, Technology and Innovation Management Beyond 2020: New Challenges, New Approaches, ICE/ITMC 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781538607749

ASJC Scopus subject areas: Computer Science Applications, Software, Engineering (miscellaneous), Computer Networks and Communications

Keywords: Cloud Based, Data Collection, Enterprise, Multi-Agent Systems, supply Chain

DOIs:

10.1109/ICE.2017.8280018

Source: Scopus

Source ID: 85047492606

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **An approach to production scheduling optimization a case of an oil lubrication and hydraulic systems manufacturer**

Cloud-enabled tools developed in the Cloud Collaborative Manufacturing Networks (C2NET) project address the needs of small and medium enterprises with respect to information exchange and visibility across the collaboration partners in the supply network, coupled with automated and collaborative production planning and supply management. This paper analyses a case of an oil lubrication and hydraulic systems manufacturer and describes a pilot application of C2NET where the production schedule is optimized according to the priorities of the pilot company. In this case the goal is a highly adaptive just-in-time manufacturing schedule with guaranteed on time delivery.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Automation and Hydraulic Engineering, VTT Technical Research Centre of Finland, Roberto Camp Fluidhouse Ltd.

Contributors: Katasonov, A., Lastusilta, T., Korvola, T., Saari, L., Bendas, D., Mohammed, W. M., Lee, A. N.

Number of pages: 8

Pages: 1123-1130

Publication date: 2 Feb 2018

#### **Host publication information**

Title of host publication: 2017 International Conference on Engineering, Technology and Innovation : Engineering, Technology and Innovation Management Beyond 2020: New Challenges, New Approaches, ICE/ITMC 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781538607749

ASJC Scopus subject areas: Computer Science Applications, Software, Engineering (miscellaneous), Computer Networks and Communications

Keywords: cloud-supported manufacturing, enterprise collaboration, information exchange, just-in-time manufacturing, Mixed-Integer Linear Programming, on time delivery, optimization, production scheduling, Small and Medium size

Enterprise, supply network

DOIs:

10.1109/ICE.2017.8280007

Source: Scopus

Source ID: 85047524893

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Configuring and visualizing the data resources in a cloud-based data collection framework**

The Manufacturing Enterprise Solutions Association (MESA) provided the abstract and general definition of the Manufacturing Execution Systems (MES). A dedicated function has been reserved for the data collection activities. In this matter, the Cloud Collaborative Manufacturing Networks (C2NET) project tends to provide a cloud based platform for hosting the interactions of the supply chain in a collaborative network. Within the architecture of the C2NET project, a Data Collection Framework (DCF) is designed to fulfill the function of data collection. This allows the companies to provide their data, which can be both enterprise and Internet of Things (IoT) devices type of data to the platform for further use. The collection of the data is achieved by a specific third party application, i.e., the Legacy System Hub (LSH). This research work presents the approach of configuring and visualizing the data resources in the C2NET platform. This approach employs the web-based applications and the help of the LSH. This permits the C2NET platform to adapt to any kind of third party application, which manipulates enterprise data, following the generic and flexible solution of this approach.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Automation and Hydraulic Engineering, Research group: Automation and Systems Theory, Instituto de Desenvolvimento de Novas Tecnologias

Contributors: Mohammed, W. M., Ferrer, B. R., Jose, L., Lastra, M., Aleixo, D., Agostinho, C.

Number of pages: 8

Pages: 1201-1208

Publication date: 2 Feb 2018

#### **Host publication information**

Title of host publication: 2017 International Conference on Engineering, Technology and Innovation : Engineering, Technology and Innovation Management Beyond 2020: New Challenges, New Approaches, ICE/ITMC 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781538607749

ASJC Scopus subject areas: Computer Science Applications, Software, Engineering (miscellaneous), Computer Networks and Communications

Keywords: Cloud Based, Data Collection, Data Resources, Supply Chain, Visualization

DOIs:

10.1109/ICE.2017.8280017

#### **Bibliographical note**

INT=aut,"Jose, L."

Source: Scopus

Source ID: 85047476305

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Exploiting suppliers' potential in construction innovations**

There is a need to understand ways to enhance innovations in the construction industry. It is argued that suppliers have potential to develop new innovations, but they are largely neglected in earlier construction-related research. This research focuses on suppliers' role in construction innovations, and the aim of the research is to increase understanding of practices for exploiting suppliers' potential in that context. A qualitative, explanatory research strategy is employed in the context of construction industry in Finland. Eighteen interviews are conducted with contractors to discover experiences and practices related to suppliers' potential in construction innovations. The results reveal practices for exploiting supplier's potential in construction innovations. As a key contribution, the research shows that suppliers have an important role in construction innovation but exploitation of suppliers' potential is still rather underdeveloped.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Center for Research on Operations Projects and Services, Industrial and Information Management

Contributors: Sariola, R.

Number of pages: 7

Pages: 678-684  
Publication date: 2 Feb 2018

### Host publication information

Title of host publication: 2017 International Conference on Engineering, Technology and Innovation : Engineering, Technology and Innovation Management Beyond 2020: New Challenges, New Approaches, ICE/ITMC 2017 - Proceedings  
Publisher: IEEE  
ISBN (Electronic): 9781538607749  
ASJC Scopus subject areas: Computer Science Applications, Software, Engineering (miscellaneous), Computer Networks and Communications  
Keywords: construction innovation, project networks, supplier management  
DOIs:  
10.1109/ICE.2017.8279950  
Source: Scopus  
Source ID: 85047528988  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Memory-Constrained vectorization and scheduling of dataflow graphs for hybrid CPU-GPU platforms

The increasing use of heterogeneous embedded systems with multi-core CPUs and Graphics Processing Units (GPUs) presents important challenges in effectively exploiting pipeline, task, and data-level parallelism to meet throughput requirements of digital signal processing applications. Moreover, in the presence of system-level memory constraints, hand optimization of code to satisfy these requirements is inefficient and error prone and can therefore, greatly slow down development time or result in highly underutilized processing resources. In this article, we present vectorization and scheduling methods to effectively exploit multiple forms of parallelism for throughput optimization on hybrid CPU-GPU platforms, while conforming to system-level memory constraints. The methods operate on synchronous dataflow representations, which are widely used in the design of embedded systems for signal and information processing. We show that our novel methods can significantly improve system throughput compared to previous vectorization and scheduling approaches under the same memory constraints. In addition, we present a practical case-study of applying our methods to significantly improve the throughput of an orthogonal frequency division multiplexing receiver system for wireless communications.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Pervasive Computing, University of Maryland, Department of Electrical and Computer Engineering  
Contributors: Lin, S., Wu, J., Bhattacharyya, S. S.  
Publication date: 1 Feb 2018  
Peer-reviewed: Yes

### Publication information

Journal: ACM Transactions on Embedded Computing Systems  
Volume: 17  
Issue number: 2  
Article number: 50  
ISSN (Print): 1539-9087  
Ratings:  
Scopus rating (2018): CiteScore 3 SJR 0.326 SNIP 0.979  
Original language: English  
ASJC Scopus subject areas: Software, Hardware and Architecture  
Keywords: Dataflow models, Design optimization, Heterogeneous computing, Signal processing systems, Software synthesis  
DOIs:  
10.1145/3157669  
Source: Scopus  
Source ID: 85042527088  
Research output: Contribution to journal > Article > Scientific > peer-review

### Feature synthesis for image classification and retrieval via one-against-all perceptrons

Most existing content-based image retrieval and classification systems rely on low-level features which are automatically extracted from images. However, often these features lack the discrimination power needed for accurate description of the image content, and hence, they may lead to a poor retrieval or classification performance. We propose a novel technique to improve low-level features which uses parallel one-against-all perceptrons to synthesize new features with a higher discrimination power which in turn leads to improved classification and retrieval results. The proposed method can be applied on any database and low-level features as long as some ground-truth information is available. The main merits of

the proposed technique are its simplicity and faster computation compared to existing feature synthesis methods. Extensive simulation results show a significant improvement in the features' discrimination power.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Video, Qatar University

Contributors: Raitoharju, J., Kiranyaz, S., Gabbouj, M.

Number of pages: 15

Pages: 943–957

Publication date: Feb 2018

Peer-reviewed: Yes

Early online date: 29 Jul 2016

#### Publication information

Journal: Neural Computing and Applications

Volume: 29

Issue number: 4

ISSN (Print): 0941-0643

Ratings:

Scopus rating (2018): CiteScore 4.9 SJR 0.637 SNIP 1.521

Original language: English

ASJC Scopus subject areas: Artificial Intelligence, Software

Keywords: Content-based image retrieval and classification, Feature synthesis, Multi-dimensional particle swarm optimization, Multi-layer perceptrons

DOIs:

10.1007/s00521-016-2504-4

#### Bibliographical note

EXT="Kiranyaz, Serkan"

Source: Scopus

Source ID: 84979997953

Research output: Contribution to journal > Article > Scientific > peer-review

#### A Dataset for Camera Independent Color Constancy

In this paper, we provide a novel dataset designed for camera independent color constancy research. Camera independence corresponds to the robustness of an algorithm's performance when run on images of the same scene taken by different cameras. Accordingly, the images in our database correspond to several lab and field scenes each of which is captured by three different cameras with minimal registration errors. The lab scenes are also captured under five different illuminations. The spectral responses of cameras and the spectral power distributions of the lab light sources are also provided, as they may prove beneficial for training future algorithms to achieve color constancy. For a fair evaluation of future methods, we provide guidelines for supervised methods with indicated training, validation and testing partitions. Accordingly, we evaluate two recently proposed convolutional neural network based color constancy algorithms as baselines for future research. As a side contribution, this dataset also includes images taken by a mobile camera with color shading corrected and uncorrected results. This allows research on the effect of color shading as well.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Multimedia Research Group - MRG, Intel Corporation

Contributors: Aytekin, C., Nikkanen, J., Gabbouj, M.

Pages: 530-544

Publication date: 2018

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Transactions on Image Processing

Volume: 27

Issue number: 2

ISSN (Print): 1057-7149

Ratings:

Scopus rating (2018): CiteScore 12.8 SJR 1.809 SNIP 4.285

Original language: English

ASJC Scopus subject areas: Software, Computer Graphics and Computer-Aided Design

Keywords: Cameras, Color constancy, color shading, illumination estimation, Image color analysis, Lighting, platform independence, Reflectivity, Robustness, Sensitivity, Training



DOIs:

10.1109/TIP.2017.2764264

Source: Scopus

Source ID: 85032268285

Research output: Contribution to journal > Article > Scientific > peer-review

### **An algebraic approach to reducing the number of variables of incompletely defined discrete functions**

In this paper, we consider incompletely defined discrete functions, i.e., Boolean and multiple-valued functions,  $f : S \rightarrow \{0, 1, \dots, q - 1\}$  where  $S \subseteq \{0, 1, \dots, q - 1\}^n$  i.e., the function value is specified only on a certain subset  $S$  of the domain of the corresponding completely defined function. We assume the function to be sparse i.e.  $|S|$  is 'small' relative to the cardinality of the domain. We show that by embedding the domain  $\{0, 1, \dots, q - 1\}^n$ , where  $n$  is the number of variables and  $q$  is a prime power, in a suitable ring structure, the multiplicative structure of the ring can be used to construct a linear function  $\{0, 1, \dots, q - 1\}^n \rightarrow \{0, 1, \dots, q - 1\}^m$  that is injective on  $S$  provided that  $m > 2 \log_q |S| + \log_q (n - 1)$ . In this way we find a linear transform that reduces the number of variables from  $n$  to  $m$ , and can be used e.g. in implementation of an incompletely defined discrete function by using linear decomposition.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Faculty of Electronics Niš

Contributors: Astola, J., Astola, P., Stanković, R., Tabus, I.

Number of pages: 15

Pages: 239-253

Publication date: 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Multiple-Valued Logic and Soft Computing

Volume: 31

Issue number: 3

ISSN (Print): 1542-3980

Ratings:

Scopus rating (2018): CiteScore 1.2 SJR 0.224 SNIP 0.605

Original language: English

ASJC Scopus subject areas: Software, Theoretical Computer Science, Logic

#### **Bibliographical note**

EXT="Stanković, Radomir"

Source: Scopus

Source ID: 85055661435

Research output: Contribution to journal > Article > Scientific > peer-review

### **Architectural patterns for microservices: A systematic mapping study**

Microservices is an architectural style increasing in popularity. However, there is still a lack of understanding how to adopt a microservice-based architectural style. We aim at characterizing different microservice architectural style patterns and the principles that guide their definition. We conducted a systematic mapping study in order to identify reported usage of microservices and based on these use cases extract common patterns and principles. We present two key contributions. Firstly, we identified several agreed microservice architecture patterns that seem widely adopted and reported in the case studies identified. Secondly, we presented these as a catalogue in a common template format including a summary of the advantages, disadvantages, and lessons learned for each pattern from the case studies. We can conclude that different architecture patterns emerge for different migration, orchestration, storage and deployment settings for a set of agreed principles.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Free University of Bolzano-Bozen

Contributors: Taibi, D., Lenarduzzi, V., Pahl, C.

Number of pages: 12

Pages: 221-232

Publication date: 2018

#### **Host publication information**

Title of host publication: CLOSER 2018 - Proceedings of the 8th International Conference on Cloud Computing and Services Science

Publisher: SCITEPRESS

ISBN (Electronic): 9789897582950

ASJC Scopus subject areas: Computer Science (miscellaneous), Software, Computer Science Applications

Keywords: Architectural style, Architecture pattern, Cloud migration, Cloud native, DevOps, Microservices

DOIs:

10.5220/0006798302210232

Source: Scopus

Source ID: 85046716130

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Blind estimation of white Gaussian noise variance in highly textured images**

In the paper, a new method of blind estimation of noise variance in a single highly textured image is proposed. An input image is divided into 8x8 blocks and discrete cosine transform (DCT) is performed for each block. A part of 64 DCT coefficients with lowest energy calculated through all blocks is selected for further analysis. For the DCT coefficients, a robust estimate of noise variance is calculated. Corresponding to the obtained estimate, a part of blocks having very large values of local variance calculated only for the selected DCT coefficients are excluded from the further analysis. These two steps (estimation of noise variance and exclusion of blocks) are iteratively repeated three times. For the verification of the proposed method, a new noise-free test image database TAMPERE17 consisting of many highly textured images is designed. It is shown for this database and different values of noise variance from the set {25, 49, 100, 225}, that the proposed method provides approximately two times lower estimation root mean square error than other methods.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Don State Technical University

Contributors: Ponomarenko, M., Gapon, N., Voronin, V., Egiazarian, K.

Publication date: 2018

### **Host publication information**

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Blind estimation of noise characteristics, Discrete cosine transform (DCT), Noise free test image database

DOIs:

10.2352/ISSN.2470-1173.2018.13.IPAS-382

### **Bibliographical note**

jufoid=84313

Source: Scopus

Source ID: 85052856410

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Combined local and global image enhancement algorithm**

We present a new image enhancement algorithm based on combined local and global image processing. The basic idea is to apply  $\alpha$ -rooting image enhancement approach for different image blocks. For this purpose, we split image in moving windows on disjoint blocks with different size (8 by 8, 16 by 16, 32 by 32 and, i.e.). The parameter  $\alpha$  for every block driven through optimization of measure of enhancement (EME). The resulting image is a weighted mean of all processing blocks. This strategy for image enhancement allows getting more contrast image with the following properties: irregular lighting and brightness gradient. Some experimental results are presented to illustrate the performance of the proposed algorithm.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Don State Technical University, College of Staten Island

Contributors: Voronin, V., Semenishchev, E., Ponomarenko, M., Agaian, S.

Publication date: 2018

### **Host publication information**

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

DOIs:

10.2352/ISSN.2470-1173.2018.13.IPAS-220

#### **Bibliographical note**

jufoid=84313

Source: Scopus

Source ID: 85052861928

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Compression of signs of DCT coefficients for additional lossless compression of JPEG images**

One of the main approaches to additional lossless compression of JPEG images is decoding of quantized values of discrete cosine transform (DCT) coefficients and further more effective recompression of the coefficients. Values of amplitudes of DCT coefficients are highly correlated and it is possible to effectively compress them. At the same time, signs of DCT coefficients, which occupy up to 20% of compressed image, are often considered unpredictable. In the paper, a new and effective method for compression of signs of quantized DCT coefficients is proposed. The proposed method takes into account both correlation between DCT coefficients of the same block and correlation between DCT coefficients of neighbor blocks. For each of 64 DCT coefficients, positions of 3 reference coefficients inside the block are determined and stored in the compressed file. Four reference coefficients with fixed positions are used from the neighbor blocks. For all reference coefficients, 15 frequency models to predict signs of a given coefficient are used. All 7 probabilities (that the sign is negative) are mixed by logistic mixing. For test set of JPEG images, we show that the proposed method allows compressing signs of DCT coefficients by 1.1 ... 1.3 times, significantly outperforming nearest analogues.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Kharkiv National Aerospace University

Contributors: Miroshnichenko, O., Ponomarenko, M., Lukin, V., Egiazarian, K.

Publication date: 2018

#### **Host publication information**

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

Keywords: Discrete cosine transform, JPEG, JPEG additional compression, Sign compression

DOIs:

10.2352/ISSN.2470-1173.2018.13.IPAS-385

#### **Bibliographical note**

jufoid=84313

EXT="Lukin, Vladimir"

Source: Scopus

Source ID: 85052859716

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Conversion of sparsely-captured light field into alias-free fullparallax multiview content**

We propose shearlet decomposition based light field (LF) reconstruction and filtering techniques for mitigating artifacts in the visualized contents of 3D multiview displays. Using the LF reconstruction capability, we first obtain the densely sampled light field (DSLRF) of the scene from a sparse set of view images. We design the filter via tiling the Fourier domain of epipolar image by shearlet atoms that are directionally and spatially localized versions of the desired display passband. In this way, it becomes possible to process the DSLRF in a depth-dependent manner. That is, the problematic areas in the 3D scene that are outside of the display depth of field (DoF) can be selectively filtered without sacrificing high details in the areas near the display, i.e. inside the DoF. The proposed approach is tested on a synthetic scene and the improvements achieved by means of the quality of the visualized content are verified, where the visualization process is simulated using a geometrical optics model of the human eye.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Electronics and Telecommunication Research Institute (ETRI)

Contributors: Sahin, E., Vagharshakyan, S., Bregovic, R., Lee, G., Gotchev, A.

Number of pages: 5

Pages: 1441-1445

Publication date: 2018

### Host publication information

Title of host publication: Electronic Imaging : Stereoscopic Displays and Applications XXIX

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
DOIs:

10.2352/ISSN.2470-1173.2018.04.SDA-144

### Bibliographical note

jufoid=84313

Source: Scopus

Source ID: 85052854954

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Deep p-Fibonacci scattering networks

Recently, the use of neural networks for image classification has become widely spread. Thanks to the availability of increased computational power, better performing architectures have been designed, such as the Deep Neural networks. In this work, we propose a novel image representation framework exploiting the Deep p- Fibonacci scattering network. The architecture is based on the structured p-Fibonacci scattering over graph data. This approach allows to provide good accuracy in classification while reducing the computational complexity. Experimental results demonstrate that the performance of the proposed method is comparable to state-of-the-art unsupervised methods while being computationally more efficient.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, University "Roma Tre"

Contributors: Battisti, F., Carli, M., De Paola, E., Egiazarian, K.

Publication date: 2018

### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI

Publisher: Society for Imaging Science and Technology

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
DOIs:

10.2352/ISSN.2470-1173.2018.13.IPAS-193

### Bibliographical note

jufoid=84313

EXT="Battisti, F."

EXT="Carli, M."

Source: Scopus

Source ID: 85052873638

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Fair testing and stubborn sets

Partial order methods alleviate state explosion by considering only a subset of actions in each constructed state. The choice of the subset depends on the properties that the method promises to preserve. Many methods have been developed ranging from deadlock-preserving to CTL(Formula presented.)-preserving and divergence-sensitive branching bisimilarity preserving. The less the method preserves, the smaller state spaces it constructs. Fair testing equivalence unifies deadlocks with livelocks that cannot be exited and ignores the other livelocks. It is the weakest congruence that preserves whether or not the system may enter a livelock that it cannot leave. We prove that a method that was designed for trace equivalence also preserves fair testing equivalence. We demonstrate its effectiveness on a protocol with a connection and data transfer phase. This is the first practical partial order method that deals with a practical fairness assumption.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Mathematics, University of Augsburg

Contributors: Valmari, A., Vogler, W.

Number of pages: 22

Pages: 589-610

Publication date: 2018

Peer-reviewed: Yes  
Early online date: 11 Dec 2017

### Publication information

Journal: International Journal on Software Tools for Technology Transfer

ISSN (Print): 1433-2779

Ratings:

Scopus rating (2018): CiteScore 4.8 SJR 0.472 SNIP 1.693

Original language: English

ASJC Scopus subject areas: Software, Information Systems

Keywords: Fair testing equivalence, Fairness, Partial order methods, Progress, Stubborn sets

Electronic versions:

fairSTTT. Embargo ended: 11/12/18

DOIs:

10.1007/s10009-017-0481-2

URLs:

<http://urn.fi/URN:NBN:fi:tty-201811222757>. Embargo ended: 11/12/18

Source: Scopus

Source ID: 85037686390

Research output: Contribution to journal › Article › Scientific › peer-review

### Federated IoT services leveraging 5G technologies at the edge

The Internet of Things (IoT) ecosystem is evolving towards the deployment of integrated environments, wherein heterogeneous devices pool their capacities together to match wide-ranging user and service requirements. As a consequence, solutions for efficient and synergistic cooperation among objects acquire great relevance. Along this line, this paper focuses on the adoption of the promising MIFaaS (Mobile-IoT-Federation-as-a-Service) paradigm to support delay-sensitive applications for high-end IoT devices in next-to-come fifth generation (5G) environments. MIFaaS fosters the provisioning of IoT services and applications with low-latency requirements by leveraging cooperation among private/public clouds of IoT objects at the edge of the network. A performance assessment of the MIFaaS paradigm in a cellular 5G environment based on both Long Term Evolution (LTE) and the recent Narrowband IoT (NB-IoT) is presented. Obtained results demonstrate that the proposed solution outperforms classic approaches, highlighting significant benefits derived from the joint use of LTE and NB-IoT bandwidths in terms of increased number of successfully delivered IoT services.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electronics and Communications Engineering, Universita degli Studi di Reggio Calabria, Peoples' Friendship University of Russia

Contributors: Farris, I., Orsino, A., Militano, L., Iera, A., Araniti, G.

Pages: 58-69

Publication date: 2018

Peer-reviewed: Yes

### Publication information

Journal: Ad Hoc Networks

Volume: 68

ISSN (Print): 1570-8705

Ratings:

Scopus rating (2018): CiteScore 7.7 SJR 0.648 SNIP 2.03

Original language: English

ASJC Scopus subject areas: Software, Hardware and Architecture, Computer Networks and Communications

Keywords: 5G, IoT, Multi-access edge computing, Narrowband-IoT

DOIs:

10.1016/j.adhoc.2017.09.002

### Bibliographical note

INT=ELT, "Orsino, A."

Source: Scopus

Source ID: 85030565702

Research output: Contribution to journal › Article › Scientific › peer-review

### **How to design gamification? A method for engineering gamified software**

Context: Since its inception around 2010, gamification has become one of the top technology and software trends. However, gamification has also been regarded as one of the most challenging areas of software engineering. Beyond traditional software design requirements, designing gamification requires the command of disciplines such as (motivational/behavioral) psychology, game design, and narratology, making the development of gamified software a challenge for traditional software developers. Gamification software inhabits a finely tuned niche of software engineering that seeks for both high functionality and engagement; beyond technical flawlessness, gamification has to motivate and affect users. Consequently, it has also been projected that most gamified software is doomed to fail. Objective: This paper seeks to advance the understanding of designing gamification and to provide a comprehensive method for developing gamified software. Method: We approach the research problem via a design science research approach; firstly, by synthesizing the current body of literature on gamification design methods and by interviewing 25 gamification experts, producing a comprehensive list of design principles for developing gamified software. Secondly, and more importantly, we develop a detailed method for engineering of gamified software based on the gathered knowledge and design principles. Finally, we conduct an evaluation of the artifacts via interviews of ten gamification experts and implementation of the engineering method in a gamification project. Results: As results of the study, we present the method and key design principles for engineering gamified software. Based on the empirical and expert evaluation, the developed method was deemed as comprehensive, implementable, complete, and useful. We deliver a comprehensive overview of gamification guidelines and shed novel insights into the nature of gamification development and design discourse. Conclusion: This paper takes first steps towards a comprehensive method for gamified software engineering.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: TUT Game Lab, Pervasive Computing, University of Duisburg-Essen

Contributors: Morschheuser, B., Hassan, L., Werder, K., Hamari, J.

Pages: 219-237

Publication date: 2018

Peer-reviewed: Yes

Early online date: 2017

#### **Publication information**

Journal: Information and Software Technology

Volume: 95

ISSN (Print): 0950-5849

Ratings:

Scopus rating (2018): CiteScore 7.9 SJR 0.615 SNIP 3.085

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Computer Science Applications

Keywords: Design science research, Game design, Gameful design, Gamification, Persuasive technology, Playfulness, Software engineering

DOIs:

10.1016/j.infsof.2017.10.015

Source: Scopus

Source ID: 85035150495

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Information Exchange Architecture for Collaborative Industrial Ecosystem**

Due to the networked nature of modern industrial business, repeated information exchange activities are necessary. Unfortunately, information exchange is both laborious and expensive with the current communication media, which causes errors and delays. To increase the efficiency of communication, this study introduces an architecture to exchange information in a digitally processable manner in industrial ecosystems. The architecture builds upon commonly agreed business practices and data formats, and an open consortium and information mediators enable it. Following the architecture, a functional prototype has been implemented for a real industrial scenario. This study has its focus on the technical information of equipment, but the architecture concept can also be applied in financing and logistics. Therefore, the concept has potential to completely reform industrial communication.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation and Hydraulic Engineering, Research group: Automation and Systems Theory, Collaxion Oy

Contributors: Kannisto, P., Hästbacka, D., Marttinen, A.

Pages: 1-16

Publication date: 2018

Peer-reviewed: Yes

Early online date: 2018

## Publication information

Journal: Information Systems Frontiers

ISSN (Print): 1387-3326

Ratings:

Scopus rating (2018): CiteScore 7.6 SJR 0.797 SNIP 2.201

Original language: English

ASJC Scopus subject areas: Software, Theoretical Computer Science, Information Systems, Computer Networks and Communications

Keywords: Digital business ecosystem, Industrial information management, Lifecycle management, Multi-sided platform, Operations and maintenance, Systems integration

Electronic versions:

Kannisto2018\_Article\_InformationExchangeArchitectur

DOIs:

10.1007/s10796-018-9877-0

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201901041013>

Source: Scopus

Source ID: 85052098014

Research output: Contribution to journal › Article › Scientific › peer-review

## Information models and information exchange in plant-wide monitoring and control of industrial processes

The efficiency of industrial processes depends on how well the processes can be controlled and this affects the quality, use of resources as well as the environmental impact. Advanced monitoring and control solutions for large-scale industrial processes require information from different systems. The challenge in integration is diverse messaging structures and lack of common semantics in exchange of information between related information systems as well as their human operators. This paper provides a comparison of some of the existing standards of the domain defining suitable structures. Based on these, a model for data and event message structures is developed. The approach builds on a separation of concerns keeping the messaging semantics independent of the transport layer. The requirement is to enable also asynchronous communication as adapters are often needed in distributed environments with heterogeneous systems and communication protocols. The developed structures have been found suitable for communicating measurements and events in industrial process settings as shown by case examples.

## General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Automation and Hydraulic Engineering

Contributors: Hästbacka, D., Kannisto, P., Viikko, M.

Number of pages: 7

Pages: 216-222

Publication date: 2018

## Host publication information

Title of host publication: Proceedings of the 10th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management - Volume 3: KMIS : September 18-20, 2018, Seville, Spain

Publisher: SCITEPRESS

ISBN (Electronic): 9789897583308

ASJC Scopus subject areas: Software

Keywords: Data exchange, Industrial processes, Information models, Interoperability

DOIs:

10.5220/0006960602160222

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202005205512>

<https://trepo.tuni.fi/handle/10024/122133>

## Bibliographical note

Jufo\_ID: 73527

Source: Scopus

Source ID: 85059085263

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

## Is Texture Denoising Efficiency Predictable?

Images of different origin contain textures, and textural features in such regions are frequently employed in pattern recognition, image classification, information extraction, etc. Noise often present in analyzed images might prevent a proper solution of basic tasks in the aforementioned applications and is worth suppressing. This is not an easy task since

even the most advanced denoising methods destroy texture in a more or less degree while removing noise. Thus, it is desirable to predict the filtering behavior before any denoising is applied. This paper studies the efficiency of texture image denoising for different noise intensities and several filter types under different visual quality criteria (quality metrics). It is demonstrated that the most efficient existing filters provide very similar results. From the obtained results, it is possible to generalize and employ the prediction strategy earlier proposed for denoising techniques based on the discrete cosine transform. Accuracy of such a prediction is studied and the ways to improve it are considered. Some practical recommendations concerning a decision to undertake whether it is worth applying a filter are given.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI

Contributors: Rubel, O., Lukin, V., Abramov, S., Vozel, B., Pogrebnyak, O., Egiazarian, K.

Publication date: 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Pattern Recognition and Artificial Intelligence

Volume: 32

Issue number: 1

Article number: 1860005

ISSN (Print): 0218-0014

Ratings:

Scopus rating (2018): CiteScore 2.2 SJR 0.304 SNIP 0.718

Original language: English

ASJC Scopus subject areas: Software, Computer Vision and Pattern Recognition, Artificial Intelligence

Keywords: image processing, noise suppression, Texture denoising, visual quality

Electronic versions:

S0218001418600054

DOIs:

10.1142/S0218001418600054

URLs:

<http://urn.fi/URN:NBN:fi:ty-201708241829>

Source: Scopus

Source ID: 85025804856

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Making the cloud work for software producers: Linking architecture, operating cost and revenue**

Cloud migration is concerned with moving an on-premise software system into the cloud. In this paper, we focus on software producers adopting the cloud to provide their solutions to enterprise customers. Their challenge is to migrate a software product, developed in-house and traditionally delivered on-premise, to an Infrastructure-as-a-Service or Platform-as-a-Service solution, while also mapping an existing traditional licensing model on to a cloud monetization model. The analysis of relevant cost types and factors of cloud computing generate relevant information for the software producers when deciding to adopt cloud computing, and defining software pricing. We present an integrated framework for informing cloud monetization based on operational cost factors for migrating to the cloud and test it in a real-life case study. Differences between basic virtualization of the software product and using fully cloud-native platform services for re-architecting the product in question are discussed.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Dublin City University, Free University of Bolzano-Bozen, Human-Centered Technology (IHTE)

Contributors: Rosati, P., Fowley, F., Pahl, C., Taibi, D., Lynn, T.

Number of pages: 12

Pages: 364-375

Publication date: 2018

#### **Host publication information**

Title of host publication: CLOSER 2018 - Proceedings of the 8th International Conference on Cloud Computing and Services Science

Publisher: SCITEPRESS

ISBN (Electronic): 9789897582950

ASJC Scopus subject areas: Computer Science (miscellaneous), Software, Computer Science Applications

Keywords: Architecture migration, Cloud migration, Monetization, Software producer, Total cost of ownership



DOIs:

10.5220/0006679303640375

Source: Scopus

Source ID: 85048894202

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Memory Tampering Attack on Binary GCD Based Inversion Algorithms

In the field of cryptography engineering, implementation-based attacks are a major concern due to their proven feasibility. Fault injection is one attack vector, nowadays a major research line. In this paper, we present how a memory tampering-based fault attack can be used to severely limit the output space of binary GCD based modular inversion algorithm implementations. We frame the proposed attack in the context of ECDSA showing how this approach allows recovering the private key from only one signature, independent of the key size. We analyze two memory tampering proposals, illustrating how this technique can be adapted to different implementations. Besides its application to ECDSA, it can be extended to other cryptographic schemes and countermeasures where binary GCD based modular inversion algorithms are employed. In addition, we describe how memory tampering-based fault attacks can be used to mount a previously proposed fault attack on scenarios that were initially discarded, showing the importance of including memory tampering attacks in the frameworks for analyzing fault attacks and their countermeasures.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Pervasive Computing, Research area: Information security, Universidad Tecnológica de la Habana José Antonio Echeverría, Universidad de Sevilla

Contributors: Aldaya, A. C., Brumley, B. B., Sarmiento, A. J., Sánchez-Solano, S.

Pages: 1-20

Publication date: 2018

Peer-reviewed: Yes

Early online date: 2018

#### Publication information

Journal: International Journal of Parallel Programming

ISSN (Print): 0885-7458

Ratings:

Scopus rating (2018): CiteScore 2.4 SJR 0.289 SNIP 0.97

Original language: English

ASJC Scopus subject areas: Software, Theoretical Computer Science, Information Systems

Keywords: Binary GCD, Bitstream manipulation, ECDSA, Fault attacks, FPGA memory tampering

Electronic versions:

beea\_tampering. Embargo ended: 29/11/19

DOIs:

10.1007/s10766-018-0610-x

URLs:

<http://urn.fi/URN:NBN:fi:tty-201901141092>. Embargo ended: 29/11/19

Source: Scopus

Source ID: 85057616270

Research output: Contribution to journal › Article › Scientific › peer-review

### Methods and tools for denoising of complex-valued images based on block-matching and high order singular value decomposition

Noise suppression in complex-valued data is an important task for a wide class of applications, in particular concerning the phase retrieval in coherent imaging. The approaches based on BM3D techniques are ones of the most successful in the field. In this paper, we propose and develop a new class of BM3Dstyle algorithms, which use high order (3D and 4D) singular value decomposition (HOSVD) for transform design in complex domain. This set of the novel algorithms is implemented as a toolbox In Matlab. This development is produced for various types of the complex-domain sparsity: directly in complex domain, real/imaginary and phase/ amplitude parts of complexvalued variables. The group-wise transform design is combined with the different kinds of thresholding including multivariable Wiener filtering. The toolbox includes iterative and non-iterative novel complex-domain algorithms (filters). The efficiency of the developed algorithms is demonstrated on denoising problems with an additive Gaussian complex-valued noise. A special set of the complex-valued test-images was developed with spatially varying correlated phase and amplitudes imitating data typical for optical interferometry and holography. It is shown that for this class of the test-images the developed algorithms demonstrate the stateof- the-art performance.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing  
Contributors: Ponomarenko, M., Katkovnik, V., Egiazarian, K.  
Publication date: 2018

#### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI  
Publisher: Society for Imaging Science and Technology  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
Keywords: Block matching, Complex domain, Higher-order singular value decomposition, Image denoising, Phase imaging, Sparsity  
DOIs:  
10.2352/ISSN.2470-1173.2018.13.IPAS-306

#### Bibliographical note

jufoid=84313  
Source: Scopus  
Source ID: 85052877244  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Mixed-integer linear programming approach for global discrete sizing optimization of frame structures

This paper focuses on discrete sizing optimization of frame structures using commercial profile catalogs. The optimization problem is formulated as a mixed-integer linear programming (MILP) problem by including the equations of structural analysis as constraints. The internal forces of the members are taken as continuous state variables. Binary variables are used for choosing the member profiles from a catalog. Both the displacement and stress constraints are formulated such that for each member limit values can be imposed at predefined locations along the member. A valuable feature of the formulation, lacking in most contemporary approaches, is that global optimality of the solution is guaranteed by solving the MILP using branch-and-bound techniques. The method is applied to three design problems: a portal frame, a two-story frame with three load cases and a multiple-bay multiple-story frame. Performance profiles are determined to compare the MILP reformulation method with a genetic algorithm.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Civil Engineering, KU Leuven  
Contributors: van Mellaert, R., Mela, K., Tiainen, T., Heinisuo, M., Lombaert, G., Schevenels, M.  
Number of pages: 15  
Pages: 579–593  
Publication date: 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Structural and Multidisciplinary Optimization  
Volume: 57  
Issue number: 2  
ISSN (Print): 1615-147X  
Ratings:  
Scopus rating (2018): CiteScore 5.1 SJR 1.835 SNIP 1.887  
Original language: English  
ASJC Scopus subject areas: Control and Systems Engineering, Software, Computer Science Applications, Computer Graphics and Computer-Aided Design, Control and Optimization  
Keywords: Discrete optimization, Frame structures, Global optimization, Mixed-integer linear programming, Sizing optimization  
DOIs:  
10.1007/s00158-017-1770-9  
Source: Scopus  
Source ID: 85026724545  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Modeling and estimation of signal-dependent and correlated noise

The additive white Gaussian noise (AWGN) model is ubiquitous in signal processing. This model is often justified by central-limit theorem (CLT) arguments. However, whereas the CLT may support a Gaussian distribution for the random errors, it does not provide any justification for the assumed additivity and whiteness. As a matter of fact, data acquired in real applications can seldom be described with good approximation by the AWGN model, especially because errors are

typically correlated and not additive. Failure to model accurately the noise leads to inaccurate analysis, ineffective filtering, and distortion or even failure in the estimation. This chapter provides an introduction to both signal-dependent and correlated noise and to the relevant models and basic methods for the analysis and estimation of these types of noise. Generic one-parameter families of distributions are used as the essential mathematical setting for the observed signals. The distribution families covered as leading examples include Poisson, mixed Poisson–Gaussian, various forms of signal-dependent Gaussian noise (including multiplicative families and approximations of the Poisson family), as well as doubly censored heteroskedastic Gaussian distributions. We also consider various forms of noise correlation, encompassing pixel and readout cross-talk, fixed-pattern noise, column/row noise, etc., as well as related issues like photo-response and gain nonuniformity. The introduced models and methods are applicable to several important imaging scenarios and technologies, such as raw data from digital camera sensors, various types of radiation imaging relevant to security and to biomedical imaging.

#### General information

Publication status: Published

MoE publication type: A3 Part of a book or another research book

Organisations: Signal Processing, Research group: Signal and Image Restoration-RST, University of São Paulo

Contributors: Azzari, L., Borges, L. R., Foi, A.

Number of pages: 36

Pages: 1-36

Publication date: 2018

#### Host publication information

Title of host publication: Denoising of Photographic Images and Video : Fundamentals, Open Challenges and New Trends

Publisher: SPRINGER-VERLAG LONDON LTD

ISBN (Print): 978-3-319-96028-9

#### Publication series

Name: Advances in Computer Vision and Pattern Recognition

ISSN (Print): 2191-6586

ISSN (Electronic): 2191-6594

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Artificial Intelligence  
Electronic versions:

Azzari2018-Modeling\_and\_estimation\_of\_signal\_dependent\_and\_correlated\_noise. Embargo ended: 11/09/19

DOIs:

10.1007/978-3-319-96029-6\_1

URLs:

<http://urn.fi/URN:NBN:fi:tty-201907151959>. Embargo ended: 11/09/19

Source: Scopus

Source ID: 85053409603

Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

#### Multisensor Time–Frequency Signal Processing MATLAB package: An analysis tool for multichannel non-stationary data

The Multisensor Time–Frequency Signal Processing (MTFSP) MATLAB package is an analysis tool for multichannel non-stationary signals collected from an array of sensors. By combining array signal processing for non-stationary signals and multichannel high resolution time–frequency methods, MTFSP enables applications such as cross-channel causality relationships, automated component separation and direction of arrival estimation, using multisensor time–frequency distributions (MTFDs). MTFSP can address old and new applications such as: abnormality detection in biomedical signals, source localization in wireless communications or condition monitoring and fault detection in industrial plants. It allows e.g. the reproduction of the results presented in Boashash and Aïssa-El-Bey (in press) [2].

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: University of Queensland

Contributors: Boashash, B., Aïssa-El-Bey, A., Al-Sa'd, M. F.

Pages: 53-58

Publication date: 2018

Peer-reviewed: Yes

#### Publication information

Journal: SoftwareX

Volume: 8

ISSN (Print): 2352-7110

Ratings:

Scopus rating (2018): CiteScore 10.8 SJR 4.539 SNIP 5.206

Original language: English

ASJC Scopus subject areas: Software, Computer Science Applications

Keywords: Automated component separation, Blind source separation, Cross-channel causality analysis, Direction of arrival, Multisensor time–frequency analysis, Non-stationary array processing

DOIs:

10.1016/j.softx.2017.12.002

Source: Scopus

Source ID: 85041238142

Research output: Contribution to journal › Article › Scientific › peer-review

### **Multi-view predictive latent space learning**

In unsupervised circumstances, multi-view learning seeks a shared latent representation by taking the consensus and complementary principles into account. However, most existing multi-view unsupervised learning approaches do not explicitly lay stress on the predictability of the latent space. In this paper, we propose a novel multi-view predictive latent space learning (MVP) model and apply it to multi-view clustering and unsupervised dimension reduction. The latent space is forced to be predictive by maximizing the correlation between the latent space and feature space of each view. By learning a multi-view graph with adaptive view-weight learning, MVP effectively combines the complementary information from multi-view data. Experimental results on benchmark datasets show that MVP outperforms the state-of-the-art multi-view clustering and unsupervised dimension reduction algorithms.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Tianjin University

Contributors: Yuan, J., Gao, K., Zhu, P., Egiazarian, K.

Publication date: 2018

Peer-reviewed: Yes

Early online date: 2018

### **Publication information**

Journal: Pattern Recognition Letters

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2018): CiteScore 5.8 SJR 0.662 SNIP 1.729

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Artificial Intelligence

Keywords: Multi-view learning, Predictive latent space learning, Unsupervised clustering, Unsupervised dimension reduction

DOIs:

10.1016/j.patrec.2018.06.022

Source: Scopus

Source ID: 85049094619

Research output: Contribution to journal › Article › Scientific › peer-review

### **On the degeneracy of the Randić entropy and related graph measures**

Numerous quantitative graph measures have been defined and applied in various disciplines. Such measures may be differentiated according to whether they are information-theoretic or non-information-theoretic. In this paper, we examine an important property of Randić entropy, an information-theoretic measure, and examine some related graph measures based on random roots. In particular, we investigate the degeneracy of these structural graph measures and discuss numerical results. Finally, we draw some conclusions about the measures' applicability to deterministic and non-deterministic networks.

### **General information**

Publication status: E-pub ahead of print

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Medicine and Statistical Learning Laboratory (CMSL), Research group: Predictive Society and Data Analytics (PSDA), University of Applied Sciences Upper Austria, School of Management, Nankai University, Hall in Tyrol, The City College of New York (CUNY), Production and Operations Management, Tianjin University of Technology

Contributors: Dehmer, M., Chen, Z., Mowshowitz, A., Jodlbauer, H., Emmert-Streib, F., Shi, Y., Tripathi, S., Xia, C.

Publication date: 2018

Peer-reviewed: Yes

### **Publication information**

Journal: Information Sciences

ISSN (Print): 0020-0255

Ratings:

Scopus rating (2018): CiteScore 10.4 SJR 1.62 SNIP 2.744

Original language: English

ASJC Scopus subject areas: Software, Control and Systems Engineering, Theoretical Computer Science, Computer Science Applications, Information Systems and Management, Artificial Intelligence

Keywords: Data science, Graphs, Networks, Quantitative graph theory, Structural graph measures, Structural network analysis

DOIs:

10.1016/j.ins.2018.11.011

### Bibliographical note

EXT="Tripathi, Shailesh"

Source: Scopus

Source ID: 85057760552

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Probabilistic saliency estimation

In this paper, we model the salient object detection problem under a probabilistic framework encoding the boundary connectivity saliency cue and smoothness constraints into an optimization problem. We show that this problem has a closed form global optimum solution, which estimates the salient object. We further show that along with the probabilistic framework, the proposed method also enjoys a wide range of interpretations, i.e. graph cut, diffusion maps and one-class classification. With an analysis according to these interpretations, we also find that our proposed method provides approximations to the global optimum to another criterion that integrates local/global contrast and large area saliency cues. The proposed unsupervised approach achieves mostly leading performance compared to the state-of-the-art unsupervised algorithms over a large set of salient object detection datasets including around 17k images for several evaluation metrics. Furthermore, the computational complexity of the proposed method is favorable/comparable to many state-of-the-art unsupervised techniques.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Multimedia Research Group - MRG

Contributors: Aytekin, C., Iosifidis, A., Gabbouj, M.

Number of pages: 14

Pages: 359-372

Publication date: 2018

Peer-reviewed: Yes

Early online date: 20 Sep 2017

### Publication information

Journal: Pattern Recognition

Volume: 74

ISSN (Print): 0031-3203

Ratings:

Scopus rating (2018): CiteScore 10.4 SJR 1.363 SNIP 3.211

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Artificial Intelligence

Keywords: Diffusion maps, One-class classification, Probabilistic model, Saliency, Salient object detection, Spectral graph cut

DOIs:

10.1016/j.patcog.2017.09.023

Source: Scopus

Source ID: 85032271491

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Reduction of variables of index generation functions using linear and quadratic transformations

In many applications in communication, data retrieval and processing, digital system design, and related areas, incompletely specified switching (Boolean or multiple-valued) functions are encountered. A particular class of highly incompletely specified functions are the so-called index generation functions, which being defined on a small fraction of input combinations, often do not require all the variables to be represented. Reducing the variables of index generation functions is an important task, since they are used mainly in real-time applications and compactness of their representations influences performances of related systems. One approach towards reducing the number of variables in index generation functions are linear transformations meaning that initial variables are replaced by their linear

combinations. A drawback is that finding an optimal transformation can be difficult. Therefore, in this paper, we first formulate the problem of finding a good linear transformation by using linear subspaces. This formulation serves as a basis to propose non-linear (polynomial) transformations to reduce the number of variables in index generation functions.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Signal Processing, Faculty of Electronics  
Contributors: Astola, H., Stanković, R., Astola, J.  
Number of pages: 16  
Pages: 255-270  
Publication date: 2018  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Multiple-Valued Logic and Soft Computing  
Volume: 31  
Issue number: 3  
ISSN (Print): 1542-3980  
Ratings:  
Scopus rating (2018): CiteScore 1.2 SJR 0.224 SNIP 0.605  
Original language: English  
ASJC Scopus subject areas: Software, Theoretical Computer Science, Logic  
Keywords: Index generation function, Linear transformation, Non-linear transformation, Reed-Muller expression

#### Bibliographical note

EXT="Stanković, Radomir"  
Source: Scopus  
Source ID: 85055671990  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Robust linearized combined metrics of image visual quality

Existing full-reference metrics still do not provide a desirable degree of adequacy to a human visual perception, for evaluation of images with different types and levels of distortions. One reason for this is that it is difficult to incorporate the peculiarities of human visual system in the metrics design. In this paper, a robust approach to full-reference metrics' design is proposed, based on a combination of several existing full-reference metrics. A preliminary linearization (fitting) of the dependence of MOS with respect to the components metrics is performed in order to compensate shortcomings of each component. The proposed method is tested on several known databases, and demonstrate better performance than existing metrics.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing, Kharkiv National Aerospace University  
Contributors: Ieremeiev, O., Lukin, V., Ponomarenko, N., Egiazarian, K.  
Publication date: 2018

#### Host publication information

Title of host publication: Electronic Imaging : Image Processing: Algorithms and Systems XVI  
Publisher: Society for Imaging Science and Technology  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
Keywords: Combined metrics, Full-reference metrics, Image visual quality assessment, Robust metrics  
DOIs:  
10.2352/ISSN.2470-1173.2018.13.IPAS-260

#### Bibliographical note

jufoid=84313  
EXT="Ponomarenko, Nikolay"  
EXT="Lukin, Vladimir"  
Source: Scopus  
Source ID: 85052901571  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

## Time-of-Flight Range Measurement in Low-sensing Environment: Noise Analysis and Complex-domain Non-local Denoising

In this work, we deal with the problem of denoising 3D scene range measurements acquired by Time-of-flight (ToF) range sensors and composed in the form of 2D image-like depth maps. We address the specific case of ToF low-sensing environment (LSE). Such environment is set by low-light sensing conditions, low-power hardware requirements, and low-reflectivity scenes. We demonstrate that data captured by a device in such mode can be effectively post-processed in order to reach the same measurement accuracy as if the device was working in normal operating mode. In order to achieve this, we first present an elaborated analysis of noise properties of ToF data sensed in LSE and verify the derived noise models by empirical measurements. Then, we develop a related novel non-local denoising approach working in complex domain and demonstrate its superiority against the state of the art for data acquired by an off-the-shelf ToF device.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: 3D MEDIA, Research group: 3D MEDIA

Contributors: Georgiev, M., Bregovic, R., Gotchev, A.

Publication date: 2018

Peer-reviewed: Yes

Early online date: 15 Feb 2018

### Publication information

Journal: IEEE Transactions on Image Processing

Volume: 27

Issue number: 6

ISSN (Print): 1057-7149

Ratings:

Scopus rating (2018): CiteScore 12.8 SJR 1.809 SNIP 4.285

Original language: English

ASJC Scopus subject areas: Software, Computer Graphics and Computer-Aided Design

Keywords: 3D, Delays, denoising, Filtering, Harmonic analysis, low-sensing environment, Noise measurement, noise model, Noise reduction, Phase measurement, phase-wrap, range sensing, Sensors, Time-of-Flight (ToF)

Electronic versions:

Time-of-Flight Range Measurement in Low-sensing Environment

DOIs:

[10.1109/TIP.2018.2807126](https://doi.org/10.1109/TIP.2018.2807126)

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001171377>

Source: Scopus

Source ID: 85042184733

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

## How developers perceive smells in source code: A replicated study

Context. In recent years, smells, also referred to as bad smells, have gained popularity among developers. However, it is still not clear how harmful they are perceived from the developers' point of view. Many developers talk about them, but only few know what they really are, and even fewer really take care of them in their source code. Objective. The goal of this work is to understand the perceived criticality of code smells both in theory, when reading their description, and in practice. Method. We executed an empirical study as a differentiated external replication of two previous studies. The studies were conducted as surveys involving only highly experienced developers (63 in the first study and 41 in the second one). First the perceived criticality was analyzed by proposing the description of the smells, then different pieces of code infected by the smells were proposed, and finally their ability to identify the smells in the analyzed code was tested. Results. According to our knowledge, this is the largest study so far investigating the perception of code smells with professional software developers. The results show that developers are very concerned about code smells in theory, nearly always considering them as harmful or very harmful (17 out of 23 smells). However, when they were asked to analyze an infected piece of code, only few infected classes were considered harmful and even fewer were considered harmful because of the smell. Conclusions. The results confirm our initial hypotheses that code smells are perceived as more critical in theory but not as critical in practice.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Free University of Bolzano-Bozen, Free University of Bozen-Bolzano

Contributors: Taibi, D., Janes, A., Lenarduzzi, V.

Number of pages: 13

Pages: 223-235

Publication date: 1 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Information and Software Technology

Volume: 92

ISSN (Print): 0950-5849

Ratings:

Scopus rating (2017): CiteScore 7.2 SJR 0.581 SNIP 2.913

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Computer Science Applications

Keywords: Antipatterns, Bad smells, Code smells, Refactoring, Software maintenance

DOIs:

10.1016/j.infsof.2017.08.008

Source: Scopus

Source ID: 85028762206

Research output: Contribution to journal › Article › Scientific › peer-review

### Multilinear class-specific discriminant analysis

There has been a great effort to transfer linear discriminant techniques that operate on vector data to high-order data, generally referred to as Multilinear Discriminant Analysis (MDA) techniques. Many existing works focus on maximizing the inter-class variances to intra-class variances defined on tensor data representations. However, there has not been any attempt to employ class-specific discrimination criteria for the tensor data. In this paper, we propose a multilinear subspace learning technique suitable for applications requiring class-specific tensor models. The method maximizes the discrimination of each individual class in the feature space while retains the spatial structure of the input. We evaluate the efficiency of the proposed method on two problems, i.e. facial image analysis and stock price prediction based on limit order book data.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Aarhus Universitet, Laboratory of Signal Processing

Contributors: Thanh Tran, D., Gabbouj, M., Iosifidis, A.

Number of pages: 6

Pages: 131-136

Publication date: 1 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Pattern Recognition Letters

Volume: 100

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2017): CiteScore 5.5 SJR 0.662 SNIP 1.605

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Artificial Intelligence

Keywords: Class-specific discriminant learning, Face verification, Multilinear discriminant analysis, Stock price prediction

DOIs:

10.1016/j.patrec.2017.10.027

URLs:

<https://arxiv.org/abs/1710.10695>

### Bibliographical note

INT=sgn,"Thanh Tran, Dat"

Source: Scopus

Source ID: 85032300703

Research output: Contribution to journal › Article › Scientific › peer-review

### Quantitative Graph Theory: A new branch of graph theory and network science

In this paper, we describe some highlights of the new branch QUANTITATIVE GRAPH THEORY and explain its significant different features compared to classical graph theory. The main goal of quantitative graph theory is the structural quantification of information contained in complex networks by employing a measurement approach based on numerical invariants and comparisons. Furthermore, the methods as well as the networks do not need to be deterministic but can be statistic. As such this complements the field of classical graph theory, which is descriptive and deterministic in nature. We provide examples of how quantitative graph theory can be used for novel applications in the context of the overarching



concept network science.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Computational Medicine and Statistical Learning Laboratory (CMSL), Faculty of Biomedical Sciences and Engineering, BioMediTech, Research group: Predictive Society and Data Analytics (PSDA), Nankai University

Contributors: Dehmer, M., Emmert-Streib, F., Shi, Y.

Number of pages: 6

Pages: 575-580

Publication date: 1 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Information Sciences

Volume: 418-419

ISSN (Print): 0020-0255

Ratings:

Scopus rating (2017): CiteScore 10 SJR 1.635 SNIP 2.304

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Theoretical Computer Science, Software, Computer Science Applications, Information Systems and Management, Artificial Intelligence

Keywords: Data Science, Graphs, Networks, Quantitative Graph Theory, Statistics

DOIs:

10.1016/j.ins.2017.08.009

URLs:

<https://arxiv.org/abs/1710.05660>

Source: Scopus

Source ID: 85027400753

Research output: Contribution to journal > Article > Scientific > peer-review

### Sparse approximations in complex domain based on BM3D modeling

In this paper the concept of sparsity for complex-valued variables is introduced in the following three types: directly in complex domain and for two real-valued pairs phase/amplitude and real/imaginary parts of complex variables. The nonlocal block-matching technique is used for sparsity implementation and filter design for each type of sparsity. These filters are complex domain generalizations of the Block Matching 3D collaborative (BM3D) filter based on the high-order singular value decomposition (HOSVD) in order to generate group-wise adaptive analysis/synthesis transforms. Complex domain denoising is developed and studied as a test-problem for comparison of the designed filters as well as the different types of sparsity modeling.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Computational Imaging-CI

Contributors: Katkovnik, V., Ponomarenko, M., Egiazarian, K.

Number of pages: 13

Pages: 96-108

Publication date: 1 Dec 2017

Peer-reviewed: Yes

### Publication information

Journal: Signal Processing

Volume: 141

ISSN (Print): 0165-1684

Ratings:

Scopus rating (2017): CiteScore 7.1 SJR 0.94 SNIP 1.974

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Software, Signal Processing, Computer Vision and Pattern Recognition, Electrical and Electronic Engineering

Keywords: Block matching, Complex domain, Denoising, Elsevier article, Phase imaging, Sample document, Sparsity

DOIs:

10.1016/j.sigpro.2017.05.032

Source: Scopus

Source ID: 85020311730

### **Multi-factor authentication for wearables: Configuring system parameters with risk function**

The users of today are already about to enter the era of highly integrated modern wearable devices-the time when smart accessories will, in turn, push aside regular Smartphones and Tablets bringing a variety of new security challenges. The number of simultaneously used bio-sensors, both integrated into smart wearables and connected over wireless interfaces, allows novel opportunities for Multi-factor Authentication (MFA) of the user. This manuscript proposes a solution for configuring the MFA based on the averaged direct and indirect losses risk analysis. The example application of Bayesian function for MFA presents the applicability of the proposed framework for the utilization with wearables.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electronics and Communications Engineering, ITMO University, St. Petersburg State University of Aerospace Instrumentation

Contributors: Bezzateev, S., Afanasyeva, A., Voloshina, N., Ometov, A.

Publication date: 13 Nov 2017

#### **Host publication information**

Title of host publication: Proceedings of the 2nd International Conference on Advanced Wireless Information, Data, and Communication Technologies, AWICT 2017

Publisher: ACM

ISBN (Electronic): 9781450353106

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Information security, Multi-factor authentication, Risk function, Wearables

Electronic versions:

Multi-factor authentication for wearables 2017

DOIs:

10.1145/3231830.3231834

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002262382>

Source: Scopus

Source ID: 85045304145

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Big Media Data Analysis**

In this editorial a short introduction to the special issue on Big Media Data Analysis is given. The scope of this Editorial is to briefly present methodologies, tasks and applications of big media data analysis and to introduce the papers of the special issue. The special issue includes six papers that span various media analysis application areas like generic image description, medical image and video analysis, distance calculation acceleration and data collection.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Multimedia Research Group - MRG, Aarhus Universitet, University of Milan Bicocca, Department of Informatics, Aristotle University of Thessaloniki

Contributors: Iosifidis, A., Tefas, A., Pitas, I., Gabbouj, M.

Number of pages: 4

Pages: 105-108

Publication date: 1 Nov 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Signal Processing: Image Communication

Volume: 59

ISSN (Print): 0923-5965

Ratings:

Scopus rating (2017): CiteScore 4.6 SJR 0.551 SNIP 1.512

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Electrical and Electronic Engineering

Keywords: Big Media Data, Data analytics, Deep learning, Machine learning, Statistical learning

DOIs:

10.1016/j.image.2017.10.004

#### **Bibliographical note**

EXT="Tefas, Anastasios"

Source: Scopus

Source ID: 85033445526

Research output: Contribution to journal › Editorial › Scientific › peer-review

#### **Gamified crowdsourcing: Conceptualization, literature review, and future agenda**

Two parallel phenomena are gaining attention in human–computer interaction research: gamification and crowdsourcing. Because crowdsourcing's success depends on a mass of motivated crowdsourcees, crowdsourcing platforms have increasingly been imbued with motivational design features borrowed from games; a practice often called gamification. While the body of literature and knowledge of the phenomenon have begun to accumulate, we still lack a comprehensive and systematic understanding of conceptual foundations, knowledge of how gamification is used in crowdsourcing, and whether it is effective. We first provide a conceptual framework for gamified crowdsourcing systems in order to understand and conceptualize the key aspects of the phenomenon. The paper's main contributions are derived through a systematic literature review that investigates how gamification has been examined in different types of crowdsourcing in a variety of domains. This meticulous mapping, which focuses on all aspects in our framework, enables us to infer what kinds of gamification efforts are effective in different crowdsourcing approaches as well as to point to a number of research gaps and lay out future research directions for gamified crowdsourcing systems. Overall, the results indicate that gamification has been an effective approach for increasing crowdsourcing participation and the quality of the crowdsourced work; however, differences exist between different types of crowdsourcing: the research conducted in the context of crowdsourcing of homogenous tasks has most commonly used simple gamification implementations, such as points and leaderboards, whereas crowdsourcing implementations that seek diverse and creative contributions employ gamification with a richer set of mechanics.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: TUT Game Lab, Pervasive Computing, Robert Bosch GmbH, Karlsruhe Institute of Technology, Institute for Technical Physics, Germany, Gamification Group

Contributors: Morschheuser, B., Hamari, J., Koivisto, J., Maedche, A.

Number of pages: 18

Pages: 26-43

Publication date: 1 Oct 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Human-Computer Studies

Volume: 106

ISSN (Print): 1071-5819

Ratings:

Scopus rating (2017): CiteScore 5.9 SJR 0.605 SNIP 2.146

Original language: English

ASJC Scopus subject areas: Human Factors and Ergonomics, Software, Education, Engineering(all), Human-Computer Interaction, Hardware and Architecture

Keywords: Crowdsourcing, Gamification, Human computation, Literature review, Persuasive technology, Research agenda

DOIs:

10.1016/j.ijhcs.2017.04.005

Source: Scopus

Source ID: 85019568466

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Highly unique network descriptors based on the roots of the permanent polynomial**

In this paper, we examine the zeros of permanent polynomials as highly unique network descriptors. We employ exhaustively generated networks and demonstrate that our defined graph measures based on the moduli of the zeros of permanent polynomials are quite efficient when distinguishing graphs structurally. In this work, we continue with a line of research that relates to the search of almost complete graph invariants. These highly unique network measures may serve as a powerful tool for tackling graph isomorphism.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Computational Medicine and Statistical Learning Laboratory (CMSL), BioMediTech, Research group: Predictive Society and Data Analytics (PSDA), Institute for Bioinformatics and Translational Research, Laboratory of Biosystem Dynamics, BioMediTech Institute and Faculty of Biomedical Sciences and Engineering, Universität der Bundeswehr München, Nankai University, Babes-Bolyai University  
Contributors: Dehmer, M., Emmert-Streib, F., Hu, B., Shi, Y., Stefu, M., Tripathi, S.

Number of pages: 6

Pages: 176-181

Publication date: 1 Oct 2017

Peer-reviewed: Yes

### Publication information

Journal: Information Sciences

Volume: 408

ISSN (Print): 0020-0255

Ratings:

Scopus rating (2017): CiteScore 10 SJR 1.635 SNIP 2.304

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Theoretical Computer Science, Software, Computer Science Applications, Information Systems and Management, Artificial Intelligence

Keywords: Data science, Graphs, Networks, Quantitative graph theory, Statistics

DOIs:

10.1016/j.ins.2017.04.041

Source: Scopus

Source ID: 85018769218

Research output: Contribution to journal > Article > Scientific > peer-review

### Predicting academic success based on learning material usage

In this work, we explore students' usage of online learning material as a predictor of academic success. In the context of an introductory programming course, we recorded the amount of time that each element such as a text paragraph or an image was visible on the students' screen. Then, we applied machine learning methods to study to what extent material usage predicts course outcomes. Our results show that the time spent with each paragraph of the online learning material is a moderate predictor of student success even when corrected for student time-on-task, and that the information can be used to identify at-risk students. The predictive performance of the models is dependent on the quantity of data, and the predictions become more accurate as the course progresses. In a broader context, our results indicate that course material usage can be used to predict academic success, and that such data can be collected in-situ with minimal interference to the students' learning process.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: Software engineering, University of Helsinki

Contributors: Leppänen, L., Leinonen, J., Ihanntola, P., Hellas, A.

Number of pages: 6

Pages: 13-18

Publication date: 27 Sep 2017

### Host publication information

Title of host publication: SIGITE 2017 - Proceedings of the 18th Annual Conference on Information Technology Education

Publisher: ACM

ISBN (Electronic): 9781450351003

ASJC Scopus subject areas: Computational Theory and Mathematics, Artificial Intelligence, Computer Science Applications, Software

Keywords: Academic success prediction, Educational data mining, Element-level web logs, Online learning materials, Web log mining

DOIs:

10.1145/3125659.3125695

Source: Scopus

Source ID: 85037111531

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Architecting liquid software

The Liquid Software metaphor refers to software that can operate seamlessly across multiple devices owned by one or multiple users. Liquid Software applications can take advantage of the computing, storage and communication resources available on all the devices owned by the user. Liquid Software applications can also dynamically migrate from one device to another, following the user's attention and usage context. The key design goal in Liquid Software development is to

minimize the additional efforts arising from multiple device ownership (e.g., installation, synchronization and general maintenance of personal computers, smartphones, tablets, home and car displays, and wearable devices), while keeping the users in full control of their devices, applications and data. In this paper we present the design space for Liquid Software, categorizing and discussing the most important architectural dimensions and technical choices. We also provide an introduction and comparison of two frameworks implementing Liquid Software capabilities in the context of the World Wide Web.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Pervasive Computing, Università della Svizzera Italiana, University of Helsinki, Nokia Technologies Oy

Contributors: Gallidabino, A., Pautasso, C., Mikkonen, T., Systä, K., Voutilainen, J., Taivalaari, A.

Number of pages: 38

Pages: 433-470

Publication date: 1 Sep 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Web Engineering

Volume: 16

Issue number: 5-6

ISSN (Print): 1540-9589

Ratings:

Scopus rating (2017): CiteScore 1.1 SJR 0.157 SNIP 0.455

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Computer Networks and Communications

Keywords: Design space, Liquid software, Multi-device programming, Multiple device ownership, Software architecture

DOIs:

10.26421/JWE16.5-6

#### **Bibliographical note**

EXT="Mikkonen, Tommi"

EXT="Taivalaari, Antero"

Source: Scopus

Source ID: 85020531917

Research output: Contribution to journal > Article > Scientific > peer-review

#### **Comparison of time metrics in programming**

Research on the indicators of student performance in introductory programming courses has traditionally focused on individual metrics and specific behaviors. These metrics include the amount of time and the quantity of steps such as code compilations, the number of completed assignments, and metrics that one cannot acquire from a programming environment. However, the differences in the predictive powers of different metrics and the cross-metric correlations are unclear, and thus there is no generally preferred metric of choice for examining time on task or effort in programming. In this work, we contribute to the stream of research on student time on task indicators through the analysis of a multi-source dataset that contains information about students' use of a programming environment, their use of the learning material as well as self-reported data on the amount of time that the students invested in the course and per-Assignment perceptions on workload, educational value and difficulty. We compare and contrast metrics from the dataset with course performance. Our results indicate that traditionally used metrics from the same data source tend to form clusters that are highly correlated with each other, but correlate poorly with metrics from other data sources. Thus, researchers should utilize multiple data sources to gain a more accurate picture of students' learning.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: Software engineering, University of Helsinki

Contributors: Leinonen, J., Leppänen, L., Ihantola, P., Hellas, A.

Number of pages: 9

Pages: 200-208

Publication date: 14 Aug 2017

#### **Host publication information**

Title of host publication: ICER 2017 - Proceedings of the 2017 ACM Conference on International Computing Education Research

Publisher: ACM

ISBN (Electronic): 9781450349680

ASJC Scopus subject areas: Computational Theory and Mathematics, Computer Science Applications, Software, Education

DOIs:

10.1145/3105726.3106181

Source: Scopus

Source ID: 85030162903

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Hardware design methodology using lightweight dataflow and its integration with low power techniques**

Dataflow models of computation are capable of providing high-level descriptions for hardware and software components and systems, facilitating efficient processes for system-level design. The modularity and parallelism of dataflow representations make them suitable for key aspects of design exploration and optimization, such as efficient scheduling, task synchronization, memory and power management. The lightweight dataflow (LWDF) programming methodology provides an abstract programming model that supports dataflow-based design of signal processing hardware and software components and systems. Due to its formulation in terms of abstract application programming interfaces, the LWDF methodology can be integrated with a wide variety of simulation- and implementation-oriented languages, and can be targeted across different platforms, which allows engineers to integrate dataflow modeling approaches relatively easily into existing design processes. Previous work on LWDF techniques has emphasized their application to DSP software implementation (e.g., through integration with C and CUDA). In this paper, we efficiently integrate the LWDF methodology with hardware description languages (HDLs), and we apply this HDL-integrated form of the methodology to develop efficient methods for low power DSP hardware implementation. The effectiveness of the proposed LWDF-based hardware design methodology is demonstrated through a case study of a deep neural network application for vehicle classification.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Pervasive Computing, Signal Processing, Research group: Vision, Research area: Computer engineering, Dept. of Electrical and Electronic Engineering, University of Maryland, PolComIng - Information Engineering Unit

Contributors: Fanni, T., Li, L., Viitanen, T., Sau, C., Xie, R., Palumbo, F., Raffo, L., Huttunen, H., Takala, J., Bhattacharyya, S. S.

Number of pages: 15

Pages: 15-29

Publication date: 1 Aug 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Systems Architecture

Volume: 78

ISSN (Print): 1383-7621

Ratings:

Scopus rating (2017): CiteScore 3 SJR 0.255 SNIP 1.274

Original language: English

ASJC Scopus subject areas: Software, Hardware and Architecture

Keywords: Clock gating, Dataflow, Deep neural networks, Digital systems design, Globally asynchronous locally synchronous, Low power design, Signal processing

DOIs:

10.1016/j.sysarc.2017.06.003

#### **Bibliographical note**

INT=tie,"Xie, Renjie"

Source: Scopus

Source ID: 85020917888

Research output: Contribution to journal › Article › Scientific › peer-review

### **Multi-robot active information gathering with periodic communication**

A team of robots sharing a common goal can benefit from coordination of the activities of team members, helping the team to reach the goal more reliably or quickly. We address the problem of coordinating the actions of a team of robots with periodic communication capability executing an information gathering task. We cast the problem as a multi-agent optimal decision-making problem with an information theoretic objective function. We show that appropriate techniques for solving decentralized partially observable Markov decision processes (Dec-POMDPs) are applicable in such information gathering problems. We quantify the usefulness of coordinated information gathering through simulation studies, and demonstrate the feasibility of the method in a real-world target tracking domain.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Automation and Hydraulic Engineering, Department of Informatics, Centre for Structural Systems Biology

Contributors: Lauri, M., Heinänen, E., Frintrop, S.

Number of pages: 6

Pages: 851-856

Publication date: 21 Jul 2017

#### Host publication information

Title of host publication: ICRA 2017 - IEEE International Conference on Robotics and Automation

Publisher: IEEE

ISBN (Electronic): 9781509046331

ASJC Scopus subject areas: Control and Systems Engineering, Software, Artificial Intelligence, Electrical and Electronic Engineering

DOIs:

10.1109/ICRA.2017.7989104

#### Bibliographical note

EXT="Lauri, Mikko"

Source: Scopus

Source ID: 85027996313

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Robustifying correspondence based 6D object pose estimation

We propose two methods to robustify point correspondence based 6D object pose estimation. The first method, curvature filtering, is based on the assumption that low curvature regions provide false matches, and removing points in these regions improves robustness. The second method, region pruning, is more general by making no assumptions about local surface properties. Our region pruning segments a model point cloud into cluster regions and searches good region combinations using a validation set. The robustifying methods are general and can be used with any correspondence based method. For the experiments, we evaluated three correspondence selection methods, Geometric Consistency (GC) [1], Hough Grouping (HG) [2] and Search of Inliers (SI) [3] and report systematic improvements for their robustified versions with two distinct datasets.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Mechanical Engineering and Industrial Systems, Research group: Vision, University of Southern Denmark

Contributors: Hietanen, A., Halme, J., Buch, A. G., Latokartano, J., Kamarainen, J.

Number of pages: 7

Pages: 739-745

Publication date: 21 Jul 2017

#### Host publication information

Title of host publication: ICRA 2017 - IEEE International Conference on Robotics and Automation

Publisher: IEEE

ISBN (Electronic): 9781509046331

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Electronic versions:

icra2017\_robust\_pose

DOIs:

10.1109/ICRA.2017.7989091

URLs:

<http://urn.fi/URN:NBN:fi:tty-201907151965>

Source: Scopus

Source ID: 85028009977

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### A convolutional neural network approach for acoustic scene classification

This paper presents a novel application of convolutional neural networks (CNNs) for the task of acoustic scene classification (ASC). We here propose the use of a CNN trained to classify short sequences of audio, represented by their log-mel spectrogram. We also introduce a training method that can be used under particular circumstances in order to make full use of small datasets. The proposed system is tested and evaluated on three different ASC datasets and compared to other state-of-the-art systems which competed in the 'Detection and Classification of Acoustic Scenes and

Events' (DCASE) challenges held in 2016<sup>1</sup> and 2013. The best accuracy scores obtained by our system on the DCASE 2016 datasets are 79.0% (development) and 86.2% (evaluation), which constitute a 6.4% and 9% improvements with respect to the baseline system. Finally, when tested on the DCASE 2013 evaluation dataset, the proposed system manages to reach a 77.0% accuracy, improving by 1% the challenge winner's score.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Research group: Audio research group - ARG, Department of Information Engineering

Contributors: Valenti, M., Squartini, S., Diment, A., Parascandolo, G., Virtanen, T.

Number of pages: 8

Pages: 1547-1554

Publication date: 30 Jun 2017

#### Host publication information

Title of host publication: 2017 International Joint Conference on Neural Networks, IJCNN 2017

Publisher: IEEE

ISBN (Electronic): 9781509061815

ASJC Scopus subject areas: Software, Artificial Intelligence

Electronic versions:

[ijcnn\\_paper\\_valenti\\_extended](#)

DOIs:

[10.1109/IJCNN.2017.7966035](https://doi.org/10.1109/IJCNN.2017.7966035)

URLs:

<http://urn.fi/URN:NBN:fi:tty-201802141222>

#### Bibliographical note

jufoid=58177

Source: Scopus

Source ID: 85031008536

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Analyzing Forty years of software maintenance models

Software maintenance has dramatically evolved in the last four decades, to cope with the continuously changing software development models, and programming languages and adopting increasingly advanced prediction models. In this work, we present the initial results of a Systematic Literature Review (SLR), highlighting the evolution of the metrics and models adopted in the last forty years.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Innopolis University, Former organisation of the author

Contributors: Lenarduzzi, V., Sillitti, A., Taibi, D.

Publication date: 30 Jun 2017

#### Host publication information

Title of host publication: Proceedings - 2017 IEEE/ACM 39th International Conference on Software Engineering Companion, ICSE-C 2017

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7965284

ISBN (Electronic): 9781538615898

ASJC Scopus subject areas: Software, Safety, Risk, Reliability and Quality

Keywords: Software Maintenance, Systematic Literature Review

DOIs:

[10.1109/ICSE-C.2017.122](https://doi.org/10.1109/ICSE-C.2017.122)

Source: Scopus

Source ID: 85026754322

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Class-specific kernel discriminant analysis based on Cholesky decomposition

In this paper we describe a method for nonlinear class-specific discriminant learning that is based on Cholesky Decomposition. We show that the optimization problem solved in Class-Specific Kernel Discriminant Analysis is equivalent to that of Low-Rank Kernel Regression using training data independent target vectors. This connection allows us to devise a new Class-Specific Kernel Discriminant Analysis method that can be trained by exploiting fast linear system approaches, like the Cholesky decomposition. We verify our analysis in publicly available verification problems designed for human



action recognition.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing  
Contributors: Iosifidis, A., Gabbouj, M.  
Number of pages: 6  
Pages: 1141-1146  
Publication date: 30 Jun 2017

#### Host publication information

Title of host publication: 2017 International Joint Conference on Neural Networks, IJCNN 2017  
Publisher: IEEE  
ISBN (Electronic): 9781509061815  
ASJC Scopus subject areas: Software, Artificial Intelligence  
DOIs:  
10.1109/IJCNN.2017.7965980

#### Bibliographical note

jufoid=58177  
Source: Scopus  
Source ID: 85031037603  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### DevOps in regulated software development: Case medical devices

DevOps and continuous development are getting popular in the software industry. Adopting these modern approaches in regulatory environments, such as medical device software, is not straightforward because of the demand for regulatory compliance. While DevOps relies on continuous deployment and integration, regulated environments require strict audits and approvals before releases. Therefore, the use of modern development approaches in regulatory environments is rare, as is the research on the topic. However, as software is more and more predominant in medical devices, modern software development approaches become attractive. This paper discusses the fit of DevOps for regulated medical device software development. We examine two related standards, IEC 62304 and IEC 82304-1, for obstacles and benefits of using DevOps for medical device software development. We found these standards to set obstacles for continuous delivery and integration. Respectively, development tools can help fulfilling the requirements of traceability and documentation of these standards.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Pervasive Computing, University of Central Lancashire, University of Helsinki  
Contributors: Laukkarinen, T., Kuusinen, K., Mikkonen, T.  
Number of pages: 4  
Pages: 15-18  
Publication date: 30 Jun 2017

#### Host publication information

Title of host publication: Proceedings - 2017 IEEE/ACM 39th International Conference on Software Engineering: New Ideas and Emerging Results Track, ICSE-NIER 2017  
Publisher: IEEE  
ISBN (Electronic): 9781538626757  
ASJC Scopus subject areas: Organizational Behavior and Human Resource Management, Software, Management of Technology and Innovation  
Keywords: agile development, DevOps, medical software development standards, Regulated software  
DOIs:  
10.1109/ICSE-NIER.2017.20

#### Bibliographical note

EXT="Kuusinen, Kati"  
Source: Scopus  
Source ID: 85026751442  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Generalized model of biological neural networks: Progressive operational perceptrons

Traditional Artificial Neural Networks (ANNs) such as Multi-Layer Perceptrons (MLPs) and Radial Basis Functions (RBFs) were designed to simulate biological neural networks; however, they are based only loosely on biology and only provide a

crude model. This in turn yields well-known limitations and drawbacks on the performance and robustness. In this paper we shall address them by introducing a novel feed-forward ANN model, Generalized Operational Perceptrons (GOPs) that consist of neurons with distinct (non-)linear operators to achieve a generalized model of the biological neurons and ultimately a superior diversity. We modified the conventional back-propagation (BP) to train GOPs and furthermore, proposed Progressive Operational Perceptrons (POPs) to achieve self-organized and depth-adaptive GOPs according to the learning problem. The most crucial property of the POPs is their ability to simultaneously search for the optimal operator set and train each layer individually. The final POP is, therefore, formed layer by layer and this ability enables POPs with minimal network depth to attack the most challenging learning problems that cannot be learned by conventional ANNs even with a deeper and significantly complex configuration.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Research group: Multimedia Research Group - MRG, Qatar University, Izmir University of Economics

Contributors: Kiranyaz, S., Ince, T., Iosifidis, A., Gabbouj, M.

Number of pages: 9

Pages: 2477-2485

Publication date: 30 Jun 2017

#### **Host publication information**

Title of host publication: 2017 International Joint Conference on Neural Networks, IJCNN 2017

Publisher: IEEE

ISBN (Electronic): 9781509061815

ASJC Scopus subject areas: Software, Artificial Intelligence

DOIs:

10.1109/IJCNN.2017.7966157

#### **Bibliographical note**

jufoid=58177

EXT="Kiranyaz, Serkan"

EXT="Ince, Turker"

Source: Scopus

Source ID: 85031016878

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Running software research programs: An agile approach**

Agile, lean processes have become the de-facto way to operate in the domain of software intensive products.

Methodologies such as the lean startup are reshaping the way new companies and even well-established enterprises seek new opportunities in their operations. In contrast, in research, little has changed during that time - organizations that fund research still expect a solid, linear research plan. In this paper, we present an attempt to challenge this model in software research, based on 7 years of experiences in two large, national, industry-led projects that followed a more agile mindset. Furthermore, we also provide an insight to key learnings and best practices of running software research in agile fashion.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, F-Secure, VTT Technical Research Centre of Finland

Contributors: Järvinen, J., Huomo, T., Mikkonen, T.

Number of pages: 3

Pages: 314-316

Publication date: 30 Jun 2017

#### **Host publication information**

Title of host publication: Proceedings - 2017 IEEE/ACM 39th International Conference on Software Engineering Companion, ICSE-C 2017

Publisher: IEEE

ISBN (Electronic): 9781538615898

ASJC Scopus subject areas: Software, Safety, Risk, Reliability and Quality

Keywords: Agile, Experimentation, Lean, Software research

DOIs:

10.1109/ICSE-C.2017.59

Source: Scopus

Source ID: 85026771688

### **Using and collecting fine-grained usage data to improve online learning materials**

As educators seek to create better learning materials, knowledge about how students actually use the materials is priceless. The advent of online learning materials has allowed tracking of student movement on levels not previously possible with on-paper materials: Server logs can be parsed for details on when students opened certain pages. But such data is extremely coarse and only allows for rudimentary usage analysis. How do students move within the course pages? What do they read in detail and what do they glance over? Traditionally, answering such questions has required complex setups with eye tracking labs. In this paper we investigate how fine-grained data about student movement within an online learning material can be used to improve said material in an informed fashion. Our data is collected by a JavaScript-component that tracks which elements of the online learning material are visible on the student's browser window as they study. The data is collected in situ, and no software needs to be installed on the student's computer. We further investigate how such data can be combined with data from a separate learning environment in which students work on course assignments and if the types of movements made by the students are correlated with student self-regulation metrics or course outcomes. Our results indicate that the use of rather simple and non-invasive tracking of students' movements in course materials allows material creators to quickly see major problem-areas in their materials and to highlight sections that students keep returning to. In addition, when the tracking data is combined with student course assignment data, inferring meaningful assignment-specific areas within the course material becomes possible. Finally, we determine that high-level statistics of user movements are not correlated with course outcomes or certain self-regulation related metrics.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: Software engineering, University of Helsinki

Contributors: Leppänen, L., Leinonen, J., Ihantola, P., Hellas, A.

Number of pages: 9

Pages: 4-12

Publication date: 29 Jun 2017

#### **Host publication information**

Title of host publication: Proceedings - 2017 IEEE/ACM 39th International Conference on Software Engineering: Software Engineering and Education Track, ICSE-SEET 2017

Publisher: IEEE

ISBN (Electronic): 9781538626719

ASJC Scopus subject areas: Computer Science Applications, Software, Education

Keywords: course material usage, e-learning, heat map, learning material evaluation, student behavior, visualization

DOIs:

10.1109/ICSE-SEET.2017.12

Source: Scopus

Source ID: 85026769227

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Children designing videos: Tools, pedagogical models, and best practices for digital storytelling and media-making in the classroom**

Although video sharing is common among youth, schools are only beginning to apply digital videos and digital storytelling to formal learning. This paper presents pedagogical models, examples, best practices, and outcomes that illustrate how teachers and students design and use digital stories in knowledge creation in cross-cultural settings. The results are based on the empirical data and findings from several international pilot studies. On the one hand, working with digital video stories drove engagement. However, on the other hand, technical issues significantly lowered engagement. In addition, the video inquiry pedagogy supported inquiry learning. Students began to pose scientifically oriented questions and seek answers together.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: TUT Game Lab, Pervasive Computing, University of Helsinki, Pepperdine University

Contributors: Multisilta, J., Niemi, H., Hamilton, E.

Number of pages: 4

Pages: 693-696

Publication date: 27 Jun 2017

#### **Host publication information**

Title of host publication: IDC 2017 - Proceedings of the 2017 ACM Conference on Interaction Design and Children

Publisher: ACM

ISBN (Electronic): 9781450349215

ASJC Scopus subject areas: Software, Education, Human-Computer Interaction, Developmental and Educational Psychology

Keywords: Children, Media-making, Pedagogical models, STEM, Storytelling, Video

DOIs:

10.1145/3078072.3091982

Source: Scopus

Source ID: 85026309191

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Barriers for bridging interpersonal gaps: Three inspirational design patterns for increasing collocated social interaction**

Positive face-to-face social encounters between strangers can strengthen the sense of community in modern urban environments. However, it is not always easy to initiate friendly encounters due to various inhibiting social norms. We present three inspirational design patterns for reducing inhibitions to interact with unfamiliar others. These abstractions are based on a broad design space review of concepts, encompassing examples across a range of scales, fields, media and forms. Each inspirational pattern is formulated as a response to a different challenge to initiating social interaction but all share an underlying similarity in offering varieties of barriers and filters that paradoxically also separate people. The patterns are "Closer Through Not Seeing"; "Closer Through Not Touching"; and "Minimize Encounter Duration". We believe these patterns can support designers, in understanding, articulating, and generating approaches to creating embodied interventions and systems that enable unacquainted people to interact.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: User experience, University of Southern Denmark

Contributors: Mitchell, R., Olsson, T.

Number of pages: 9

Pages: 2-10

Publication date: 26 Jun 2017

#### **Host publication information**

Title of host publication: C&T 2017 - 8th International Conference on Communities and Technologies, Conference Proceedings

Publisher: ACM

ISBN (Electronic): 9781450348546

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Collocated interaction, Face-to-face interaction, Social interaction design, pattern languages, embodied interaction

DOIs:

10.1145/3083671.3083697

Source: Scopus

Source ID: 85025125983

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **A k-nearest neighbor multilabel ranking algorithm with application to content-based image retrieval**

Multilabel ranking is an important machine learning task with many applications, such as content-based image retrieval (CBIR). However, when the number of labels is large, traditional algorithms are either infeasible or show poor performance. In this paper, we propose a simple yet effective multilabel ranking algorithm that is based on k-nearest neighbor paradigm. The proposed algorithm ranks labels according to the probabilities of the label association using the neighboring samples around a query sample. Different from traditional approaches, we take only positive samples into consideration and determine the model parameters by directly optimizing ranking loss measures. We evaluated the proposed algorithm using four popular multilabel datasets. The proposed algorithm achieves equivalent or better performance than other instance-based learning algorithms. When applied to a CBIR system with a dataset of 1 million samples and over 190 thousand labels, which is much larger than any other multilabel datasets used earlier, the proposed algorithm clearly outperforms the competing algorithms.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Research group: Multimedia Research Group - MRG, Qatar University

Contributors: Zhang, H., Kiranyaz, S., Gabbouj, M.

Number of pages: 5

Pages: 2587-2591

Publication date: 16 Jun 2017

#### Host publication information

Title of host publication: 2017 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781509041176

ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering

Keywords: Content-Based Image Retrieval, k-Nearest Neighbor, Multilabel Learning

DOIs:

10.1109/ICASSP.2017.7952624

Source: Scopus

Source ID: 85023746875

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### An accumulative fusion architecture for discriminating people and vehicles using acoustic and seismic signals

In this paper, we develop new multiclass classification algorithms for detecting people and vehicles by fusing data from a multimodal, unattended ground sensor node. The specific types of sensors that we apply in this work are acoustic and seismic sensors. We investigate two alternative approaches to multiclass classification in this context - the first is based on applying Dempster-Shafer Theory to perform score-level fusion, and the second involves the accumulation of local similarity evidences derived from a feature-level fusion model that combines both modalities. We experiment with the proposed algorithms using different datasets obtained from acoustic and seismic sensors in various outdoor environments, and evaluate the performance of the two algorithms in terms of receiver operating characteristic and classification accuracy. Our results demonstrate overall superiority of the proposed new feature-level fusion approach for multiclass discrimination among people, vehicles and noise.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, U.S. Army Research Laboratory, Department of Electrical and Computer Engineering, University of Maryland

Contributors: Lee, K., Riggan, B. S., Bhattacharyya, S. S.

Number of pages: 5

Pages: 2976-2980

Publication date: 16 Jun 2017

#### Host publication information

Title of host publication: 2017 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781509041176

ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering

Keywords: multiclass classification, Sensor fusion, target detection, tracking

DOIs:

10.1109/ICASSP.2017.7952702

Source: Scopus

Source ID: 85023750747

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Inband full-duplex radio access system with self-backhauling: Transmit power minimization under QoS requirements

In this paper, a self-backhauling radio access system is studied and analyzed. In particular, we consider a scenario where a full-duplex access node is serving mobile users simultaneously in uplink and downlink, while also maintaining a wireless backhaul connection. The full-duplex capability of the access node, together with large antenna arrays, allows it to do all of this using the same center frequency. The minimum transmit powers for such a system are solved in a closed form under the condition that certain Quality of Service (QoS) requirements, defined in terms of minimum uplink and downlink data rates, are fulfilled. It is demonstrated with numerical results that, by using the derived expressions for the optimal transmit powers, the probability of fulfilling the QoS requirements is greatly increased, while simultaneously the overall transmit power usage of the system is significantly reduced when compared to a benchmark scheme.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electronics and Communications Engineering, Research group: Wireless Communications and Positioning, Aalto University

Contributors: Korpi, D., Riihonen, T., Valkama, M.  
Number of pages: 5  
Pages: 6558-6562  
Publication date: 16 Jun 2017

#### Host publication information

Title of host publication: 2017 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2017 - Proceedings  
Publisher: IEEE  
ISBN (Electronic): 9781509041176  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: Full-duplex, massive MIMO, self-backhauling  
Electronic versions:  
Inband full-duplex radio access system 2017  
DOIs:  
10.1109/ICASSP.2017.7953420  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202002061908>  
Source: Scopus  
Source ID: 85023776611  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Reduced-complexity digital predistortion for massive MIMO

A novel reduced-complexity digital predistortion (DPD) solution is presented in this paper. The proposed DPD can suppress the unwanted distortions due to power amplifier (PA) nonlinearity and I/Q modulator impairments in direct conversion transmitters using reduced-bandwidth filtered basis functions. Moreover, the DPD parameter estimation is based on very simple decorrelation based closed-loop processing and reduced-bandwidth observation, thus further reducing the overall complexity. The proposed DPD can be used in large array or massive MIMO systems with large number of radio transceivers and PAs, where reducing the complexity of the DPD processing is very critical.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Electronics and Communications Engineering, Research group: Wireless Communications and Positioning  
Contributors: Abdelaziz, M., Anttila, L., Valkama, M.  
Number of pages: 5  
Pages: 6478-6482  
Publication date: 16 Jun 2017

#### Host publication information

Title of host publication: 2017 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2017 - Proceedings  
Publisher: IEEE  
ISBN (Electronic): 9781509041176  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: 5G, Digital Predistortion, Direct Conversion Transmitters, I/Q imbalance, Massive MIMO, Power Amplifiers  
Electronic versions:  
Reduced-complexity digital predistortion 2017  
DOIs:  
10.1109/ICASSP.2017.7953404  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202002132040>  
Source: Scopus  
Source ID: 85023738523  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Comparing communication effort within the scrum, scrum with Kanban, XP, and Banana development processes

[Context]: Communication plays an important role in any development process. However, communication overhead has been rarely compared among development processes. [Objective]: The goal of this work is to compare the communication overhead and the different channels applied in three agile processes (XP, Scrum, Scrum with Kanban) and in an unstructured process. [Method]: We designed an empirical study asking four teams to develop the same application with the four development processes, and we compare the communication overhead among them. [Results]: As expected, face-to-face communication is most frequently employed in the teams. Scrum with Kanban turned out to be the process that requires the least communication. Unexpectedly, despite requiring much more time to develop the same application,

the unstructured process required comparable communication overhead (25% of the total development time) as the agile processes.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: University of Oulu, Former organisation of the author  
Contributors: Taibi, D., Lenarduzzi, V., Ahmad, M. O., Liukkunen, K.  
Number of pages: 6  
Pages: 258-263  
Publication date: 15 Jun 2017

#### **Host publication information**

Title of host publication: Proceedings of the 21st International Conference on Evaluation and Assessment in Software Engineering, EASE 2017  
Volume: Part F128635  
Publisher: Association for Computing Machinery  
ISBN (Electronic): 9781450348041  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Agile processes, Case study, Communication, Empirical software engineering  
DOIs:  
10.1145/3084226.3084270  
Source: Scopus  
Source ID: 85025468824  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Operationalizing the experience factory for effort estimation in agile processes**

[Background] The effort required to systematically collect historical data is not always allocable in agile processes and historical data management is usually delegated to the developers' experience, who need to remember previous project details. However, even if well trained, developers cannot precisely remember a huge number of details, resulting in wrong decisions being made during the development process. [Aims] The goal of this paper is to operationalize the Experience Factory in an agile way, i.e., defining a strategy for collecting historical project data using an agile approach. [Method] We provide a mechanism for understanding whether a measure must be collected or not, based on the Return on Invested Time (ROIT). In order to validate this approach, we instantiated the factory with an exploratory case study, comparing four projects that did not use our approach with one project that used it after 12 weeks out of 37 and two projects that used it from the beginning. [Results] The proposed approach helps developers to constantly improve their estimation accuracy with a very positive ROIT of the collected measure. [Conclusions] From this first experience, we can conclude that the Experience Factory can be applied effectively to agile processes, supporting developers in improving their performance and reducing potential decision mistakes.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Fraunhofer IESE, University of Cagliari, Former organisation of the author  
Contributors: Taibi, D., Lenarduzzi, V., Diebold, P., Lunesu, I.  
Number of pages: 10  
Pages: 31-40  
Publication date: 15 Jun 2017

#### **Host publication information**

Title of host publication: Proceedings of the 21st International Conference on Evaluation and Assessment in Software Engineering, EASE 2017  
Volume: Part F128635  
Publisher: Association for Computing Machinery  
ISBN (Electronic): 9781450348041  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Agile software development, Experience factory, Knowledge management  
DOIs:  
10.1145/3084226.3084240  
Source: Scopus  
Source ID: 85025449243  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Microservices in agile software development: A workshop-based study into issues, advantages, and disadvantages**

In the last years, cloud-native architectures have emerged as a target platform for the deployment of microservice architectures. The migration of existing monoliths into cloud-native applications is still in the early phase, and only few companies already started their migrations. Therefore, success and failure stories about different approaches are not available in the literature. This context connects also to the recently discussed DevOps context where development and continuous deployment are closely linked.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Free University of Bolzano-Bozen, Former organisation of the author

Contributors: Taibi, D., Lenarduzzi, V., Pahl, C., Janes, A.

Publication date: 22 May 2017

#### **Host publication information**

Title of host publication: Proceedings of the XP2017 Scientific Workshops, XP 2017

Volume: Part F129907

Publisher: Association for Computing Machinery

Article number: a23

ISBN (Electronic): 9781450352642

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Cloud software, Microservices, SOA, Software architecture

DOIs:

10.1145/3120459.3120483

Source: Scopus

Source ID: 85029863670

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Comparing the Built-In Application Architecture Models in the Web Browser**

Depending on one's viewpoint, a generic standards-compatible web browser supports three, four or five built-in application rendering and programming models. In this paper, we provide an overview of the built-in client-side web application architectures. While the dominance of the base HTML/CSS/JS technologies cannot be ignored, we foresee Web Components and WebGL gaining popularity as the world moves towards more complex and even richer web applications, including systems supporting virtual and augmented reality.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Nokia, University of Helsinki, USI Lugano

Contributors: Taivalsaari, A., Mikkonen, T., Pautasso, C., Systä, K.

Number of pages: 4

Pages: 51-54

Publication date: 16 May 2017

#### **Host publication information**

Title of host publication: 2017 IEEE International Conference on Software Architecture (ICSA)

Publisher: IEEE

Article number: 7930198

ISBN (Electronic): 9781509057290

ASJC Scopus subject areas: Software, Computer Networks and Communications, Hardware and Architecture

Keywords: web application architectures, Web development

DOIs:

10.1109/ICSA.2017.23

#### **Bibliographical note**

EXT="Taivalsaari, Antero"

EXT="Mikkonen, Tommi"

jufoid=69204

Source: Scopus

Source ID: 85021433872

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review



### **Effects of extrinsic noise are promoter kinetics dependent**

Studies in *Escherichia coli* using in vivo single-RNA detection and time-lapse confocal microscopy showed that transcription is a multiple rate-limiting steps process, in agreement with previous in vitro measurements. Here, from simulations of a stochastic model of transcription validated empirically that accounts for cell-to-cell variability in RNA polymerase (RNAP) numbers, we investigate the hypothesis that the cell-to-cell variability in RNA numbers due to RNAP variability differs with the promoter rate-limiting steps dynamics. We find that increasing the cell-to-cell variability in RNAP numbers increases the cell-to-cell diversity in RNA numbers, but the degree with which it increases is promoter kinetics dependent. Namely, promoters whose open complex formation is relatively longer lasting dampen more efficiently this noise propagation phenomenon. We conclude that cell-to-cell variability in RNA numbers due to variability in RNAP numbers is promoter-sequence dependent and, thus, evolvable.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Laboratory of Biosystem Dynamics-LBD

Contributors: Bahrudeen, M. N., Startceva, S., Ribeiro, A. S.

Number of pages: 4

Pages: 44-47

Publication date: 14 May 2017

#### **Host publication information**

Title of host publication: Proceedings of the 2017 9th International Conference on Bioinformatics and Biomedical Technology, ICBBT 2017

Publisher: ACM

ISBN (Electronic): 9781450348799

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Extrinsic noise, Gene expression, Phenotypic diversity, Rate-limiting steps, Stochastic models, Transcription initiation

Electronic versions:

Effects\_of\_extrinsic\_noise\_are\_promoter\_kinetics\_dependent

DOIs:

10.1145/3093293.3093295

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911186013>

Source: Scopus

Source ID: 85025117782

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Preventing keystroke based identification in open data sets**

Large-scale courses such as Massive Online Open Courses (MOOCs) can be a great data source for researchers. Ideally, the data gathered on such courses should be openly available to all researchers. Studies could be easily replicated and novel studies on existing data could be conducted. However, very fine-grained data such as source code snapshots can contain hidden identifiers. For example, distinct typing patterns that identify individuals can be extracted from such data. Hence, simply removing explicit identifiers such as names and student numbers is not sufficient to protect the privacy of the users who have supplied the data. At the same time, removing all keystroke information would decrease the value of the shared data significantly. In this work, we study how keystroke data from a programming context could be modified to prevent keystroke latency based identification whilst still retaining information that can be used to e.g. infer programming experience. We investigate the degree of anonymization required to render identification of students based on their typing patterns unreliable. Then, we study whether the modified keystroke data can still be used to infer the programming experience of the students as a case study of whether the anonymized typing patterns have retained at least some informative value. We show that it is possible to modify data so that keystroke latency based identification is no longer accurate, but the programming experience of the students can still be inferred, i.e. the data still has value to researchers. In a broader context, our results indicate that information and anonymity are not necessarily mutually exclusive.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: Software engineering, University of Helsinki

Contributors: Leinonen, J., Ihantola, P., Hellas, A.

Number of pages: 9

Pages: 101-109

Publication date: 12 Apr 2017

### Host publication information

Title of host publication: L@S 2017 - Proceedings of the 4th (2017) ACM Conference on Learning at Scale

Publisher: ACM

ISBN (Electronic): 9781450344500

ASJC Scopus subject areas: Computer Networks and Communications, Education, Software, Computer Science Applications

Keywords: Data anonymization, Data privacy, Keystroke dynamics, Programming experience inference, Source code snapshots

DOIs:

10.1145/3051457.3051458

Source: Scopus

Source ID: 85018432742

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### On continuous deployment maturity in customer projects

The practice of making new software available to end users as soon as it gets implemented is becoming commonplace.

This paper investigates a set of projects and their development practices in a mid-sized Finnish software company Solita Ltd. to understand how continuous deployment practices are applied in development teams. This was done by establishing a maturity scale and using it to survey the teams. In addition, we interviewed members of selected teams to understand why a particular level of maturity is desirable for a project, and to reveal the issues that impact team's ability to improve. We found that while the team, the customer, and the product all benefit from mature development practices associated with continuous deployment, some obstacles can be solved only by changing the organizational modus operandi.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: Software engineering, Solita Ltd., University of Central Lancashire, University of Helsinki

Contributors: Virtanen, A., Kuusinen, K., Leppänen, M., Luoto, A., Kilamo, T., Mikkonen, T.

Number of pages: 8

Pages: 1205-1212

Publication date: 3 Apr 2017

### Host publication information

Title of host publication: 32nd Annual ACM Symposium on Applied Computing, SAC 2017

Publisher: ACM

ISBN (Electronic): 9781450344869

ASJC Scopus subject areas: Software

Keywords: Agile, Continuous delivery, DevOps, Lean software development, Maturity model, Systems thinking

DOIs:

10.1145/3019612.3019777

### Bibliographical note

EXT="Mikkonen, Tommi"

EXT="Virtanen, Antti"

EXT="Kuusinen, Kati"

Source: Scopus

Source ID: 85020898562

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### User generated soundscapes activating museum visitors

Museums are seeking various ways to attract and engage audience. Activities like virtual museums, mobile audio guides, augmented reality as well as interactive digital stories aim to provide interactive experiences for an audience with familiarity of digital interaction. Our target is to enable visitor's role change from a passive audience to an active participator as content creator. We concentrate on audio augmentation for museum context because audio provides another perspective into the content in question. In this paper, we discuss our experiences of bringing user generated soundscapes as a part of museums' activities by developing a soundscape platform and a number of mobile applications running on it. Most of the functionality is distributed as ease of use and intuitive mobile applications, which have been evaluated in real context in two workshops. The workshops had different user groups and goals. The first one evaluated ease of use and feelings evoked of the young audiences, and the second one ease of use and acceptance of use for other museums than the Museum of Technology, which was our primary design environment. Copyright is held by the owner/author(s).

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Helsinki Metropolia University of Applied Sciences

Contributors: Salo, K., Bauters, M., Mikkonen, T.

Number of pages: 8

Pages: 220-227

Publication date: 3 Apr 2017

### Host publication information

Title of host publication: 32nd Annual ACM Symposium on Applied Computing, SAC 2017

Publisher: ACM

ISBN (Electronic): 9781450344869

ASJC Scopus subject areas: Software

Keywords: Android, Audio Augmented Reality, Engagement, Mobile Sound mixing, Participatory design, Research-based design, Soundscape, User centered design, User generated content

DOIs:

10.1145/3019612.3019691

Source: Scopus

Source ID: 85020887194

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### A Mixed Finite Element Method to Solve the EEG Forward Problem

Finite element methods have been shown to achieve high accuracies in numerically solving the EEG forward problem and they enable the realistic modeling of complex geometries and important conductive features such as anisotropic conductivities. To date, most of the presented approaches rely on the same underlying formulation, the continuous Galerkin (CG)-FEM. In this article, a novel approach to solve the EEG forward problem based on a mixed finite element method (Mixed-FEM) is introduced. To obtain the Mixed-FEM formulation, the electric current is introduced as an additional unknown besides the electric potential. As a consequence of this derivation, the Mixed-FEM is, by construction, current preserving, in contrast to the CG-FEM. Consequently, a higher simulation accuracy can be achieved in certain scenarios, e.g., when the diameter of thin insulating structures, such as the skull, is in the range of the mesh resolution. A theoretical derivation of the Mixed-FEM approach for EEG forward simulations is presented, and the algorithms implemented for solving the resulting equation systems are described. Subsequently, first evaluations in both sphere and realistic head models are presented, and the results are compared to previously introduced CG-FEM approaches. Additional visualizations are shown to illustrate the current preserving property of the Mixed-FEM. Based on these results, it is concluded that the newly presented Mixed-FEM can at least complement and in some scenarios even outperform the established CG-FEM approaches, which motivates a further evaluation of the Mixed-FEM for applications in bioelectromagnetism.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Mathematics, Research group: Inverse Problems, University of Utah, Cluster of Excellence EXC, University of Münster

Contributors: Vorwerk, J., Engwer, C., Pursiainen, S., Wolters, C. H.

Number of pages: 12

Pages: 930-941

Publication date: 1 Apr 2017

Peer-reviewed: Yes

### Publication information

Journal: IEEE Transactions on Medical Imaging

Volume: 36

Issue number: 4

Article number: 7731161

ISSN (Print): 0278-0062

Ratings:

Scopus rating (2017): CiteScore 9.3 SJR 1.895 SNIP 2.904

Original language: English

ASJC Scopus subject areas: Software, Radiological and Ultrasound Technology, Computer Science Applications, Electrical and Electronic Engineering

Keywords: EEG, forward problem, mixed finite element method, realistic head modeling, source analysis

DOIs:

10.1109/TMI.2016.2624634

Source: Scopus

Source ID: 85017598893

Research output: Contribution to journal > Article > Scientific > peer-review

### **Modular audio story platform for museums**

Museums are seeking different ways to attract and engage audiences. Digital stories in various forms have been utilized as one approach to increase audience experience. This paper presents how to bring audio stories as a part of museum's activities by developing a modular audio story platform. Most of the functionality is included in Android applications, which allow visitors to attach stories with emotions to artifacts, share stories with other visitors and enrich existing stories with sounds. All the audio files, linking of the artifacts and related audio files are managed by audio digital asset management system. Our platform supports curated audio stories, but the main emphasis is in the visitors' audio stories. We differentiate from the other digital storytelling systems by attaching emotions onto the visitor stories, and combining the soundscapes and audio stories as visitor modified audio stories. Copyright is held by the owner/author(s).

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Helsinki Metropolia University of Applied Sciences, University of Helsinki

Contributors: Salo, K., Zinin, V., Bauters, M., Mikkonen, T.

Number of pages: 4

Pages: 113-116

Publication date: 7 Mar 2017

#### **Host publication information**

Title of host publication: IUI 2017 - Companion of the 22nd International Conference on Intelligent User Interfaces

Publisher: ACM

ISBN (Electronic): 9781450348935

ASJC Scopus subject areas: Software, Human-Computer Interaction

Keywords: Android, Audio story, Emotions, Mobile Sound mixing, Museum, Soundscape, User generated content

DOIs:

10.1145/3030024.3040975

Source: Scopus

Source ID: 85016642268

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Post-deployment data: A recipe for satisfying knowledge needs in software development?**

In the field of improving software processes, one of the clear trends has been the ever tighter engagement of end users in the software development process. This is demonstrated by the shift from Agile processes to Continuous Deployment, which requires more rapid ways to validate the developed software and its value than is possible with traditional communication mechanisms and methods, such as face to face conversations with customers. While post-deployment data has been used for years as an extra data source - companies like Microsoft and Intuit have moved a few steps further from that already - we believe that there are numerous uncovered ways of taking advantage of post-deployment data in software development. In this paper, we study how automatically collected post-deployment data could be used for responding to knowledge needs of software development teams. The paper builds on data collected from a number of companies operating in Finland using a questionnaire study. The focus of questionnaire study was to approach post-deployment data - especially usage data - as means of getting information to support understanding of customer and end users.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: Software engineering

Contributors: Suonsyrjä, S., Hokkanen, L., Terho, H., Systä, K., Mikkonen, T.

Number of pages: 9

Pages: 139-147

Publication date: 6 Jan 2017

#### **Host publication information**

Title of host publication: 2016 Joint Conference of the International Workshop on Software Measurement and the International Conference on Software Process and Product Measurement (IWSM-MENSURA)

Publisher: IEEE

ISBN (Electronic): 9781509041473

ASJC Scopus subject areas: Software, Information Systems and Management

Keywords: Agile software development, Post-deployment data, Software development, Software usage data

DOIs:

10.1109/IWSM-Mensura.2016.029

Source: Scopus

Source ID: 85011977790

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Stop it, and be stubborn!

This publication discusses how automatic verification of concurrent systems can be made more efficient by focusing on always may-terminating systems. First, making a system always may-terminating is a method for meeting a modelling need that exists independently of this publication. It is illustrated that without doing so, non-progress errors may be lost. Second, state explosion is often alleviated with stubborn, ample, and persistent set methods. They use expensive cycle or terminal strong component conditions in many cases. It is proven that for many important classes of properties, if the systems are always may-terminating, then these conditions can be left out.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Mathematics, Research group: MAT Computer Science and Applied Logics

Contributors: Valmari, A.

Publication date: 1 Jan 2017

Peer-reviewed: Yes

### Publication information

Journal: ACM Transactions on Embedded Computing Systems

Volume: 16

Issue number: 2

Article number: 46

ISSN (Print): 1539-9087

Ratings:

Scopus rating (2017): CiteScore 2.5 SJR 0.32 SNIP 1.093

Original language: English

ASJC Scopus subject areas: Software, Hardware and Architecture

Keywords: Ignoring problem, Safety/progress/liveness properties, Stubborn set/ample set/persistent set/partial order methods

DOIs:

10.1145/3012279

Source: Scopus

Source ID: 85011350059

Research output: Contribution to journal › Article › Scientific › peer-review

### BM3D-HVS: Content-Adaptive denoising for improved visual quality

We introduce a content-Adaptive approach to image denoising where the filter design is based on mean opinion scores (MOSs) from preliminary experiments with volunteers who evaluated the quality of denoised image fragments. This allows to tune the filter parameters so to improve the perceptual quality of the output image, implicitly accounting for the peculiarities of the human visual system (HVS). A modification of the BM3D image denoising filter (Dabov et al., IEEE TIP, 2007), namely BM3DHVS, is proposed based on this framework. We show that it yields a higher visual quality than the conventional BM3D. Further, we have also analyzed the MOSs against popular full-reference visual quality metrics such as SSIM (Wang et al., IEEE TIP, 2004), its extension FSIM (Zhang et al., IEEE TIP, 2011), and the no-reference IL-NIQE (Zhang et al., IEEE TIP, 2015) over each image fragment. Both the Spearman and the Kendall rank order correlation show that these metrics do not correspond well to the human perception. This calls for new visual quality metrics tailored for the benchmarking and optimization of image denoising methods.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing, Kharkiv National Aerospace University, Noiseless Imaging Ltd

Contributors: Egiazarian, K., Danielyan, A., Ponomarenko, N., Foia, A., Ieremeiev, O., Lukin, V.

Number of pages: 8

Pages: 48-55

Publication date: 2017

### Host publication information

Title of host publication: Image Processing: Algorithms and Systems XV

### Publication series

Name: Electronic Imaging

ISSN (Print): 2470-1173

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics

DOIs:

10.2352/ISSN.2470-1173.2017.13.DPMI-083

#### **Bibliographical note**

EXT="Danielyan, Aram"

EXT="Lukin, Vladimir"

jufoid=84313

Source: Scopus

Source ID: 85040604686

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Data Rate Assessment on L2–L3 CPU Bus and Bus between CPU and RAM in Modern CPUs**

In this paper, modern CPU architecture with several different cache levels is described and current CPU performance limitations such as frequency increase bounds are discussed. As changes to the currently existing architecture are usually proposed as a way of increasing CPU performance, data rates of the internal and external CPU interfaces must be known. This information would help to assess the applicability of proposed solutions and to optimize them. This paper is aimed at obtaining real values of traffic on an L2–L3 cache interface inside a CPU and a CPU–RAM bus load, as well as showing the dependences of the total traffic on the studied interfaces on the number of active cores, CPU frequency, and test type. A measurement methodology using an Intel Performance Counter Monitor is provided and the equations used to obtain data rates from the internal CPU counters are explained. Both real-life and synthetic tests are described. The dependence of total traffic on the number of active cores and the dependence of total traffic on CPU frequency are provided as plots. The dependence of total traffic on test type is provided as a bar plot for multiple CPU frequencies.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electronics and Communications Engineering, Yaroslavl State University

Contributors: Komar, M. S.

Number of pages: 8

Pages: 701-708

Publication date: 2017

Peer-reviewed: Yes

#### **Publication information**

Journal: Automatic Control and Computer Sciences

Volume: 51

Issue number: 7

ISSN (Print): 0146-4116

Ratings:

Scopus rating (2017): CiteScore 0.6 SJR 0.218 SNIP 0.613

Original language: English

ASJC Scopus subject areas: Software, Control and Systems Engineering, Signal Processing

Keywords: data rate assessment, multicore CPUs, Network-on-Chip, NoC, System-on-Chip, Wireless Network- on-Chip, WNoC

DOIs:

10.3103/S014641161707029X

#### **Bibliographical note**

INT=elt,"Komar, M. S."

Source: Scopus

Source ID: 85042229432

Research output: Contribution to journal > Article > Scientific > peer-review

#### **From theories to game mechanics: Developing a game for training rational numbers**

The paper reports the results from an ongoing project that aims to develop an engaging and effective digital game for training conceptual rational number knowledge. The overall research approach is design science. In the paper we report the results of an iteration in which we studied how students used a Semideus School game prototype and how they experienced the core mechanics of the game. 20 fourth graders and 32 sixth graders played Semideus School game for approximately 2.5 hours. Students were allowed to freely play the game with their iPads. Playing experience was studied with a digital questionnaire that included items about flow experience (Flow Short Scale), perceived playability, and acceptance of game-based math training. Additionally, a researcher observed the playing sessions and discussed with the

students about the implementation of the game. Students experienced reasonable high flow experience while playing the game. The results revealed that 4th graders would be more willing to study rational numbers with a game and they also appreciated the playability of the game more than sixth graders. Moreover, sixth graders demanded more complex game mechanics, but 4th graders were happy with the core mechanics. We redesigned the game mechanics based on the findings. The paper describes the new mechanics and the theoretical basis of the new design.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Pervasive Computing  
Contributors: Kiili, K.  
Number of pages: 7  
Pages: 328-334  
Publication date: 2017

#### **Host publication information**

Title of host publication: Proceedings of the 11th European Conference on Games Based Learning, ECGBL 2017  
Publisher: Academic Conferences and Publishing International Limited  
ISBN (Electronic): 9781911218562  
ASJC Scopus subject areas: Software, Computer Graphics and Computer-Aided Design, Computer Networks and Communications, Artificial Intelligence, Human-Computer Interaction, Control and Systems Engineering, Education  
Keywords: Game design, Game mechanic, Game-based learning, Mathematics, Playing experience, Rational numbers  
Source: Scopus  
Source ID: 85036471818  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Full-reference metrics multidistortional analysis**

This paper is devoted to analysis and further improvement of full-reference metrics of image visual quality. The effectiveness of a metric is characterized by the rank correlation factors between the obtained array of mean opinion scores (MOS) and the corresponding array of given metric values. This allows to determine the correspondence of a considered metric to a human visual system (HVS). Results obtained on the database TID2013 show that Spearman correlation for the best existing metrics (PSNRHMA, FSIM, SFF, etc.) does not exceed 0.85. In this paper, extended verification tools that allow to detect the shortcomings of the metrics taking into account combined distortions is proposed. An example for further improvement of the PSNRHMA metric is presented.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing, Kharkiv National Aerospace University  
Contributors: Ieremeiev, O., Lukin, V., Ponomarenko, N., Egiazarian, K.  
Number of pages: 9  
Pages: 27-35  
Publication date: 2017

#### **Host publication information**

Title of host publication: Image Processing: Algorithms and Systems XV

#### **Publication series**

Name: Electronic Imaging  
ISSN (Print): 2470-1173  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Science Applications, Human-Computer Interaction, Software, Electrical and Electronic Engineering, Atomic and Molecular Physics, and Optics  
Keywords: Full-reference metrics, Image visual quality assessment, Metrics analysis, Metrics verification, Multiple distortions  
DOIs:  
10.2352/ISSN.2470-1173.2017.13.IPAS-202

#### **Bibliographical note**

jufoid=84313  
EXT="Ponomarenko, Nikolay"  
EXT="Lukin, Vladimir"  
Source: Scopus  
Source ID: 85040625876  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Method for Simulating Dose Reduction in Digital Breast Tomosynthesis

This work proposes a new method of simulating dose reduction in digital breast tomosynthesis (DBT), starting from a clinical image acquired with a standard radiation dose. It considers both signal-dependent quantum and signal-independent electronic noise. Furthermore, the method accounts for pixel crosstalk, which causes the noise to be frequency-dependent, thus increasing the simulation accuracy. For an objective assessment, simulated and real images were compared in terms of noise standard deviation, signal-to-noise ratio (SNR) and normalized noise power spectrum (NNPS). A two-alternative forced-choice (2-AFC) study investigated the similarity between the noise strength of low-dose simulated and real images. Six experienced medical physics specialists participated on the study, with a total of 2,160 readings. Objective assessment showed no relevant trends with the simulated noise. The relative error in the standard deviation of the simulated noise was less than 2%; for every projection angle. The relative error of the SNR was less than 1.5%, and the NNPS of the simulated images had errors less than 2.5%. The 2-AFC human observer experiment yielded no statistically significant difference ( $p=0.84$ ) in the perceived noise strength between simulated and real images. Furthermore, the observer study also allowed the estimation of a dose difference at which the observer perceived a just-noticeable difference (JND) in noise levels. The estimated JND value indicated that a change of 17% in the current-time product was sufficient to cause a noticeable difference in noise levels. The observed high accuracy, along with the flexible calibration, make this method an attractive tool for clinical image-based simulations of dose reduction.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Signal and Image Restoration-RST

Contributors: Borges, L. R., Guerrero, I., Bakic, P. R., Foi, A., Maidment, A. D., Vieira, M. A.

Pages: 2331-2342

Publication date: 2017

Peer-reviewed: Yes

### Publication information

Journal: IEEE Transactions on Medical Imaging

Volume: 36

Issue number: 11

ISSN (Print): 0278-0062

Ratings:

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Original language: English

ASJC Scopus subject areas: Software, Radiological and Ultrasound Technology, Computer Science Applications, Electrical and Electronic Engineering

Keywords: Biomedical imaging, Breast, Calibration, digital breast tomosynthesis, dose reduction, Electronic noise, Estimation, Image reconstruction, quantum noise, Signal to noise ratio, Standards

Electronic versions:

Borges-DBT\_Sim-TMI2017

DOIs:

10.1109/TMI.2017.2715826

URLs:

<http://urn.fi/URN:NBN:fi:tty-201708071662>

Source: Scopus

Source ID: 85023177059

Research output: Contribution to journal > Article > Scientific > peer-review

### Urban 3D segmentation and modelling from street view images and LiDAR point clouds

3D urban maps with semantic labels and metric information are not only essential for the next generation robots such as autonomous vehicles and city drones, but also help to visualize and augment local environment in mobile user applications. The machine vision challenge is to generate accurate urban maps from existing data with minimal manual annotation. In this work, we propose a novel methodology that takes GPS registered LiDAR (Light Detection And Ranging) point clouds and street view images as inputs and creates semantic labels for the 3D points clouds using a hybrid of rule-based parsing and learning-based labelling that combine point cloud and photometric features. The rule-based parsing boosts segmentation of simple and large structures such as street surfaces and building facades that span almost 75% of the point cloud data. For more complex structures, such as cars, trees and pedestrians, we adopt boosted decision trees that exploit both structure (LiDAR) and photometric (street view) features. We provide qualitative examples of our methodology in 3D visualization where we construct parametric graphical models from labelled data and in 2D image segmentation where 3D labels are back projected to the street view images. In quantitative evaluation we report classification accuracy and computing times and compare results to competing methods with three popular databases: NAVTEQ True, Paris-Rue-Madame and TLS (terrestrial laser scanned) Velodyne.



### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Signal Processing, Research group: Vision, Nokia  
Contributors: Babahajani, P., Fan, L., Kämäräinen, J., Gabbouj, M.  
Number of pages: 16  
Pages: 679–694  
Publication date: 2017  
Peer-reviewed: Yes

### Publication information

Journal: Machine Vision and Applications  
Volume: 28  
Issue number: 7  
ISSN (Print): 0932-8092  
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Scopus rating (2017): CiteScore 5.3 SJR 0.485 SNIP 1.683  
Original language: English  
ASJC Scopus subject areas: Software, Hardware and Architecture, Computer Vision and Pattern Recognition, Computer Science Applications  
Keywords: LiDAR, Point cloud, Robotics, Semantic segmentation, Street view, Urban 3D  
Electronic versions:  
Urban 3D segmentation and modelling from street view images and LiDAR point clouds  
DOIs:  
10.1007/s00138-017-0845-3  
URLs:  
<http://urn.fi/URN:NBN:fi:ty-201706121590>

### Bibliographical note

EXT="Babahajani, Pouria"  
Source: Scopus  
Source ID: 85019692066  
Research output: Contribution to journal > Article > Scientific > peer-review

### Improving the delivery cycle: A multiple-case study of the toolchains in Finnish software intensive enterprises

Context: Software companies seek to gain benefit from agile development approaches in order to meet evolving market needs without losing their innovative edge. Agile practices emphasize frequent releases with the help of an automated toolchain from code to delivery. Objective: We investigate, which tools are used in software delivery, what are the reasons omitting certain parts of the toolchain and what implications toolchains have on how rapidly software gets delivered to customers. Method: We present a multiple-case study of the toolchains currently in use in Finnish software-intensive organizations interested in improving their delivery frequency. We conducted qualitative semi-structured interviews in 18 case organizations from various software domains. The interviewees were key representatives of their organization, considering delivery activities. Results: Commodity tools, such as version control and continuous integration, were used in almost every organization. Modestly used tools, such as UI testing and performance testing, were more distinctly missing from some organizations. Uncommon tools, such as artifact repository and acceptance testing, were used only in a minority of the organizations. Tool usage is affected by the state of current workflows, manual work and relevancy of tools. Organizations whose toolchains were more automated and contained fewer manual steps were able to deploy software more rapidly. Conclusions: There is variety in the need for tool support in different development steps as there are domain-specific differences in the goals of the case organizations. Still, a well-founded toolchain supports speedy delivery of new software.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Pervasive Computing, Research area: Software engineering, University of Helsinki, Aalto University  
Contributors: Mäkinen, S., Leppänen, M., Kilamo, T., Mattila, A., Laukkanen, E., Pagels, M., Männistö, T.  
Number of pages: 13  
Pages: 1339–1351  
Publication date: 1 Dec 2016  
Peer-reviewed: Yes

### Publication information

Journal: Information and Software Technology  
Volume: 80

ISSN (Print): 0950-5849

Ratings:

Scopus rating (2016): CiteScore 6.1 SJR 0.801 SNIP 2.568

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Computer Science Applications

Keywords: Agile software development, Continuous delivery, Continuous deployment, Deployment pipeline, Software development tools

DOIs:

10.1016/j.infsof.2016.09.001

Source: Scopus

Source ID: 84988001567

Research output: Contribution to journal › Article › Scientific › peer-review

### Casual immersive viewing with smartphones

In this paper, we explore how to better integrate virtual reality viewing to a smartphone. We present novel designs for casual (short-term) immersive viewing of spatial and 3D content, such as augmented and virtual reality, with smartphones. Our goal is to create a simple and low-cost casual-viewing design which could be retrofitted and eventually be embedded into smartphones, instead of using larger spatial viewing accessories. We explore different designs and implemented several prototypes. One prototype uses thin and light near-to-eye optics with a smartphone display, thus providing the user with the functionality of a large, high-resolution virtual display. Our designs also enable 3D user interfaces. Easy interaction through various gestures and other modalities is possible by using the inertial and other sensors and camera of the smartphone. Our preliminary concepts are a starting point for exploring useful constructions and designs for such usage.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electronics and Communications Engineering, Research group: Personal Electronics Group, University of California, Santa Barbara

Contributors: Rakkolainen, I., Raisamo, R., Turk, M., Höllerer, T., Palovuori, K.

Number of pages: 4

Pages: 449-452

Publication date: 17 Oct 2016

### Host publication information

Title of host publication: AcademicMindtrek 2016 - Proceedings of the 20th International Academic Mindtrek Conference

Publisher: ACM

ISBN (Electronic): 978-1-4503-4367-1

ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Science Applications

Keywords: 3D interaction, Augmented reality, Mobile computing, Near-to-eye display, Virtual reality

DOIs:

10.1145/2994310.2994314

### Bibliographical note

EXT="Rakkolainen, Ismo"

Source: Scopus

Source ID: 84994852921

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Focusing on user experience and business models in startups: Investigation of two-dimensional value creation

While good user experience (UX) can be seen to provide competitive advantage for the company and added value to users, resources for achieving UX may often be lacking in software startups. Furthermore, in different phases of business and product development process, concentrating on the focal things can be challenging. In this study, we investigated the factors affecting UX work in startups as well as UX goals startups set for their products. Furthermore, we reviewed the goals in terms of the Minimum Viable UX framework as well as value creation aspects. We present qualitative results of a survey study with 20 software startups as well as findings of a literature review. Our study suggests that while startups aim to provide products with good usability, the lack of a more comprehensive approach to UX can hinder their value creation; affecting both user satisfaction and business success. As a result, this may affect the successful implementation of startup's business model.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research area: User experience, Department of Pervasive Computing, University of Oulu

Contributors: Hokkanen, L., Xu, Y., Väänänen, K.  
Number of pages: 9  
Pages: 59-67  
Publication date: 17 Oct 2016

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Title of host publication: AcademicMindtrek 2016 - Proceedings of the 20th International Academic Mindtrek Conference  
Publisher: ACM  
ISBN (Electronic): 9781450343671  
ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Science Applications  
Keywords: Business model, Software, Startup, User experience, Value  
DOIs:  
10.1145/2994310.2994371  
Source: Scopus  
Source ID: 84994831715  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Participatory development of user experience design guidelines for a B2B company

As business success is increasingly dependent on an organization's ability to provide a pleasant user experiences (UX) for its products, companies need to find ways to harness every employee to think about UX in their daily work. To support this goal, we present a participatory development process to create user experience design guidelines for a company developing materials-handling equipment for warehouses. The guidelines were developed to steer the work of all R&D designers and developers towards experience-driven design of the products in business-to-business context. The participatory process includes six steps: Spreading awareness of UX within the company, providing information on UX, supporting understanding of UX, co-creation of guidelines, reviewing the outcome, and implementing the guidelines. This paper concentrates on describing the first five phases. The participatory approach is applicable by other organizations to support the change towards experience-driven design. The process and outcome aims to support employees' everyday work aiming for products with pleasant UX.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Pervasive Computing, Research area: User experience, Rocla Oy, Aalto University  
Contributors: Hildén, E., Väättäjä, H., Roto, V., Uusitalo, K.  
Number of pages: 10  
Pages: 49-58  
Publication date: 17 Oct 2016

#### Host publication information

Title of host publication: AcademicMindtrek '16 Proceedings of the 20th International Academic Mindtrek Conference  
Publisher: ACM  
ISBN (Electronic): 978-1-4503-4367-1  
ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Science Applications  
Keywords: B2B, Design, Guideline, Mindset, Organizational change, Participatory Design, User experience  
DOIs:  
10.1145/2994310.2994355

#### Bibliographical note

EXT="Roto, Virpi"  
Source: Scopus  
Source ID: 84994834980  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Software visualization today - Systematic literature review

Software visualization means visualizing various aspects and artifacts related to software. By this definition a wide range of different software engineering aspects from program comprehension to understanding software process and usage are covered. This paper presents the results of systematic literature review spanning six years of software visualization literature. The main result shows that the most studied topics in the past six years are related to software structure, behavior and evolution. Software process and usage are addressed only in few studies. In the future studying the adoption of software visualization tools in industry context would be beneficial.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Pervasive Computing, Research area: Software engineering, Research area: User experience

Contributors: Mattila, A., Ihantola, P., Kilamo, T., Luoto, A., Nurminen, M., Väättäjä, H.  
Number of pages: 10  
Pages: 262-271  
Publication date: 17 Oct 2016

#### Host publication information

Title of host publication: AcademicMindtrek 2016 - Proceedings of the 20th International Academic Mindtrek Conference  
Publisher: ACM  
ISBN (Electronic): 9781450343671  
ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Science Applications  
Keywords: Human-centered computing, Software visualization, Systematic literature review  
DOIs:  
10.1145/2994310.2994327  
Source: Scopus  
Source ID: 84994910745  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Temporal dimensions of affect in user experience of digital news in the field

This paper examines temporal dimensions of affective experiences as part of user experience of digital news reading in field conditions in two case studies. The first study focused on user experience of novel browser optimized versions of news for tablet computers. The second study examined the experience of digital replicas. The participants were active readers of newspapers studied. The daily reporting of affect was done over the usage period of one week. The results of both studies showed that there are differences between positive and negative affect, in their dynamism over time and individual differences they captured. The amount of negative emotions was very low with small individual differences and it reduced over time. In contrast, positive affect indicated slightly positive user experience with larger amount of individual differences. Its main dynamism was expressed at the beginning of study.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Pervasive Computing, Research area: User experience, Eindhoven University of Technology  
Contributors: Jumisko-Pyykkö, S., Pesonen, E., Väättäjä, H.  
Pages: 192-197  
Publication date: 17 Oct 2016

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Title of host publication: AcademicMindtrek 2016 - Proceedings of the 20th International Academic Mindtrek Conference  
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ISBN (Electronic): 9781450343671  
ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Science Applications  
Keywords: Authentication, Browser, Digital news, Digital replica, Emotion, Reading, Tablet, User experience  
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Source: Scopus  
Source ID: 84994817765  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Ensembles of dense and dense sampling descriptors for the HEp-2 cells classification problem

The classification of Human Epithelial (HEp-2) cells images, acquired through Indirect Immunofluorescence (IIF) microscopy, is an effective method to identify staining patterns in patient sera. Indeed it can be used for diagnostic purposes, in order to reveal autoimmune diseases. However, the automated classification of IIF HEp-2 cell patterns represents a challenging task, due to the large intra-class and the small inter-class variability. Consequently, recent HEp-2 cell classification contests have greatly spurred the development of new IIF image classification systems. Here we propose an approach for the automatic classification of IIF HEp-2 cell images by fusion of several texture descriptors by ensemble of support vector machines combined by sum rule. Its effectiveness is evaluated using the HEp-2 cells dataset used for the "Performance Evaluation of Indirect Immunofluorescence Image Analysis Systems" contest, hosted by the International Conference on Pattern Recognition in 2014: the accuracy on the testing set is 79.85%. The same dataset was used to test an ensemble of ternary-encoded local phase quantization descriptors, built by perturbation approaches: the accuracy on the training set is 84.16%. Finally, this ensemble was validated on 14 additional datasets, obtaining the best performance on 11 datasets. Our MATLAB code is available at <https://www.dei.unipd.it/node/2357>.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Computational Biophysics and Imaging Group, BioMediTech, Integrated Technologies for Tissue Engineering Research (ITTE), Università degli Studi di Padova, Italy, University of Bologna

Contributors: Nanni, L., Lumini, A., dos Santos, F. L. C., Paci, M., Hyttinen, J.

Pages: 28-35

Publication date: 15 Oct 2016

Peer-reviewed: Yes

### Publication information

Journal: Pattern Recognition Letters

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ISSN (Print): 0167-8655

Ratings:

Scopus rating (2016): CiteScore 5.2 SJR 0.729 SNIP 1.678

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Bag-of-features, Ensemble, HEP-2 cell classification, Machine learning, Support vector machine, Texture descriptors

Electronic versions:

Ensembles of dense and dense sampling descriptors for the HEP -2 cells classification problem. Embargo ended:

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DOIs:

10.1016/j.patrec.2016.01.026

URLs:

<http://urn.fi/URN:NBN:fi:tty-201611294825>. Embargo ended: 15/10/18

Source: Scopus

Source ID: 84961195136

Research output: Contribution to journal > Article > Scientific > peer-review

### MVP Explained: A Systematic Mapping Study on the Definitions of Minimal Viable Product

Context: One of the most important steps of the Lean Startup methodology is the definition of Minimum Viable Product (MVP), needed to start the learning process by integrating the early adopters' feedbacks as soon as possible. Objective: This study aims at identifying the common definitions of MVP proposed and the key factors identified to help entrepreneurs efficiently define their MVP, reducing errors due to unconsidered unknown factors. Method: We identified the MVP definitions and key factors by means of a systematic mapping study, defining the research questions and the protocol to be used. We selected the bibliographic sources, the keywords, and the selection criteria for searching the relevant papers. Results: We found 97 articles and, through inclusion and exclusion criteria, removed 75 articles, which reduced the total to 22 at the end of the process. The results are a classification schema for characterizing the definition of Minimum Viable Product in Lean Startups and a set of common key factors identified in the MVP definitions. Conclusion: The identified key factors are related to technical characteristics of the product as well as market and customer aspects. We found a positive improvement of the state of the art of MVP and the definition of Minimum.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Free University of Bolzano-Bozen

Contributors: Lenarduzzi, V., Taibi, D.

Number of pages: 8

Pages: 112-119

Publication date: 14 Oct 2016

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Title of host publication: Proceedings - 42nd Euromicro Conference on Software Engineering and Advanced Applications, SEAA 2016

Publisher: IEEE

ISBN (Electronic): 9781509028191

ASJC Scopus subject areas: Computer Science Applications, Software

Keywords: Entrepreneurship, Lean Startup, Minimum Viable Product, Startup

DOIs:

10.1109/SEAA.2016.56

### Bibliographical note

EXT="Lenarduzzi, Valentina"

Source: Scopus

Source ID: 85018685711

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Using elicitation studies to generate collocated interaction methods

Elicitation studies allow collecting interaction methods directly from end-users by presenting the users with the end effect of an operation and then asking them to perform the action that caused it. Applying elicitation studies in the domain of collocated interaction might enable designing more intuitive and natural group interaction methods. However, in the past elicitation studies have primarily been conducted with individual users - they have rarely been applied to groups. In this paper, we report our initial experiences in using the elicitation study methodology to generate interaction methods for groups of collocated users with wearable devices.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: User experience, Nokia, Unit of Human-Centered Technology (IHTE)

Contributors: Jokela, T., Rezaei, P. P., Väänänen, K.

Number of pages: 5

Pages: 1129-1133

Publication date: 6 Sep 2016

#### Host publication information

Title of host publication: Proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct, MobileHCI 2016

Publisher: ACM

ISBN (Electronic): 9781450344135

ASJC Scopus subject areas: Information Systems, Computer Networks and Communications, Human-Computer Interaction, Software

Keywords: Collocated interaction, Elicitation study, Guessability study, Multi-device user interfaces, Wearable devices

Electronic versions:

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10.1145/2957265.2962654

URLs:

<http://urn.fi/URN:NBN:fi:tty-201903291362>

Source: Scopus

Source ID: 84991110295

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Nyström-based approximate kernel subspace learning

In this paper, we describe a method for the determination of a subspace of the feature space in kernel methods, which is suited to large-scale learning problems. Linear model learning in the obtained space corresponds to a nonlinear model learning process in the input space. Since the obtained feature space is determined only by exploiting properties of the training data, this approach can be used for generic nonlinear pattern recognition. That is, nonlinear data mapping can be considered to be a pre-processing step exploiting nonlinear relationships between the training data. Linear techniques can be subsequently applied in the new feature space and, thus, they can model nonlinear properties of the problem at hand. In order to appropriately address the inherent problem of kernel learning methods related to their time and memory complexities, we follow an approximate learning approach. We show that the method can lead to considerable operation speed gains and achieve very good performance. Experimental results verify our analysis.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Video, Research Community on Data-to-Decision (D2D)

Contributors: Iosifidis, A., Gabbouj, M.

Number of pages: 8

Pages: 190-197

Publication date: Sep 2016

Peer-reviewed: Yes

#### Publication information

Journal: Pattern Recognition

ISSN (Print): 0031-3203

Ratings:

Scopus rating (2016): CiteScore 9 SJR 1.501 SNIP 3.005

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Kernel methods, Nonlinear pattern recognition, Nonlinear projection trick, Nyström approximation

DOIs:

10.1016/j.patcog.2016.03.018

Source: Scopus

Source ID: 85013223573

Research output: Contribution to journal > Article > Scientific > peer-review

### **Trading exploits online: A preliminary case study**

A software defect that exposes a software system to a cyber security attack is known as a software vulnerability. A software security exploit is an engineered software solution that successfully exploits the vulnerability. Exploits are used to break into computer systems, but exploits are currently used also for security testing, security analytics, intrusion detection, consultation, and other legitimate and legal purposes. A well-established market emerged in the 2000s for software vulnerabilities. The current market segments populated by small and medium-sized companies exhibit signals that may eventually lead to a similar industrialization of software exploits. To these ends and against these industry trends, this paper observes the first online market place for trading exploits between buyers and sellers. The paper adopts three different perspectives to study the case. The paper (a) portrays the studied exploit market place against the historical background in the software security industry. A qualitative assessment is made to (b) evaluate the case against the common characteristics of traditional online market places. The qualitative observations are used in the quantitative part (c) for predicting the price of exploits with partial least squares regression. The results show that (i) the case is unique from a historical perspective, although (ii) the online market place characteristics are familiar. The regression estimates also indicate that (iii) the pricing of exploits is only partially dependent on such factors as the targeted platform, the date of disclosure of the exploited vulnerability, and the quality assurance service provided by the market place provider. The results allow to contemplate (iv) practical means for enhancing the market place.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University of Turku, Department of Information Technology

Contributors: Ruohonen, J., Hyrynsalmi, S., Leppänen, V.

Publication date: 23 Aug 2016

### **Host publication information**

Title of host publication: IEEE RCIS 2016 - IEEE 10th International Conference on Research Challenges in Information Science

Publisher: IEEE COMPUTER SOCIETY PRESS

ISBN (Electronic): 9781479987092

ASJC Scopus subject areas: Computer Science Applications, Information Systems, Software

Keywords: attack code, cyber security, e-commerce, offensive security, penetration testing, software vulnerability

DOIs:

10.1109/RCIS.2016.7549301

Source: Scopus

Source ID: 84987653537

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **SoftWater: Software-defined networking for next-generation underwater communication systems**

Underwater communication systems have drawn the attention of the research community in the last 15 years. This growing interest can largely be attributed to new civil and military applications enabled by large-scale networks of underwater devices (e.g., underwater static sensors, unmanned autonomous vehicles (AUVs), and autonomous robots), which can retrieve information from the aquatic and marine environment, perform in-network processing on the extracted data, and transmit the collected information to remote locations. Currently underwater communication systems are inherently hardware-based and rely on closed and inflexible architectural design. This imposes significant challenges into adopting new underwater communication and networking technologies, prevent the provision of truly-differentiated services to highly diverse underwater applications, and induce great barriers to integrate heterogeneous underwater devices. Software-defined networking (SDN), recognized as the next-generation networking paradigm, relies on the highly flexible, programmable, and virtualizable network architecture to dramatically improve network resource utilization, simplify network management, reduce operating cost, and promote innovation and evolution. In this paper, a software-defined architecture, namely SoftWater, is first introduced to facilitate the development of the next-generation underwater communication systems. More specifically, by exploiting the network function virtualization (NFV) and network virtualization concepts, SoftWater architecture can easily incorporate new underwater communication solutions, accordingly maximize the network capacity, can achieve the network robustness and energy efficiency, as well as can

provide truly differentiated and scalable networking services. Consequently, the SoftWater architecture can simultaneously support a variety of different underwater applications, and can enable the interoperability of underwater devices from different manufacturers that operate on different underwater communication technologies based on acoustic, optical, or radio waves. Moreover, the essential network management tools of SoftWater are discussed, including reconfigurable multi-controller placement, hybrid in-band and out-of-band control traffic balancing, and utility-optimal network virtualization. Furthermore, the major benefits of SoftWater architecture are demonstrated by introducing software-defined underwater networking solutions, including the throughput-optimal underwater routing, SDN-enhanced fault recovery, and software-defined underwater mobility management. The research challenges to realize the SoftWater are also discussed in detail.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Wireless Communications and Positioning (WICO), Georgia Institute of Technology, School of Electrical and Computer Engineering, Wichita State University

Contributors: Akyildiz, I. F., Wang, P., Lin, S. C.

Publication date: Aug 2016

Peer-reviewed: Yes

### Publication information

Journal: Ad Hoc Networks

Volume: 46

ISSN (Print): 1570-8705

Ratings:

Scopus rating (2016): CiteScore 6.1 SJR 0.648 SNIP 2.045

Original language: English

ASJC Scopus subject areas: Software, Hardware and Architecture, Computer Networks and Communications

Keywords: SDN, Underwater communications, Virtualization

DOIs:

10.1016/j.adhoc.2016.02.016

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<http://www.scopus.com/inward/record.url?scp=84992306085&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84992306085

Research output: Contribution to journal › Article › Scientific › peer-review

### On the Architecture of Liquid Software: Technology Alternatives and Design Space

The liquid metaphor refers to software that operates seamlessly across multiple devices owned by one or multiple users. Liquid software architectures can dynamically deploy and redeploy stateful software components and transparently adapt them to the capabilities of heterogeneous target devices. The key design goal in liquid software development is to minimize the efforts that are related to multiple device ownership (e.g., installation, synchronization and general maintenance of personal computers, smartphones, tablets, home displays, cars and wear-able devices), while keeping the users in full control of their devices, applications and data. In this paper we present a design space for liquid software, categorizing and discussing the most important architectural issues and alternatives. These alternatives represent relevant capabilities offered by emerging technologies and deployment platforms that are then positioned and compared within the design space presented in the paper.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Software engineering, University of Lugano (USI), Nokia Technologies

Contributors: Gallidabino, A., Pautasso, C., Ilvonen, V., Mikkonen, T., Systä, K., Voutilainen, J., Taivalsaari, A.

Number of pages: 6

Pages: 122-127

Publication date: 19 Jul 2016

### Host publication information

Title of host publication: Proceedings - 2016 13th Working IEEE/IFIP Conference on Software Architecture, WICSA 2016

Publisher: IEEE

ISBN (Electronic): 9781509021314

ASJC Scopus subject areas: Hardware and Architecture, Software

Keywords: design space, liquid software, Multi-device programming, multiple device owner-ship, software architecture

DOIs:

10.1109/WICSA.2016.14



### **Bibliographical note**

EXT="Taivalasaari, Antero"

Source: Scopus

Source ID: 84983317329

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Compressive Sensing Image Restoration Using Adaptive Curvelet Thresholding and Nonlocal Sparse Regularization**

Compressive sensing (CS) is a recently emerging technique and an extensively studied problem in signal and image processing, which suggests a new framework for the simultaneous sampling and compression of sparse or compressible signals at a rate significantly below the Nyquist rate. Maybe, designing an effective regularization term reflecting the image sparse prior information plays a critical role in CS image restoration. Recently, both local smoothness and nonlocal self-similarity have led to superior sparsity prior for CS image restoration. In this paper, first, an adaptive curvelet thresholding criterion is developed, trying to adaptively remove the perturbations appeared in recovered images during CS recovery process, imposing sparsity. Furthermore, a new sparsity measure called joint adaptive sparsity regularization (JASR) is established, which enforces both local sparsity and nonlocal 3-D sparsity in transform domain, simultaneously. Then, a novel technique for high-fidelity CS image recovery via JASR is proposed - CS-JASR. To efficiently solve the proposed corresponding optimization problem, we employ the split Bregman iterations. Extensive experimental results are reported to attest the adequacy and effectiveness of the proposed method comparing with the current state-of-the-art methods in CS image restoration.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Babol Noshirvani University of Technology

Contributors: Eslahi, N., Aghagolzadeh, A.

Number of pages: 15

Pages: 3126-3140

Publication date: 1 Jul 2016

Peer-reviewed: Yes

### **Publication information**

Journal: IEEE Transactions on Image Processing

Volume: 25

Issue number: 7

ISSN (Print): 1057-7149

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Original language: English

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Software

Keywords: adaptive curvelet thresholding, Compressive sensing, nonlocal self-similarity, sparse recovery

DOIs:

10.1109/TIP.2016.2562563

Source: Scopus

Source ID: 84973121940

Research output: Contribution to journal > Article > Scientific > peer-review

### **An evaluation framework for cross-platform mobile app development tools: A case analysis of adobe PhoneGap framework**

The 'App economy' is a highly lucrative and competitive market for independent software vendors as it potentially offers an easy highway to reach millions of users. However, the mobile application landscape is scattered and an application developer has to publish the software for several different platforms to be able to serve a majority of smartphone users. Therefore, a bunch of cross-development tools have been offered to simplify this workload. In this paper, we present an evaluation framework for comparing different cross-development tools. We use this framework to evaluate Adobe PhoneGap tool against native development in Android and Windows Phone platforms. The results of a case study reveal that while the cross-platform technique was easy to use, the appearance and usability of the app was mediocre at its best. The business impacts of these are also discussed.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Turun Yliopisto/Turun Biomateriaalikeskus

Contributors: Ahti, V., Hyrynsalmi, S., Nevalainen, O.

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Publication date: 23 Jun 2016

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Publisher: Association for Computing Machinery

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ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Cross-platform development, Hybrid mobile app, Mobile application, Multi-platform

DOIs:

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<http://www.scopus.com/inward/record.url?scp=85001085934&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85001085934

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### A survey on aims and environments of diversification and obfuscation in software security

Diversification and obfuscation methods are promising approaches used to secure software and prevent malware from functioning. Diversification makes each software instance unique so that malware attacks cannot rely on the knowledge of the program's execution environment and/or internal structure anymore. We present a systematic literature review on the state-of-the-art of diversification and obfuscation research aiming to improve software security between 1993 and 2014. As the result of systematic search, in the final phase, 209 related papers were included in this study. In this study we focus on two specific research questions: what are the aims of diversification and obfuscation techniques and what are the environments they are applied to. The former question includes the languages and the execution environments that can benefit from these two techniques, while the second question presents the goals of the techniques and also the type of attacks they mitigate. is held by the owner/author(s). Publication rights licensed to ACM.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Turun Yliopisto/Turun Biomateriaalikeskus

Contributors: Hosseinzadeh, S., Rauti, S., Laurén, S., Mäkelä, J. M., Holvitie, J., Hyrynsalmi, S., Leppänen, V.

Number of pages: 8

Pages: 113-120

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ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Diversification, Obfuscation, Software security, Systematic literature review (SLR)

DOIs:

10.1145/2983468.2983479

URLs:

<http://www.scopus.com/inward/record.url?scp=85000983786&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85000983786

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Emotional Reactions to Point-Light Display Animations

Emotional reactions to basic, artificial, yet carefully controllable point-light displays (PLDs) were investigated with ratings of valence, arousal, approachability and dominance. PLDs were varied by movement location (upper and lower) and intensity (10°, 20° and 30° angular change) for angular upward and downward movements. Half of participants (N =28) were told that PLDs were related to face while to other half nothing was hinted. Results showed that 20° and 30° angle lower location upward movements were rated as significantly more pleasant, relaxing and approachable than corresponding upper location downward movements. Informed participants rated 20° and 30° angle lower movements as significantly more controllable than corresponding upper movements. Results are important from many perspectives, like for understanding human perceptual mechanisms. When using PLDs only a small amount of information needs to be

transmitted. This enables low bandwidth requirements. As PLD visualizations are simple, there is no need for high-definition displays.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Automation Science and Engineering, Nokia

Contributors: Venesvirta, H., Surakka, V., Gizatdinova, Y., Lylykangas, J., Špakov, O., Verho, J., Vetek, A., Lekkala, J.

Number of pages: 11

Pages: 521-531

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Peer-reviewed: Yes

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Journal: Interacting with Computers

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Issue number: 4

ISSN (Print): 0953-5438

Ratings:

Scopus rating (2016): CiteScore 3.5 SJR 0.374 SNIP 1.128

Original language: English

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: biological movement, emotions, face perception, information visualization, point-light displays, psychology  
DOIs:

10.1093/iwc/iwv028

Source: Scopus

Source ID: 84976499522

Research output: Contribution to journal › Article › Scientific › peer-review

#### Exploring the use of deprecated PHP releases in the wild internet: Still a LAMP issue?

Many web sites utilize deprecated software products that are no longer maintained by the associated software producers. This paper explores the question of whether an existing big data collection can be used to predict the likelihood of deprecated PHP releases based on different abstract components in modern web deployment stacks. Building on web intelligence, software security, and data-based industry rationales, the question is examined by focusing on the most popular domains in the contemporary web-facing Internet. Logistic regression is used for classification. Although statistical classification performance is modest, the results indicate that deprecated PHP releases are associated with Linux and other open source software components. Geographical variation is small. Besides these results, the paper contributes to the web intelligence research by evaluating the feasibility of existing big data collections for mass-scale fingerprinting.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University of Turku, Department of Information Technology

Contributors: Ruohonen, J., Hyrynsalmi, S., Leppänen, V.

Publication date: 13 Jun 2016

#### Host publication information

Title of host publication: 6th International Conference on Web Intelligence, Mining and Semantics, WIMS 2016

Publisher: Association for Computing Machinery

Article number: 26

ISBN (Electronic): 9781450340564

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Cyber security, Patching, Release engineering, Web crawling

DOIs:

10.1145/2912845.2912851

Source: Scopus

Source ID: 84978522051

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Fifty years of graph matching, network alignment and network comparison

In this paper we survey methods for performing a comparative graph analysis and explain the history, foundations and differences of such techniques of the last 50 years. While surveying these methods, we introduce a novel classification scheme by distinguishing between methods for deterministic and random graphs. We believe that this scheme is useful for a better understanding of the methods, their challenges and, finally, for applying the methods efficiently in an

interdisciplinary setting of data science to solve a particular problem involving comparative network analysis.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Signal Processing  
Contributors: Emmert-Streib, F., Dehmer, M., Shi, Y.  
Number of pages: 18  
Pages: 180-197  
Publication date: 10 Jun 2016  
Peer-reviewed: Yes

#### Publication information

Journal: Information Sciences  
Volume: 346-347  
ISSN (Print): 0020-0255  
Ratings:  
Scopus rating (2016): CiteScore 8.6 SJR 1.781 SNIP 2.515  
Original language: English  
ASJC Scopus subject areas: Artificial Intelligence, Software, Control and Systems Engineering, Theoretical Computer Science, Computer Science Applications, Information Systems and Management  
Keywords: Biological networks, Computational graph theory, Graph matching, Network comparison, Network similarity, Quantitative graph theory  
DOIs:  
10.1016/j.ins.2016.01.074  
Source: Scopus  
Source ID: 84964349574  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Learning movement synchronization in multi-component robotic systems

Imitation learning of tasks in multi-component robotic systems requires capturing concurrency and synchronization requirements in addition to task structure. Learning time-critical tasks depends furthermore on the ability to model temporal elements in demonstrations. This paper proposes a modeling framework based on Petri nets capable of modeling these aspects in a programming by demonstration context. In the proposed approach, models of tasks are constructed from segmented demonstrations as task Petri nets, which can be executed as discrete controllers for reproduction. We present algorithms that automatically construct models from demonstrations, showing how elements of time-critical tasks can be mapped into task Petri net elements. The approach is validated by an experiment in which a robot plays a musical passage on a keyboard.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Intelligent Hydraulics and Automation, University of Skövde, Aalto University  
Contributors: Thabet, M., Montebelli, A., Kyrki, V.  
Number of pages: 8  
Pages: 249-256  
Publication date: 8 Jun 2016

#### Host publication information

Title of host publication: 2016 IEEE International Conference on Robotics and Automation (ICRA)  
Publisher: IEEE  
ISBN (Print): 9781467380263  
ASJC Scopus subject areas: Software, Artificial Intelligence, Control and Systems Engineering, Electrical and Electronic Engineering  
DOIs:  
10.1109/ICRA.2016.7487141  
Source: Scopus  
Source ID: 84977483663  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Optimizing gaze direction in a visual navigation task

Navigation in an unknown environment consists of multiple separable subtasks, such as collecting information about the surroundings and navigating to the current goal. In the case of pure visual navigation, all these subtasks need to utilize the same vision system, and therefore a way to optimally control the direction of focus is needed. We present a case study, where we model the active sensing problem of directing the gaze of a mobile robot with three machine vision cameras as

a partially observable Markov decision process (POMDP) using a mutual information (MI) based reward function. The key aspect of the solution is that the cameras are dynamically used either in monocular or stereo configuration. The benefits of using the proposed active sensing implementation are demonstrated with simulations and experiments on a real robot.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Automation Science and Engineering, Research area: Dynamic Systems

Contributors: Välimäki, T., Ritala, R.

Number of pages: 6

Pages: 1427-1432

Publication date: 8 Jun 2016

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Title of host publication: 2016 IEEE International Conference on Robotics and Automation (ICRA)

Publisher: IEEE

ISBN (Print): 9781467380263

ASJC Scopus subject areas: Software, Artificial Intelligence, Control and Systems Engineering, Electrical and Electronic Engineering

Electronic versions:

Välimäki, Ritala, (2016), Optimizing gaze direction in a visual navigation task

DOIs:

10.1109/ICRA.2016.7487276

URLs:

<http://urn.fi/URN:NBN:fi:tty-201609304574>

Source: Scopus

Source ID: 84977478616

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### A design framework for mapping vectorized synchronous dataflow graphs onto CPU-GPU platforms

Heterogeneous computing platforms with multicore central processing units (CPUs) and graphics processing units (GPUs) are of increasing interest to designers of embedded signal processing systems since they offer the potential for significant performance boost while maintaining the flexibility of software-based design flows. Developing optimized implementations for CPU-GPU platforms is challenging due to complex, inter-related design issues, including task scheduling, interprocessor communication, memory management, and modeling and exploitation of different forms of parallelism. In this paper, we present an automated, dataflow based, design framework called DIF-GPU for application mapping and software synthesis on heterogeneous CPU-GPU platforms. DIF-GPU is based on novel extensions to the dataflow interchange format (DIF) package, which is a software environment for developing and experimenting with dataflow-based design methods and synthesis techniques for embedded signal processing systems. DIF-GPU exploits multiple forms of parallelism by deeply incorporating efficient vectorization and scheduling techniques for synchronous dataflow specifications, and incorporating techniques for streamlining interprocessor communication. DIF-GPU also provides software synthesis capabilities to help accelerate the process of moving from high-level application models to optimized implementations.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Computer engineering, University of Maryland, Fachhochschule Salzburg, College Park

Contributors: Lin, S., Liu, Y., Plishker, W., Bhattacharyya, S. S.

Number of pages: 10

Pages: 20-29

Publication date: 23 May 2016

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Title of host publication: Proceedings of the 19th International Workshop on Software and Compilers for Embedded Systems, SCOPES 2016

Publisher: ACM

ISBN (Print): 9781450343206

ASJC Scopus subject areas: Hardware and Architecture, Software

Keywords: Dataflow, Design optimization, Heterogeneous computing, Signal processing systems, Software synthesis

DOIs:

10.1145/2906363.2906374

Source: Scopus

Source ID: 84974603317

### **Dynamic software updating techniques in practice and Educator's guides: A review**

Patching a program during its execution without restarting is called dynamic software updating (DSU). DSU is well acknowledged in research, but rarely applied in practice as witnessed by constant need for reboots and restarts of both applications as well as operating systems. This raises the question of how well DSU related techniques are supported in education. In this paper, we review how the major software engineering and education guides acknowledge dynamic software updating techniques. Our analysis indicates that although DSU is not explicitly mentioned in the guides, the need is already well motivated and many DSU concepts are implicitly supported. Based on this, we argue that DSU could be introduced as an optional topic in software engineering studies.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Software engineering

Contributors: Ilvonen, V., Ihantola, P., Mikkonen, T.

Number of pages: 5

Pages: 86-90

Publication date: 19 May 2016

#### **Host publication information**

Title of host publication: 2016 IEEE 29th International Conference on Software Engineering Education and Training (CSEET)

Publisher: IEEE

ISBN (Print): 978-1-5090-0765-3

ASJC Scopus subject areas: Software, Education

Keywords: Dynamic software updating, SEEK, Software engineering body of knowledge, Software engineering education knowledge, SWEBOK

DOIs:

10.1109/CSEET.2016.16

#### **Bibliographical note**

JUF0ID=67349

Source: Scopus

Source ID: 84974628254

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Blind sub-Nyquist GNSS signal detection**

A satellite navigation receiver traditionally searches for positioning signals using an acquisition procedure. In situations, in which the required information is only a binary decision whether at least one positioning signal is present or absent, the procedure represents an unnecessarily complex solution. This paper presents a different approach for the binary detection problem with significantly reduced computational complexity. The approach is based on a novel decision metric which is utilized to design two binary detectors. The first detector operates under the theoretical assumption of additive white Gaussian noise and is evaluated by means of Receiver Operating Characteristics. The second one considers also additional interferences and is suitable to operate in a real environment. Its performance is verified using a signal captured by a receiver front-end.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electronics and Communications Engineering, Department of Mathematics, Research group: MAT Intelligent Information Systems Laboratory, Research group: System-on-Chip for GNSS, Wireless Communications and Cyber-Physical Embedded Computing, Advanced Technology Europe, Nottingham Geospatial Institute, University of Nottingham, Chalmers University of Technology

Contributors: Daniel, O., Raasakka, J., Peltola, P., Fröhle, M., Rivero-Rodriguez, A., Wymeersch, H., Nurmi, J.

Number of pages: 5

Pages: 6575-6579

Publication date: 18 May 2016

#### **Host publication information**

Title of host publication: 2016 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)

Publisher: IEEE

ISBN (Print): 9781479999880

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: Global Navigation Satellite Systems, indoor/outdoor detection, signal detection

DOIs:

10.1109/ICASSP.2016.7472944

#### **Bibliographical note**

EXT="Raasakka, Jussi"

EXT="Peltola, Pekka"

Source: Scopus

Source ID: 84973379949

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **On Rényi's entropy estimation with one-dimensional Gaussian kernels**

Rényi's entropies play a significant role in many signal processing applications. Plug-in kernel density estimation methods have been employed to estimate such entropies with good results. However, they become computationally intractable in higher dimensions, because of the requirement to store intermediate probability density values for a large number of data points. We propose a method to reduce the number of the samples in a plug-in kernel density estimation method for Rényi's entropies of real exponents and to improve the result of the standard plug-in kernel density method. To this end, we derive a univariate estimator, using an Hermite expansion of sums of Gaussian kernels and a hierarchical clustering of the samples. On simulated data from a univariate Gaussian distribution, our method performs better than a k-nearest neighbour algorithm and other kernel density estimation methods.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing

Contributors: Sarbu, S.

Number of pages: 5

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#### **Host publication information**

Title of host publication: 2016 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)

Publisher: IEEE

ISBN (Print): 9781479999880

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: Gaussian kernels, Hermite expansion, hierarchical clustering, Rényi's entropy estimation

DOIs:

10.1109/ICASSP.2016.7472510

Source: Scopus

Source ID: 84973308366

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Supervised subspace learning based on deep randomized networks**

In this paper, we propose a supervised subspace learning method that exploits the rich representation power of deep feedforward networks. In order to derive a fast, yet efficient, learning scheme we employ deep randomized neural networks that have been recently shown to provide good compromise between training speed and performance. For optimally determining the learnt subspace, we formulate a regression problem where we employ target vectors designed to encode both the labeling information available for the training data and geometric properties of the training data, when represented in the feature space determined by the network's last hidden layer outputs. We experimentally show that the proposed approach is able to outperform deep randomized neural networks trained by using the standard network target vectors.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Video

Contributors: Iosifidis, A., Gabbouj, M.

Number of pages: 5

Pages: 2584-2588

Publication date: 18 May 2016

#### **Host publication information**

Title of host publication: 2016 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

ISBN (Print): 9781479999880

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: Deep Neural Networks, Network targets calculation, Supervised Subspace Learning

DOIs:

10.1109/ICASSP.2016.7472144

Source: Scopus

Source ID: 84973351642

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Prototyping real-Time tracking systems on mobile devices**

In this paper, we address the design and implementation of low power embedded systems for real-time tracking of humans and vehicles. Such systems are important in applications such as activity monitoring and border security. We motivate the utility of mobile devices in prototyping the targeted class of tracking systems, and demonstrate a dataflow-based and cross-platform design methodology that enables efficient experimentation with key aspects of our tracking system design, including real-time operation, experimentation with advanced sensors, and streamlined management of design versions on host and mobile platforms. Our experiments demonstrate the utility of our mobile-device-targeted design methodology in validating tracking algorithm operation; evaluating real-time performance, energy efficiency, and accuracy of tracking system execution; and quantifying trade-offs involving use of advanced sensors, which offer improved sensing accuracy at the expense of increased cost and weight. Additionally, through application of a novel, cross-platform, model-based design approach, our design requires no change in source code when migrating from an initial, host-computer-based functional reference to a fully-functional implementation on the targeted mobile device.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Computer engineering, University of Maryland, U.S.

Army Research Laboratory, Technische Universitat Munchen, Department of Electrical and Computer Engineering

Contributors: Lee, K., Salem, H. B., Damarla, T., Stechele, W., Bhattacharyya, S. S.

Number of pages: 8

Pages: 301-308

Publication date: 16 May 2016

#### **Host publication information**

Title of host publication: CF '16 Proceedings of the ACM International Conference on Computing Frontiers

Publisher: ACM

ISBN (Electronic): 9781450341288

ASJC Scopus subject areas: Software

Keywords: Dataflow, low power design, mobile platforms, model-based design, signal processing systems, target tracking

DOIs:

10.1145/2903150.2903471

Source: Scopus

Source ID: 84978481298

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Collaboration change in enterprise software development**

Enterprise software development is a complex effort that may last years. Enterprise software is often developed by a systems integrator that makes modifications to a pre-made package or builds tailored software for the specific purpose. The development may include many developer organizations, the user organization, and their different departments and sub-units. Their collaboration evolves through project incidents, phases and even crises. The practices of project management, communication, contracts, and ultimately personal relationships change intentionally or unintentionally. These changes may cause uncertainties and discontinuities for the development. This study observes changes during enterprise software development and their influence on collaboration practices in different situations. During twenty years of development both internal and external crises and changes in the business environment triggered changes in collaboration. The collaboration practices are classified with four modes of collaboration (contract, cooperation, personified, and process) that illustrate emphasis in collaboration in different circumstances.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Information Management and Logistics, Research group: Novi, Aalto University

Contributors: Smolander, K., Rossi, M., Pekkola, S.

Number of pages: 7

Pages: 68-74

Publication date: 14 May 2016

#### **Host publication information**



Title of host publication: Proceedings - 9th International Workshop on Cooperative and Human Aspects of Software Engineering, CHASE 2016  
Publisher: ACM  
ISBN (Print): 9781450341554  
ASJC Scopus subject areas: Organizational Behavior and Human Resource Management, Social Psychology, Software  
Keywords: Collaboration, Collaboration change, Enterprise software, Project management  
DOIs:  
10.1145/2897586.2897590  
Source: Scopus  
Source ID: 84974527974  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Coordinating proactive social devices in a mobile cloud: Lessons learned and a way forward**

Recent device shipment trends strongly indicate that the number of Web-enabled devices other than PCs and smart phones are growing rapidly. Marking the end of the dominant era of these two traditional device categories, people will soon commonly use various types of Internet-connected devices in their daily lives, where no single device will dominate. Since today's devices are mostly standalone and only stay in sync in limited ways, new approaches are needed for mastering the complexity arising from the world of many types of devices, created by different manufacturers and implementing competing standards. Today, the most common denominator for dealing with the differences is using clouds. Unfortunately, however, while the cloud is well suited for numerous activities, there are also serious limitations, especially when considering systems that consist of numerous, battery-powered computing devices that have limited connectivity. In this paper, we provide an insight to our research where totally cloud-based orchestration of cooperating devices is partitioned into more local actions, where constant communication with the cloud backend can be at least partially omitted.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Pervasive Computing, Research area: Software engineering  
Contributors: Mäkitalo, N., Aaltonen, T., Mikkonen, T.  
Number of pages: 10  
Pages: 179-188  
Publication date: 14 May 2016

#### **Host publication information**

Title of host publication: MOBILESoft '16 Proceedings of the International Conference on Mobile Software Engineering and Systems  
Publisher: ACM  
ISBN (Electronic): 9781450341783  
ASJC Scopus subject areas: Control and Systems Engineering, Software, Computer Science Applications, Signal Processing  
Keywords: Cloud computing, Cyber-physical systems, Internet of things, Mobile cloud, Multi-device ownership, Multi-device programming  
DOIs:  
10.1145/2897073.2897079  
Source: Scopus  
Source ID: 84983554842  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Exploring the role of ten universal values in using products and services**

The aim of this research was to explore the role of Schwartz's ten universal human values in the context of using products and services. Seventy-five participants were asked to qualitatively describe a product or service especially well in line with their values and a product or service in conflict with their values, and to evaluate them on a number of rating scales. The scales included 30 statements (three statements per universal value) probing the presence of each value in user experiences related to products and services and 10 statements studying the perceived importance of each value. The results showed that all the ten universal values were relevant in the evaluations of products and services both in line with the users' values and in conflict with the users' values. In the current sample, hedonism and self-direction were rated as the values most frequently present and most important in the evaluations of products and services in line with values. Power was rated as a moderately important value for products in conflict with values, but significantly less important for products in line with values. Achievement values were frequently reported in the qualitative descriptions, but they were less prominent in the quantitative data. The results suggest that the model of ten universal values is promising in understanding the role of users' value preferences in using products and services, and it seems to have potential for complementing the psychological needs approach in understanding user experience.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Pervasive Computing, Department of Computer Science, Aalto University  
Contributors: Partala, T., Kujala, S.  
Number of pages: 21  
Pages: 311-331  
Publication date: 1 May 2016  
Peer-reviewed: Yes

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Issue number: 3

ISSN (Print): 0953-5438

Ratings:

Scopus rating (2016): CiteScore 3.5 SJR 0.374 SNIP 1.128

Original language: English

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: empirical studies in HCI, HCI design and evaluation methods, user experience, user values, value-sensitive design

DOIs:

10.1093/iwc/iwv007

Source: Scopus

Source ID: 84966359109

Research output: Contribution to journal > Article > Scientific > peer-review

### Learnings from the Finnish game industry

The motivation behind our research was the rapid growth and business wins of world-class Finnish game companies, like Supercell, as well as the success of other game companies in Finland. In particular, Supercell's growth is something that has not been heard of before and this raised the interest to research what game companies have been doing right.

Supercell is not the only Finnish success. Rovio is also well known and has the roots for success from few years before.

There are also other game companies in Finland that have succeeded and this motivated us to investigate what is happening behind the game industry and what could be learned from there that could be applied to other software industry as well. In order to explore and explain the different success factors, we interviewed the following eight Finnish game companies: Rovio Entertainment, Fingersoft, TicBits, Boomlagoon, 10tons, Tribeflame, Star Arcade and Mountain Sheep. In addition, we investigated public sources, like interviews given to newspapers and books written about companies.

These sources cover well Supercell as they have given numerous public interviews to journalists. Similarly, Remedy was analysed based on public sources. Based on the results we recognised some 30 patterns that, depending on the context, could be used in other organisations as well. The patterns include the applicable context where they can be used, driving forces (and counterforces) that should be recognised, the problem they are solving and the solution to the problem coupled with the key enablers. Furthermore, narrative stories based on the interviews and public sources are included.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: Information security, University of Helsinki, Jyväskylän yliopisto

Contributors: Helenius, M., Kettunen, P., Frank, L.

Publication date: 7 Apr 2016

### Host publication information

Title of host publication: Proceedings of the 10th Travelling Conference on Pattern Languages of Programs, VikingPLOP 2016

Publisher: ACM

Article number: a12

ISBN (Electronic): 9781450342001

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

DOIs:

10.1145/3022636.3022648

### Bibliographical note

EXT="Frank, Lauri"

Source: Scopus

Source ID: 85015616047

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Patterns for safety system bus architecture**

Traditionally safety and controls systems have been strictly separated from each other. There are both benefits and liabilities in this approach. Thus, modern system employing control and safety system parts do not necessarily make a strict separation between these two elements of the system. Regardless of the degree of separation, the nodes belonging to either control or safety system may need to communicate with each other to implement the desired functionality. An increasing number of systems nowadays utilize a fieldbus to connect the distributed nodes of the system together. A time comes in the design process, when one needs to select the architecture of the physical fieldbus. That is, how and which nodes are connected? In this paper, two patterns to organize the fieldbus architecture are illustrated. In short, one either can separate the fieldbus between the safety and control system nodes or use a shared fieldbus between the nodes.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research area: Information Systems in Automation, Automation and Hydraulic Engineering

Contributors: Rauhamäki, J.

Publication date: 7 Apr 2016

#### **Host publication information**

Title of host publication: Proceedings of the 10th Travelling Conference on Pattern Languages of Programs, VikingPLoP 2016

Publisher: ACM

Article number: a4

ISBN (Electronic): 9781450342001

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Communication, Control system, Fieldbus, Safety system, Separated, Shared

DOIs:

10.1145/3022636.3022640

Source: Scopus

Source ID: 85015687535

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Patterns for subsidiaries as innovation tools**

In this paper, we describe two patterns for fostering innovative ideas in a company. The patterns originate from experiences in real companies. Innovations are crucial in opening up new business vistas for a company. Old business models for any company will wither as times change and, continuous innovation is needed. However, companies are geared for efficient execution of their current business, not for fostering new ideas. One way for innovation incubation is a subsidiary. A subsidiary typically has more freedom and risk-based incentives than an internal startup. To run a successful subsidiary, one must first decide when to Spin Off, then, how to run the Subsidiary and, finally, Merge and Scale the business, if feasible.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Research area: User experience

Contributors: Leppänen, M., Hokkanen, L.

Publication date: 7 Apr 2016

#### **Host publication information**

Title of host publication: Proceedings of the 10th Travelling Conference on Pattern Languages of Programs, VikingPLoP 2016

Publisher: ACM

Article number: a7

ISBN (Electronic): 9781450342001

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Innovation, Internal startup, Lean, Startups

DOIs:

10.1145/3022636.3022643

Source: Scopus

Source ID: 85015703961

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Texture classification using dense micro-block difference**

This paper is devoted to the problem of texture classification. Motivated by recent advancements in the field of compressive sensing and keypoints descriptors, a set of novel features called dense micro-block difference (DMD) is proposed. These features provide highly descriptive representation of image patches by densely capturing the granularities at multiple scales and orientations. Unlike most of the earlier work on local features, the DMD does not involve any quantization, thus retaining the complete information. We demonstrate that the DMD have dimensionality much lower than Scale Invariant Feature Transform (SIFT) and can be computed using integral image much faster than SIFT. The proposed features are encoded using the Fisher vector method to obtain an image descriptor, which considers high-order statistics. The proposed image representation is combined with the linear support vector machine classifier. Extensive experiments are conducted on five texture data sets (KTH-TIPS, UMD, KTH-TIPS-2a, Brodatz, and Curet) using standard protocols. The results demonstrate that our approach outperforms the state-of-the-art in texture classification.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Computational Imaging-CI

Contributors: Mehta, R., Egiazarian, K.

Number of pages: 13

Pages: 1604-1616

Publication date: 1 Apr 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Transactions on Image Processing

Volume: 25

Issue number: 4

ISSN (Print): 1057-7149

Ratings:

Scopus rating (2016): CiteScore 10.2 SJR 1.749 SNIP 3.397

Original language: English

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Software

Keywords: compressive sensing, descriptors, LBP, Scale Invariant Feature Transform, SVM, Texture classification

DOIs:

10.1109/TIP.2016.2526898

Source: Scopus

Source ID: 84963877958

Research output: Contribution to journal > Article > Scientific > peer-review

### **Detection of bubbles as concentric circular arrangements**

The paper proposes a method for the detection of bubble-like transparent objects in a liquid. The detection problem is non-trivial since bubble appearance varies considerably due to different lighting conditions causing contrast reversal and multiple interreflections. We formulate the problem as the detection of concentric circular arrangements (CCA). The CCAs are recovered in a hypothesize-optimize-verify framework. The hypothesis generation is based on sampling from the partially linked components of the non-maximum suppressed responses of oriented ridge filters, and is followed by the CCA parameter estimation. Parameter optimization is carried out by minimizing a novel cost-function. The performance was tested on gas dispersion images of pulp suspension and oil dispersion images. The mean error of gas/oil volume estimation was used as a performance criterion due to the fact that the main goal of the applications driving the research was the bubble volume estimation. The method achieved 28 and 13 % of gas and oil volume estimation errors correspondingly outperforming the OpenCV Circular Hough Transform in both cases and the WaldBoost detector in gas volume estimation.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Vision, Research Community on Data-to-Decision (D2D), Machine Vision and Pattern Recognition Laboratory, Lappeenranta University of Technology, Computer Vision Group, Czech Technical University in Prague, Monash University Malaysia

Contributors: Strokina, N., Matas, J., Eerola, T., Lensu, L., Kälviäinen, H.

Number of pages: 10

Pages: 387-396

Publication date: Apr 2016

Peer-reviewed: Yes

Early online date: 10 Feb 2016

### Publication information

Journal: Machine Vision and Applications

Volume: 27

Issue number: 3

ISSN (Print): 0932-8092

Ratings:

Scopus rating (2016): CiteScore 4.7 SJR 0.741 SNIP 1.433

Original language: English

ASJC Scopus subject areas: Hardware and Architecture, Computer Vision and Pattern Recognition, Software, Computer Science Applications

Keywords: Bubble detection, Circular arrangements, Image processing, Machine vision, Object segmentation

DOIs:

10.1007/s00138-016-0749-7

Source: Scopus

Source ID: 84957656160

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### An Assessment of Errors and Their Reduction in Terrestrial Laser Scanner Measurements in Marmorean Surfaces

The need for accurate documentation for the preservation of cultural heritage has prompted the use of terrestrial laser scanner (TLS) in this discipline. Its study in the heritage context has been focused on opaque surfaces with lambertian reflectance, while translucent and anisotropic materials remain a major challenge. The use of TLS for the mentioned materials is subject to significant distortion in measure due to the optical properties under the laser stimulation. The distortion makes the measurement by range not suitable for digital modelling in a wide range of cases. The purpose of this paper is to illustrate and discuss the deficiencies and their resulting errors in marmorean surfaces documentation using TLS based on time-of-flight and phase-shift. Also proposed in this paper is the reduction of error in depth measurement by adjustment of the incidence laser beam. The analysis is conducted by controlled experiments.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: School of Architecture

Contributors: Garcia-Fernandez, J.

Number of pages: 11

Pages: 1-11

Publication date: 1 Mar 2016

Peer-reviewed: Yes

### Publication information

Journal: 3D Research

Volume: 7

Issue number: 1

Article number: 2

ISSN (Print): 2092-6731

Ratings:

Scopus rating (2016): CiteScore 1.3 SJR 0.166 SNIP 0.425

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Software

Keywords: Comparison, Experimental, Laser scanning, Marble, Measurement, Translucency

DOIs:

10.1007/s13319-015-0077-0

Source: Scopus

Source ID: 84955495304

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Increasing collocated people's awareness of the mobile user's activities: A field trial of social displays

Many activities that have traditionally been performed with different dedicated physical artifacts are now done with personal mobile devices. Consequently, the privacy of mobile interfaces has hampered social observability and chances for serendipitous interactions. For example, reading an electronic newspaper with a mobile device does not allow the surrounding people to be similarly aware of the reader's activity as traditional newspapers. Social displays are additional displays on mobile devices providing the surrounding people with light-weight cues about the activities of the device user. We implemented a prototype that reveals the user's current active application and presents its name on an e-ink display on the backside of a mobile device. We conducted a ten-day field trial with 13 participants using the prototype. The results show that the prototype was able to increase awareness of users' mobile activities and occasionally triggered interactions with others, without significantly violating the sense of privacy.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Pervasive Computing, Research area: User experience  
Contributors: Jarusriboonchai, P., Malapaschas, A., Olsson, T., Väänänen, K.  
Number of pages: 12  
Pages: 1691-1702  
Publication date: 27 Feb 2016

### Host publication information

Title of host publication: CSCW '16 - Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing  
Publisher: ACM  
ISBN (Print): 9781450335928  
ASJC Scopus subject areas: Software, Computer Networks and Communications, Human-Computer Interaction  
Keywords: Activity awareness, Backside display, Collocated interaction, Face-to-face interaction, Field study, Personal interface, Social display, Social interaction, User trial  
DOIs:  
10.1145/2818048.2819990

### Bibliographical note

Kysytty rt-versiosta 8.9.2020 EJ  
Source: Scopus  
Source ID: 84963542098  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Social display...We can see what you are doing on your mobile device

Mobile devices have become powerful in terms of computing and supporting various human activities. People have moved some of their activities that earlier have been done with dedicated artifacts to mobile devices. However, due to the rather private and personal interfaces of mobile devices, activities that earlier were easily observable by surrounding others have become private, decreasing the surroundings people's awareness of a mobile user's activity and thus the possibilities for serendipitous interactions. We developed a prototype called social display; it provides light-weight visual cues about mobile user's current activity with the device. The cues are displayed on a display attached to the backside of the user's mobile device. We present the concept, explain the design decisions and briefly report key findings from, first, a focus group study and, second, a field trial study.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Pervasive Computing, Research area: User experience  
Contributors: Jarusriboonchai, P., Malapaschas, A., Olsson, T., Väänänen, K.  
Number of pages: 4  
Pages: 53-56  
Publication date: 27 Feb 2016

### Host publication information

Title of host publication: CSCW '16 Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing  
Publisher: ACM  
ISBN (Print): 9781450339506  
ASJC Scopus subject areas: Software, Computer Networks and Communications, Human-Computer Interaction  
Keywords: Activity awareness, Backside display, Collocated interaction, Face-to-face interaction, Field study, Personal interface, Social display, Social interaction, User trial  
Electronic versions:  
Social Display...We Can See What You Are Doing\_CSCW\_2016  
DOIs:  
10.1145/2818052.2874323  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202004033063>  
Source: Scopus  
Source ID: 84963574828  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Lean manufacturing methods in simulation literature: Review and association analysis**

The lean manufacturing philosophy includes several methods that aim to remove waste from production. This paper studies lean manufacturing methods and how simulation is used to consider them. In order to do this, it reviews papers that study simulation together with lean methods. The papers that are reviewed are categorized according to the lean methods used and result types obtained. Analysis is performed in order to gain knowledge about the volumes of occurrence of different methods and result types. Typical methods in the papers are different types of value stream mapping and work-in-process models. An exploratory analysis is performed to reveal the relationships between the methods and result types. This is done using association analysis. It reveals the methods that are commonly studied together in the literature. The paper also lists research areas that are not considered in the literature. These areas are often related to the analysis of variation.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation, Aalto University, Department of Engineering Design and Production

Contributors: Tokola, H., Niemi, E., Väistö, V.

Number of pages: 10

Pages: 2239-2248

Publication date: 16 Feb 2016

#### **Host publication information**

Title of host publication: 2015 Winter Simulation Conference (WSC)

ISBN (Print): 978-1-4673-9743-8

ASJC Scopus subject areas: Software, Modelling and Simulation, Computer Science Applications

DOIs:

10.1109/WSC.2015.7408336

#### **Bibliographical note**

EXT="Niemi, Esko"

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **The influence of developer multi-homing on competition between software ecosystems**

Having a large number of applications in the marketplace is considered a critical success factor for software ecosystems. The number of applications has been claimed to determine which ecosystems holds the greatest competitive advantage and will eventually dominate the market. This paper investigates the influence of developer multi-homing (i.e., participating in more than one ecosystem) in three leading mobile application ecosystems. Our results show that when regarded as a whole, mobile application ecosystems are single-homing markets. The results further show that 3% of all developers generate more than 80% of installed applications and that multi-homing is common among these developers. Finally, we demonstrate that the most installed content actually comprises only a small number of the potential value propositions. The results thus imply that attracting and maintaining developers of superstar applications is more critical for the survival of a mobile application ecosystem than the overall number of developers and applications. Hence, the mobile ecosystem is unlikely to become a monopoly. Since exclusive contracts between application developers and mobile application ecosystems are rare, multi-homing is a viable component of risk management and a publishing strategy. The study advances the theoretical understanding of the influence of multi-homing on competition in software ecosystems.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Information Technology, University of Turku, VTT Technical Research Centre of Finland

Contributors: Hyrynsalmi, S., Suominen, A., Mäntymäki, M.

Number of pages: 9

Pages: 119-127

Publication date: 1 Jan 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Systems and Software

Volume: 111

ISSN (Print): 0164-1212

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Scopus rating (2016): CiteScore 5.3 SJR 0.617 SNIP 2.139

Original language: English

ASJC Scopus subject areas: Hardware and Architecture, Software, Information Systems

Keywords: Multi-homing, Software ecosystem, Two-sided markets

DOIs:

10.1016/j.jss.2015.08.053

Source: Scopus

Source ID: 84949783538

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Analysis of a receiver-based reliable broadcast approach for vehicular networks**

The Intelligent Transportation Systems concept provides the ground to enable a wide range of applications to improve traffic safety and efficiency. Innovative communication systems must be proposed taking into account, on the one hand, unstable characteristics of vehicular communications and, on the other hand, different requirements of applications. In this paper a reliable (geo-)broadcasting scheme for vehicular ad-hoc networks is proposed and analyzed. This receiver-based technique aims at fulfilling the received message integrity yet keeping the overhead at a reasonably low level. The results are compared to simulation studies carried out in the Network Simulator-3 (NS-3) simulation environment demonstrating good agreement with each other. The analysis shows that in a single-hop scenario, receiver-based reliable broadcasting can provide good reliability, while giving very little overhead for high number of receivers.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, University of Twente

Contributors: Gholibeigi, M., Heijenck, G., Moltchanov, D., Koucheryavy, Y.

Number of pages: 13

Pages: 63-75

Publication date: 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Ad Hoc Networks

Volume: 37

ISSN (Print): 1570-8705

Ratings:

Scopus rating (2016): CiteScore 6.1 SJR 0.648 SNIP 2.045

Original language: English

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software

Keywords: (Geo)Broadcast, Performance modeling, Reliability, Vehicular ad hoc networks

DOIs:

10.1016/j.adhoc.2015.08.003

Source: Scopus

Source ID: 84947868264

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Collecting usage data for software development: Selection framework for technological approaches**

Software development methods are shifting towards faster deployments and closer to the end users. Their ever tighter engagement of end-users also requires new technologies for gathering feedback from those users. At the same time, widespread Internet connectivity of different application environments is enabling the collection of this post-deployment data also from sources other than traditional web and mobile software. However, the sheer number of different alternatives of collecting technologies makes the selection a complicated process in itself. In this paper, we describe the process of data-driven software development and study the challenges organizations face when they want to start guiding their development towards it. From these challenges, we extract evaluation criteria for technological approaches to usage data collecting. We list such approaches and evaluate them using the extracted criteria. Using a design science approach, we refine the evaluation criteria to a selection framework that can help practitioners in finding a suitable technological approach for automated collecting of usage data.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Software engineering

Contributors: Suonsyrjä, S., Systä, K., Mikkonen, T., Terho, H.

Number of pages: 6

Pages: 114-119

Publication date: 2016

#### **Host publication information**



Title of host publication: Proceedings - SEKE 2016: 28th International Conference on Software Engineering and Knowledge Engineering

Publisher: Knowledge Systems Institute Graduate School

ISBN (Electronic): 978-1-891706-39-4

ASJC Scopus subject areas: Software

Electronic versions:

paper 186

DOIs:

10.18293/SEKE2016-186

URLs:

<http://urn.fi/URN:NBN:fi:tty-201708091667>

Source: Scopus

Source ID: 84988423396

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Comparison of Feature Selection Techniques in Machine Learning for Anatomical Brain MRI in Dementia**

We present a comparative split-half resampling analysis of various data driven feature selection and classification methods for the whole brain voxel-based classification analysis of anatomical magnetic resonance images. We compared support vector machines (SVMs), with or without filter based feature selection, several embedded feature selection methods and stability selection. While comparisons of the accuracy of various classification methods have been reported previously, the variability of the out-of-training sample classification accuracy and the set of selected features due to independent training and test sets have not been previously addressed in a brain imaging context. We studied two classification problems: 1) Alzheimer's disease (AD) vs. normal control (NC) and 2) mild cognitive impairment (MCI) vs. NC classification. In AD vs. NC classification, the variability in the test accuracy due to the subject sample did not vary between different methods and exceeded the variability due to different classifiers. In MCI vs. NC classification, particularly with a large training set, embedded feature selection methods outperformed SVM-based ones with the difference in the test accuracy exceeding the test accuracy variability due to the subject sample. The filter and embedded methods produced divergent feature patterns for MCI vs. NC classification that suggests the utility of the embedded feature selection for this problem when linked with the good generalization performance. The stability of the feature sets was strongly correlated with the number of features selected, weakly correlated with the stability of classification accuracy, and uncorrelated with the average classification accuracy.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Vision, Department of Bioengineering and Aerospace Engineering, Universidad Carlos III de Madrid, Instituto de Investigación Sanitaria Gregorio Marañón

Contributors: Tohka, J., Moradi, E., Huttunen, H., Alzheimer's Disease Neuroimaging Initiative, Alzheimer's Disease Neuroimaging Initiative 2

Number of pages: 18

Pages: 279-296

Publication date: 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Neuroinformatics

Volume: 14

Issue number: 3

ISSN (Print): 1539-2791

Ratings:

Scopus rating (2016): CiteScore 5.4 SJR 1.358 SNIP 1.047

Original language: English

ASJC Scopus subject areas: Neuroscience(all), Information Systems, Software

Keywords: Alzheimer's Disease, Classification, Feature selection, Machine Learning, Magnetic Resonance Imaging,

Multivariate pattern analysis

DOIs:

10.1007/s12021-015-9292-3

#### **Bibliographical note**

EXT="Tohka, Jussi"

Source: Scopus

Source ID: 84955306208

Research output: Contribution to journal > Article > Scientific > peer-review

### **Dominant Rotated Local Binary Patterns (DRLBP) for texture classification**

In this paper, we present a novel rotation-invariant and computationally efficient texture descriptor called Dominant Rotated Local Binary Pattern (DRLBP). A rotation invariance is achieved by computing the descriptor with respect to a reference in a local neighborhood. A reference is fast to compute maintaining the computational simplicity of the Local Binary Patterns (LBP). The proposed approach not only retains the complete structural information extracted by LBP, but it also captures the complimentary information by utilizing the magnitude information, thereby achieving more discriminative power. For feature selection, we learn a dictionary of the most frequently occurring patterns from the training images, and discard redundant and non-informative features. To evaluate the performance we conduct experiments on three standard texture datasets: Outex12, Outex 10 and KTH-TIPS. The performance is compared with the state-of-the-art rotation invariant texture descriptors and results show that the proposed method is superior to other approaches.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Computational Imaging-CI

Contributors: Mehta, R., Egiazarian, K.

Number of pages: 7

Pages: 16-22

Publication date: 2016

Peer-reviewed: Yes

Early online date: 30 Nov 2015

#### **Publication information**

Journal: Pattern Recognition Letters

Volume: 71

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2016): CiteScore 5.2 SJR 0.729 SNIP 1.678

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Feature Selection, KTH-TIPS, Local Binary Pattern (LBP), Outex, Rotation Invariance, Texture Classification

DOIs:

10.1016/j.patrec.2015.11.019

Source: Scopus

Source ID: 84951106920

Research output: Contribution to journal > Article > Scientific > peer-review

### **Foveated Nonlocal Self-Similarity**

When we gaze a scene, our visual acuity is maximal at the fixation point (imaged by the fovea, the central part of the retina) and decreases rapidly towards the periphery of the visual field. This phenomenon is known as foveation. We investigate the role of foveation in nonlocal image filtering, installing a different form of self-similarity: the foveated self-similarity. We consider the image denoising problem as a simple means of assessing the effectiveness of descriptive models for natural images and we show that, in nonlocal image filtering, the foveated self-similarity is far more effective than the conventional windowed self-similarity. To facilitate the use of foveation in nonlocal imaging algorithms, we develop a general framework for designing foveation operators for patches by means of spatially variant blur. Within this framework, we construct several parametrized families of operators, including anisotropic ones. Strikingly, the foveation operators enabling the best denoising performance are the radial ones, in complete agreement with the orientation preference of the human visual system.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research area: Signal and Information Processing, Research group:

Signal and Image Restoration-RST, Dipartimento di Elettronica, Politecnico di Milano

Contributors: Foi, A., Boracchi, G.

Number of pages: 33

Pages: 78-110

Publication date: 2016

Peer-reviewed: Yes

Early online date: 9 Mar 2016

#### **Publication information**

Journal: International Journal of Computer Vision

Volume: 120  
Issue number: 1  
ISSN (Print): 0920-5691  
Ratings:

Scopus rating (2016): CiteScore 17.4 SJR 6.779 SNIP 5.171

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition

Electronic versions:

Foveated Nonlocal Self-Similarity. Embargo ended: 9/03/17

DOIs:

10.1007/s11263-016-0898-1

URLs:

<http://urn.fi/URN:NBN:fi:tty-201605274192>. Embargo ended: 9/03/17

### **Bibliographical note**

EXT="Boracchi, Giacomo"

Source: Scopus

Source ID: 84960153979

Research output: Contribution to journal > Article > Scientific > peer-review

### **Graph Embedded Extreme Learning Machine**

In this paper, we propose a novel extension of the extreme learning machine (ELM) algorithm for single-hidden layer feedforward neural network training that is able to incorporate subspace learning (SL) criteria on the optimization process followed for the calculation of the network's output weights. The proposed graph embedded ELM (GEELM) algorithm is able to naturally exploit both intrinsic and penalty SL criteria that have been (or will be) designed under the graph embedding framework. In addition, we extend the proposed GEELM algorithm in order to be able to exploit SL criteria in arbitrary (even infinite) dimensional ELM spaces. We evaluate the proposed approach on eight standard classification problems and nine publicly available datasets designed for three problems related to human behavior analysis, i.e., the recognition of human face, facial expression, and activity. Experimental results denote the effectiveness of the proposed approach, since it outperforms other ELM-based classification schemes in all the cases.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Pages: 311 - 324

Publication date: 2016

Peer-reviewed: Yes

### **Publication information**

Journal: IEEE Transactions on Cybernetics

Volume: 46

Issue number: 1

ISSN (Print): 2168-2267

Ratings:

Scopus rating (2016): CiteScore 12 SJR 2.927 SNIP 3.301

Original language: English

ASJC Scopus subject areas: Computer Science Applications, Human-Computer Interaction, Information Systems, Software, Control and Systems Engineering, Electrical and Electronic Engineering

DOIs:

10.1109/TCYB.2015.2401973

Research output: Contribution to journal > Article > Scientific > peer-review

### **Gravity gradient routing for information delivery in fog Wireless Sensor Networks**

Fog Computing is a new paradigm that has been proposed by CISCO to take full advantage of the ever growing computational capacity of the near-user or edge devices (e.g., wireless gateways and sensors). The paradigm proposes an architecture that enables the devices to host functionality of various user-centric services. While the prospects of Fog Computing promise numerous advantages, development of Fog Services remains under-investigated. This article considers an opportunity of Fog implementation for Alert Services on top of Wireless Sensor Network (WSN) technology. In particular, we focus on targeted WSN-alert delivery based on spontaneous interaction between a WSN and hand-held devices of its users. For the alert delivery, we propose a Gravity Routing concept that prioritizes the areas of high user-presence within the network. Based on the concept, we develop a routing protocol, namely the Gradient Gravity Routing (GGR) that combines targeted delivery and resilience to potential sensor-load heterogeneity within the network. The

protocol has been compared against a set of state-of-the-art solutions via a series of simulations. The evaluation has shown the ability of GGR to match the performance of the compared solutions in terms of alert delivery ratio, while minimizing the overall energy consumption of the network.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno

Contributors: Ivanov, S., Balasubramaniam, S., Botvich, D., Akan, O. B.

Pages: 61-74

Publication date: 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Ad Hoc Networks

Volume: 46

ISSN (Print): 1570-8705

Ratings:

Scopus rating (2016): CiteScore 6.1 SJR 0.648 SNIP 2.045

Original language: English

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software

Keywords: Fog Computing, User-awareness, Wireless sensor networks

DOIs:

10.1016/j.adhoc.2016.03.011

Source: Scopus

Source ID: 84964329276

Research output: Contribution to journal › Article › Scientific › peer-review

#### **HTML5-based mobile agents for Web-of-Things**

Systems and services utilizing Internet-of-Things can benefit from dynamically updated software in a significant way. In this paper we show how the most advanced variant of moving code, mobile agents, can be used for operating and managing Internet-connected systems composed of gadgets, sensors and actuators. We believe that the use of mobile agents brings several benefits, for example, mobile agents help to reduce the network load, overcome network latency, and encapsulate protocols. In addition, they can perform autonomous tasks that would otherwise require extensive configuration. The need for moving agents is even more significant if the applications and other factors of the over experience should follow the user to new contexts. When multiple agents are used to provide the user with services, some mechanisms to manage the agents are needed. In the context of Internet-of-Things such management should reflect the physical spaces and other relevant contexts. In this paper we describe the technical solutions used in implementation of the mobile agents, describe two proof concepts and we also compare our solution to related work. We also describe our visions of the future work.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Pervasive Computing, Research area: Software engineering

Contributors: Voutilainen, J. P., Mattila, A. L., Systä, K., Mikkonen, T.

Number of pages: 9

Pages: 43-51

Publication date: 2016

Peer-reviewed: Yes

#### **Publication information**

Journal: Informatica

Volume: 40

Issue number: 1

ISSN (Print): 0350-5596

Ratings:

Scopus rating (2016): CiteScore 1.2 SJR 0.136 SNIP 0.461

Original language: English

ASJC Scopus subject areas: Computer Science Applications, Software, Artificial Intelligence, Theoretical Computer Science

Keywords: Html5, Internet-of-things, Javascript, Mobile agents, Web applications, Web-of-things

Electronic versions:

HTML5-based mobile agents for Web-of-Things

URLs:

<http://urn.fi/URN:NBN:fi:tty-201605033936>

Source: Scopus

Source ID: 84963719558

Research output: Contribution to journal › Article › Scientific › peer-review

### **Methodology to obtain the security controls in multi-cloud applications**

What controls should be used to ensure adequate security level during operation is a non-trivial subject in complex software systems and applications. The problem becomes even more challenging when the application uses multiple cloud services which security measures are beyond the control of the application provider. In this paper, a methodology that enables the identification of the best security controls for multicloud applications whose components are deployed in heterogeneous clouds is presented. The methodology is based on application decomposition and modelling of threats over the components, followed by the analysis of the risks together with the capture of cloud business and security requirements. The methodology has been applied in the MUSA EU H2020 project use cases as the first step for building up the multi-cloud applications' security-aware Service Level Agreements (SLA). The identified security controls will be included in the applications' SLAs for their monitoring and fulfilment assurance at operation.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Automation Science and Engineering, Research group: Factory automation systems technology, Faculty of Engineering Sciences, Factory Automation Systems and Technologies Lab (FAST-Lab), Second University of Naples, ENEA/CREATE/Università Degli Studi Napoli Federico II, TECNALIA. ICT-European Software Institute. Parque Tecnológico de Bizkaia

Contributors: Afolaranmi, S. O., Gonzalez Moctezuma, L. E., Rak, M., Casola, V., Rios, E., Martinez Lastra, J. L.

Number of pages: 6

Pages: 327-332

Publication date: 2016

### **Host publication information**

Title of host publication: CLOSER 2016 - Proceedings of the 6th International Conference on Cloud Computing and Services Science

Volume: 1

Publisher: SCITEPRESS

ISBN (Electronic): 9789897581823

ASJC Scopus subject areas: Computer Science (miscellaneous), Computer Science Applications, Software

Keywords: Cyber-security Methodologies, Multi-cloud, Security-by-design, Threat Modelling

DOIs:

10.5220/0005912603270332

URLs:

<http://www.scopus.com/inward/record.url?scp=84979747685&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84979747685

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **One-Class Classification based on Extreme Learning and Geometric Class Information**

In this paper, we propose an extreme learning machine (ELM)-based one-class classification method that exploits geometric class information. We formulate the proposed method to exploit data representations in the feature space determined by the network hidden layer outputs, as well as in ELM spaces of arbitrary dimensions. We show that the exploitation of geometric class information enhances performance. We evaluate the proposed approach in publicly available datasets and compare its performance with the recently proposed one-class extreme learning machine algorithm, as well as with standard and recently proposed one-class classifiers. Experimental results show that the proposed method consistently outperforms the remaining approaches.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Aristotle University of Thessaloniki, Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Mygdalis, V., Tefas, A., Pitas, I.

Number of pages: 16

Pages: 1-16

Publication date: 2016

Peer-reviewed: Yes

### Publication information

Journal: Neural Processing Letters

ISSN (Print): 1370-4621

Ratings:

Scopus rating (2016): CiteScore 2.6 SJR 0.399 SNIP 0.777

Original language: English

ASJC Scopus subject areas: Software, Neuroscience(all), Computer Networks and Communications, Artificial Intelligence

Keywords: Big data, Extreme learning machine, Novelty detection, One-class classification

DOIs:

10.1007/s11063-016-9541-y

### Bibliographical note

EXT="Tefas, Anastasios"

Source: Scopus

Source ID: 84982810055

Research output: Contribution to journal › Article › Scientific › peer-review

### On the arity gap of finite functions: Results and applications

Let  $A$  be a finite set and  $B$  an arbitrary set with at least two elements. The arity gap of a function  $f: A^n \rightarrow B$  is the minimum decrease in the number of essential variables when essential variables of  $f$  are identified. A non-trivial fact is that the arity gap of such  $B$ -valued functions on  $A$  is at most  $|A|$ . Even less trivial to verify is the fact that the arity gap of  $B$ -valued functions on  $A$  with more than  $|A|$  essential variables is at most 2. These facts ask for a classification of  $B$ -valued functions on  $A$  in terms of their arity gap. In this paper, we survey what is known about this problem. We present a general characterization of the arity gap of  $B$ -valued functions on  $A$  and provide explicit classifications of the arity gap of Boolean and pseudo-Boolean functions. Moreover, we reveal unsettled questions related to this topic, and discuss links and possible applications of some results to other subjects of research.

### General information

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Department of Mathematics, Université de Lorraine, Department of Combinatorics and Optimization, University of Waterloo, Computer Science and Communications Research Unit, University of Luxembourg

Contributors: Couceiro, M., Lehtonen, E.

Number of pages: 15

Pages: 193-207

Publication date: 2016

Peer-reviewed: Yes

### Publication information

Journal: Journal of Multiple-Valued Logic and Soft Computing

Volume: 27

Issue number: 2-3

ISSN (Print): 1542-3980

Ratings:

Scopus rating (2016): CiteScore 0.9 SJR 0.26 SNIP 0.571

Original language: English

ASJC Scopus subject areas: Software, Logic, Theoretical Computer Science

URLs:

<http://www.scopus.com/inward/record.url?scp=84979953947&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84979953947

Research output: Contribution to journal › Review Article › Scientific › peer-review

### Software Startups - A Research Agenda

Software startup companies develop innovative, software-intensive products within limited time frames and with few resources, searching for sustainable and scalable business models. Software startups are quite distinct from traditional mature software companies, but also from micro-, small-, and medium-sized enterprises, introducing new challenges relevant for software engineering research. This paper's research agenda focuses on software engineering in startups, identifying, in particular, 70+ research questions in the areas of supporting startup engineering activities, startup evolution models and patterns, ecosystems and innovation hubs, human aspects in software startups, applying startup concepts in non-startup environments, and methodologies and theories for startup research. We connect and motivate this research agenda with past studies in software startup research, while pointing out possible future directions. While all authors of this research agenda have their main background in Software Engineering or Computer Science, their interest in software startups broadens the perspective to the challenges, but also to the opportunities that emerge from multi-disciplinary research. Our audience is therefore primarily software engineering researchers, even though we aim at stimulating

collaborations and research that crosses disciplinary boundaries. We believe that with this research agenda we cover a wide spectrum of the software startup industry current needs.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Pervasive Computing, Research area: User experience, Blekinge Institute of Technology, Norwegian Univ. of Sci. and Technol., Free University of Bolzano-Bozen, SICS, Lake Constance University, Natl.

University of Ireland, Galway, Universidad Politecnica de Madrid, Department of Applied Physics, University of Cagliari, National University of Ireland Maynooth, Univ of Oulu, Hochschule Konstanz

Contributors: Unterkalmsteiner, M., Abrahamsson, P., Wang, X. F., Nguyen-Duc, A., Shah, S., Bajwa, S. S., Baltes, G. H., Conboy, K., Cullina, E., Dennehy, D., Edison, H., Fernandez-Sanchez, C., Garbajosa, J., Gorschek, T., Klotins, E., Hokkanen, L., Kon, F., Lunesu, I., Marchesi, M., Morgan, L., Oivo, M., Selig, C., Seppänen, P., Sweetman, R., Tyrväinen, P., Ungerer, C., Yagüe, A.

Number of pages: 35

Pages: 89-123

Publication date: 2016

Peer-reviewed: Yes

### Publication information

Journal: e-Informatica Software Engineering Journal

Volume: 10

Issue number: 1

ISSN (Print): 1897-7979

Ratings:

Scopus rating (2016): CiteScore 1.3 SJR 0.136 SNIP 0.743

Original language: English

ASJC Scopus subject areas: Software

Keywords: Research agenda, Software startup, Software-intensive systems

DOIs:

10.5277/e-Inf160105

URLs:

<http://urn.fi/URN:NBN:fi:jyu-201610254445>

### Bibliographical note

EXT="Shah, Syed"

Source: Scopus

Source ID: 84994056890

Research output: Contribution to journal › Article › Scientific › peer-review

### Still image/video frame lossy compression providing a desired visual quality

The problem of how to automatically provide a desired (required) visual quality in lossy compression of still images and video frames is considered in this paper. The quality can be measured based on different conventional and visual quality metrics. In this paper, we mainly employ human visual system (HVS) based metrics PSNR-HVS-M and MSSIM since both of them take into account several important peculiarities of HVS. To provide a desired visual quality with high accuracy, iterative image compression procedures are proposed and analyzed. An experimental study is performed for a large number of grayscale test images. We demonstrate that there exist several coders for which the number of iterations can be essentially decreased using a reasonable selection of the starting value and the variation interval for the parameter controlling compression (PCC). PCC values attained at the end of the iterative procedure may heavily depend upon the coder used and the complexity of the image. Similarly, the compression ratio also considerably depends on the above factors. We show that for some modern coders that take HVS into consideration it is possible to give practical recommendations on setting a fixed PCC to provide a desired visual quality in a non-iterative manner. The case when original images are corrupted by visible noise is also briefly studied.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Computational Imaging-CI, National Aerospace University

Contributors: Zemliachenko, A., Lukin, V., Ponomarenko, N., Egiazarian, K., Astola, J.

Pages: 697-718

Publication date: 2016

Peer-reviewed: Yes

### Publication information

Journal: *Multidimensional Systems and Signal Processing*

Volume: 27

Issue number: 3

ISSN (Print): 0923-6082

Ratings:

Scopus rating (2016): CiteScore 3.4 SJR 0.424 SNIP 1.109

Original language: English

ASJC Scopus subject areas: Computer Science Applications, Information Systems, Signal Processing, Software, Artificial Intelligence, Hardware and Architecture, Applied Mathematics

Keywords: Compression ratio, Lossy compression, Required quality, Visual quality metrics

DOIs:

10.1007/s11045-015-0333-8

URLs:

<http://www.scopus.com/inward/record.url?scp=84930357751&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84930357751

Research output: Contribution to journal > Article > Scientific > peer-review

### **Towards component-aware function point measurement**

**Background.** Function Point Analysis is the most used technique for sizing software functional specifications. Function Point measures are widely used to estimate the effort needed to develop software, hence the cost of software. However, Function Point Analysis adopts the point of view of the end user, and-consistently-considers a software application as a whole. This approach does not allow for assessing the role of reusable components in software development. In fact, reusing available components decreases the cost of software development, but standard Function Point measures are not able to account for the savings deriving from component reuse. **Objective.** We aim at modifying the definition of Function Point Analysis so that the role of components can be taken into account. More specifically, we redefine the measurement so that when no components are used the resulting measure is the same yielded by the standard measurement process, but in presence of components, our modified measure is less than the standard measure (the bigger the role of components, the smaller the measure). **Method.** Components partly support the realization of elementary processes. Therefore, we split elementary processes into sub-processes, such that each sub-process is either totally supported by a component or it is not supported at all by any component, the size of the elementary process is defined to be inversely proportional to the size of sub-processes supported by components. **Results.** The proposed approach was applied to a Web application, which was developed in two versions: one from scratch and one using available components. As expected, the 'component-aware' measures obtained are smaller than the standard measures. We also compared the reduction in size with the reduction in development effort. **Conclusions.** The proposed method proved effective in taking into account the usage of components in the development of the considered application. However, the observed decrease in size is smaller than the decrease of development effort. The latter result suggests that this initial proposal needs further experimentation to support accurate effort estimation.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Università degli Studi Dell'Insubria, Free University of Bolzano-Bozen

Contributors: Lavazza, L., Lenarduzzi, V., Taibi, D.

Number of pages: 10

Pages: 35-44

Publication date: 2016

### **Host publication information**

Title of host publication: Proceedings - 26th International Workshop on Software Measurement, IWSM 2016 and the 11th International Conference on Software Process and Product Measurement, Mensura 2016

Publisher: IEEE

ISBN (Electronic): 9781509041473

ASJC Scopus subject areas: Software, Information Systems and Management

Keywords: Component-aware size measurement, Component-based development, Function Point Analysis, Functional size measurement

DOIs:

10.1109/IWSM-Mensura.2016.017

Source: Scopus

Source ID: 85011961359

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Network signatures based on gene pair expression ratios improve classification and the analysis of muscle-invasive urothelial cancer**



Urothelial cancer (UC) is highly recurrent and can progress from non-invasive (NMIUC) to a more aggressive muscle-invasive (MIUC) subtype that invades the muscle tissue layer of the bladder. We present a proof of principle study that network-based features of gene pairs can be used to improve classifier performance and the functional analysis of urothelial cancer gene expression data. In the first step of our procedure each individual sample of a UC gene expression dataset is inflated by gene pair expression ratios that are defined based on a given network structure. In the second step an elastic net feature selection procedure for network-based signatures is applied to discriminate between NMIUC and MIUC samples. We performed a repeated random subsampling cross validation in three independent datasets. The network signatures were characterized by a functional enrichment analysis and studied for the enrichment of known cancer genes. We observed that the network-based gene signatures from meta collections of proteinprotein interaction (PPI) databases such as CPDB and the PPI databases HPRD and BioGrid improved the classification performance compared to single gene based signatures. The network based signatures that were derived from PPI databases showed a prominent enrichment of cancer genes (e.g., TP53, TRIM27 and HNRNPA2B1). We provide a novel integrative approach for large-scale gene expression analysis for the identification and development of novel diagnostical targets in bladder cancer. Further, our method allowed to link cancer gene associations to network-based expression signatures that are not observed in gene-based expression signatures.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research Community on Data-to-Decision (D2D), Harvard Medical School, Queen's University, Belfast, Northern Ireland

Contributors: De Matos Simoes, R., Mitsiades, C., Williamson, K. E., Emmert-Streib, F.

Number of pages: 8

Pages: 1216-1223

Publication date: 16 Dec 2015

#### **Host publication information**

Title of host publication: 2015 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)

Publisher: IEEE

ISBN (Electronic): 978-1-4673-6799-8

ASJC Scopus subject areas: Software, Artificial Intelligence, Health Informatics, Biomedical Engineering

Keywords: data feature space inflation, feature selection, gene pair expression ratio, muscle-invasive, non muscleinvasive , Urothelial cancer

DOIs:

10.1109/BIBM.2015.7359855

Source: Scopus

Source ID: 84962439353

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Generative part-based Gabor object detector**

Discriminative part-based models have become the approach for visual object detection. The models learn from a large number of positive and negative examples with annotated class labels and location (bounding box). In contrast, we propose a part-based generative model that learns from a small number of positive examples. This is achieved by utilizing "privileged information", sparse class-specific landmarks with semantic meaning. Our method uses bio-inspired complex-valued Gabor features to describe local parts. Gabor features are transformed to part probabilities by unsupervised Gaussian Mixture Model (GMM). GMM estimation is robustified for a small amount of data by a randomization procedure inspired by random forests. The GMM framework is also used to construct a probabilistic spatial model of part configurations. Our detector is invariant to translation, rotation and scaling. On part level invariance is achieved by pose quantization which is more efficient than previously proposed feature transformations. In the spatial model, invariance is achieved by mapping parts to an "aligned object space". Using a small number of positive examples our generative method performs comparably to the state-of-the-art discriminative method.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Vision, Field robotics for efficient work sites (FIRE), Prostate cancer research center (PCRC), Lappeenranta University of Technology

Contributors: Riabchenko, E., Kämäräinen, J.

Number of pages: 8

Pages: 1-8

Publication date: 15 Dec 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Pattern Recognition Letters

Volume: 68

Issue number: P1  
ISSN (Print): 0167-8655  
Ratings:

Scopus rating (2015): CiteScore 5.1 SJR 0.95 SNIP 2.002

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Gabor feature, Gaussian mixture model, Generative learning, Object detection, Visual classification

DOIs:

10.1016/j.patrec.2015.08.004

### **Bibliographical note**

EXT="Riabchenko, Ekaterina"

Source: Scopus

Source ID: 84941570575

Research output: Contribution to journal › Article › Scientific › peer-review

### **A State Space Tool for Concurrent System Models Expressed In C++**

This publication introduces a state space exploration tool that is based on representing the model under verification as a piece of C++ code that obeys certain conventions. This approach facilitates experimenting with many kinds of modelling ideas. On the other hand, the use of stubborn sets and symmetries requires that either the modeller or a preprocessor tool analyses the model at a syntactic level and expresses stubborn set obligation rules and the symmetry mapping as suitable C++ functions. The tool supports the detection of illegal deadlocks, safety errors, and may progress errors. It also partially supports the detection of must progress errors.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Mathematics, Research group: MAT Computer Science and Applied Logics, Regulation of learning and active learning methods (REALMEE)

Contributors: Valmari, A.

Number of pages: 15

Pages: 91-105

Publication date: 14 Dec 2015

### **Host publication information**

Title of host publication: SPLST 2015 Symposium on Programming Languages and Software Tools : Proceedings of the 14th Symposium on Programming Languages and Software Tools (SPLST'15) Tampere, Finland, Oct 9-10, 2015

Volume: 1525

Publisher: CEUR-WS.org

Editors: Nummenmaa, J., Sievi-Korte, O., Mäkinen, E.

Article number: 7

### **Publication series**

Name: CEUR Workshop Proceedings

Volume: 1525

ISSN (Electronic): 1613-0073

ASJC Scopus subject areas: Software

Keywords: model checking; stubborn sets; symmetries; safety; progress

URLs:

<http://ceur-ws.org/Vol-1525/paper-07.pdf>

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Time series trends in software evolution**

Background The laws of software evolution were formulated to describe time series trends in software over time. Objective Building on econometrics, the paper relates the laws theoretically to the concept of stationarity. The theoretical argumentation builds on the fact that in a stationary time series, the mean and variance remain constant. The concept is further elaborated with different statistical types of time series trends. These provide the objective for the empirical experiment that evaluates whether software size measures in a typical software evolution dataset are stationary. Method The time series analysis is based on conventional statistical tests for the evaluation of stationarity. Results The empirical dataset contains time series extracted from the version control systems used in Vaadin and Tomcat between circa 2006 and 2013. The results establish that the observed time series are neither stationary nor follow simple mathematical functions that would translate into stationarity. Conclusion The testing framework presented in the paper allows evaluating the stationarity of software evolution time series. The results can be interpreted theoretically against the laws of software evolution. These methodological and theoretical contributions improve the foundations of predictive time series modeling of software evolution problems.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Managing digital industrial transformation (mDIT), University of Turku, Department of Management and Entrepreneurship, Turun Kauppakorkeakoulu

Contributors: Ruohonen, J., Hyrynsalmi, S., Leppänen, V.

Number of pages: 26

Pages: 990-1015

Publication date: 1 Dec 2015

Peer-reviewed: Yes

### Publication information

Journal: Journal of Software: Evolution and Process

Volume: 27

Issue number: 12

ISSN (Print): 2047-7473

Original language: English

ASJC Scopus subject areas: Software

Keywords: dynamic regression, software evolution, stationarity, time series analysis, unit roots

DOIs:

10.1002/smr.1755

Source: Scopus

Source ID: 84955628781

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Need to touch, wonder of discovery, and social capital: Experiences with interactive playful seats

In this article we present findings from a design experiment of MurMur Moderators, talking playful seats facilitating playful atmosphere and creativity at office environments. The article describes the design and technological composition of our two prototypes, and our experiences exposing the concept to audiences at science fairs and an office environment. This research has served as an exploratory design study, directing our focus to the seats as primary and secondary play objects with a distinct narrative. Our goal with the initial exposure was to first investigate preliminary audience reactions for the high level concept and how people interact with the prototype. This was then supplemented by testing the concept in an office environment. The data we have collected gives us insight on the seats as primary and secondary play objects and how users touch, discover and socialize.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact), RMIT University

Contributors: Nummenmaa, T., Tyni, H., Kultima, A., Alha, K., Holopainen, J.

Publication date: 16 Nov 2015

### Host publication information

Title of host publication: ACE 2015 - 12th Advances in Computer Entertainment Technology Conference, Proceedings

Volume: 16-19-November-2015

Publisher: Association for Computing Machinery

Article number: 10

ISBN (Electronic): 9781450338523

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Arduino, Audio feedback, Design research, DIY, Game studies, Internet of things, Office play, Playful furniture, Raspberry Pi

DOIs:

10.1145/2832932.2832959

URLs:

<http://www.scopus.com/inward/record.url?scp=84979747766&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84979747766

Research output: [Chapter in Book/Report/Conference proceeding](#) › [Conference contribution](#) › [Scientific](#) › [peer-review](#)

### Who is moving - User or device? Experienced quality of mobile 3D video in vehicles

'Viewing while commuting' is a typical use case for mobile video. However, experimental and behavioral influences of watching three-dimensional (3D) video in vibrating vehicles have not been widely researched. The goal of this study is 1) to explore the influence of video presentation modes (two-dimensional and stereoscopic 3D) on the quality of experience and 2) to understand the nature of the movement patterns that users perform to maintain an optimal viewing position while

viewing videos on a mobile device in three commuting contexts and in a controlled laboratory environment. A hybrid method for quality evaluation was used for combining quantitative preference ratings, qualitative descriptions of quality, situational audio/video data-collection, and sensors. The high-quality and heterogeneous audiovisual stimuli were viewed on a mobile device equipped with a parallax barrier display. The results showed that the stereoscopic 3D (S3D) video presentation mode provided more satisfying quality of experience than the two-dimensional presentation mode in all studied contexts. To maintain an optimal viewing position in the vehicles, the users moved the device in their hands to the directions around the vertical and the horizontal axes in a leaned sitting position. This movement behavior was guided by the contexts but not by the quality, indicating the general importance of these results for mobile video viewing in vibrating vehicles.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: User experience, Eindhoven University of Technology, Nokia

Contributors: Jumisko-Pyykkö, S., Markopoulos, P., Hannuksela, M. M.

Publication date: 16 Nov 2015

#### **Host publication information**

Title of host publication: ACE 2015 - 12th Advances in Computer Entertainment Technology Conference, Proceedings

Publisher: ACM

Article number: 13

ISBN (Electronic): 9781450338523

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: 3D, Experienced quality, Mobile video, Movement, Perception, Quasi-experiments

DOIs:

10.1145/2832932.2832948

Source: Scopus

Source ID: 84979759186

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Collaborative navigation in virtual worlds: How gender and game experience influence user behavior**

There exists a large base of evidence for gender differences in human navigation. However, there is not much research on gender differences in collaborative aspects of navigation, including the interaction of individuals during collaborative wayfinding tasks in virtual environments. In light of this, we present a study of a collaborative virtual environment, Berlin Kompass. The goal of this study was to find out the main differences between genders in collaborative wayfinding. The application was evaluated in the context of foreign language learning in schools with over 200 students, where the users navigated through cityscapes while interacting verbally with each other. We collected and analyzed interaction logs, questionnaire data and audio and video recordings to gain insights into gender-related differences in wayfinding in virtual worlds. Our findings suggest that several differences that are evident in single user systems are not present when the collaborative aspect is added. Male users were more immersed during the task than females. One of the explaining factors for this might be video game experience. Genders also communicated differently - males spoke in longer utterances whereas females had more, shorter utterances. Males referred more to relative directions and dynamic landmarks such as cars and pedestrians while navigating. Males with more video game experience also provided more positive subjective user experience feedback on the application.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), University of Tampere

Contributors: Kallioniemi, P., Heimonen, T., Turunen, M., Hakulinen, J., Keskinen, T., Pihkala-Posti, L., Okkonen, J., Raisamo, R.

Number of pages: 10

Pages: 173-182

Publication date: 13 Nov 2015

#### **Host publication information**

Title of host publication: Proceedings - VRST 2015: 21st ACM Symposium on Virtual Reality Software and Technology

Volume: 13-15-November-2015

Publisher: Association for Computing Machinery

ISBN (Electronic): 9781450339902

ASJC Scopus subject areas: Software

Keywords: Gender differences, Virtual environments, Wayfinding

DOIs:

10.1145/2821592.2821610

URLs:

<http://www.scopus.com/inward/record.url?scp=84980038945&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84980038945

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Executing dataflow actors as kahn processes**

Programming models which specify an application as a network of independent computational elements have emerged as a promising paradigm for programming streaming applications. The antagonism between expressivity and analysability has led to a number of different such programming models, which provide different degrees of freedom to the programmer. One example are Kahn process networks (KPNs), which, due to certain restrictions in communication, can guarantee determinacy (their results are independent of timing by construction). On the other hand, certain dataflow models, such as the CAL Actor Language, allow non-determinacy and thus higher expressivity, however at the price of static analysability and thus a potentially less efficient implementation. In many cases, however, non-determinacy is not required (or even not desired), and relying on KPN for the implementation seems advantageous. In this paper, we propose an algorithm for classifying dataflow actors (i.e. computational elements) as KPN compatible or potentially not. For KPN compatible dataflow actors, we propose an automatic KPN translation method based on this algorithm. In experiments, we show that more than 75% of all mature actors of a standard multimedia benchmark suite can be classified as KPN compatible and that their execution time can be reduced by up to 1.97x using our proposed translation technique. Finally, in a manual classification effort, we validate these results and list different classes of KPN incompatibility.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing Research Community (SPRC), HCI e 486.1, Dept. of Computer Science and Engineering, Univ of Oulu

Contributors: Tretter, A., Boutellier, J., Guthrie, J., Schor, L., Thiele, L.

Number of pages: 10

Pages: 105-114

Publication date: 4 Nov 2015

### **Host publication information**

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Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7318265

ISBN (Electronic): 9781467380799

ASJC Scopus subject areas: Software

Keywords: classification, Dataflow programming, Kahn process networks

DOIs:

10.1109/EMSOFT.2015.7318265

URLs:

<http://www.scopus.com/inward/record.url?scp=84962325193&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84962325193

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Sparse extreme learning machine classifier exploiting intrinsic graphs**

This paper presents an analysis of the recently proposed sparse extreme learning machine (S-ELM) classifier and describes an optimization scheme that can be used to calculate the network output weights. This optimization scheme exploits intrinsic graph structures in order to describe geometric data relationships in the so-called ELM space. Kernel formulations of the approach operating in ELM spaces of arbitrary dimensions are also provided. It is shown that the application of the optimization scheme exploiting geometric data relationships in the original ELM space is equivalent to the application of the original S-ELM to a transformed ELM space. The experimental results show that the incorporation of geometric data relationships in S-ELM can lead to enhanced performance.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki, Department of Informatics, Aristotle University of Thessaloniki

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 5

Pages: 192-196

Publication date: 1 Nov 2015

Peer-reviewed: Yes

### Publication information

Journal: Pattern Recognition Letters

Volume: 65

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2015): CiteScore 5.1 SJR 0.95 SNIP 2.002

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Intrinsic graphs, Single-hidden layer neural networks, Sparse extreme learning machine

DOIs:

10.1016/j.patrec.2015.07.036

Source: Scopus

Source ID: 84940388000

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### Model selection for linear classifiers using Bayesian error estimation

Regularized linear models are important classification methods for high dimensional problems, where regularized linear classifiers are often preferred due to their ability to avoid overfitting. The degree of freedom of the model is determined by a regularization parameter, which is typically selected using counting based approaches, such as K-fold cross-validation. For large data, this can be very time consuming, and, for small sample sizes, the accuracy of the model selection is limited by the large variance of CV error estimates. In this paper, we study the applicability of a recently proposed Bayesian error estimator for the selection of the best model along the regularization path. We also propose an extension of the estimator that allows model selection in multiclass cases and study its efficiency with L-1 regularized logistic regression and L-2 regularized linear support vector machine. The model selection by the new Bayesian error estimator is experimentally shown to improve the classification accuracy, especially in small sample-size situations, and is able to avoid the excess variability inherent to traditional cross-validation approaches. Moreover, the method has significantly smaller computational complexity than cross-validation. (C) 2015 Elsevier Ltd. All rights reserved.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Vision, Research Community on Data-to-Decision (D2D), Universidad Carlos III de Madrid

Contributors: Huttunen, H., Tohka, J.

Number of pages: 10

Pages: 3739-3748

Publication date: Nov 2015

Peer-reviewed: Yes

### Publication information

Journal: Pattern Recognition

Volume: 48

Issue number: 11

ISSN (Print): 0031-3203

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Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Logistic regression, Support vector machine, Regularization, Bayesian error estimator, Linear classifier, MULTINOMIAL LOGISTIC-REGRESSION, SUPPORT VECTOR MACHINES, CLASSIFICATION, PERFORMANCE, BOUNDS

DOIs:

10.1016/j.patcog.2015.05.005

### Bibliographical note

EXT="Tohka, Jussi"

Source: Scopus

Source ID: 84937812363

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

### **Antroposeeni - A mixed reality game**

In this paper, we describe Antroposeeni, a mixed reality game designed and developed for mobile devices. Antroposeeni utilizes location-based services, GPS for tracking users and augmented reality techniques for displaying captivating audiovisual content and creating rich experiences. Our demonstration will introduce a pilot version of the game, which encompasses narrative elements of the game mediated through developed media technologies. The goal for the demonstration is to give the conference visitors a chance to test the game in a specifically tailored route close to the conference site. After conducting the pilot we plan to organize a short review regarding the user experience.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Metaria Ry

Contributors: Luhtala, M., Karvonen, T., Pylväs, J., Ala-Kokko, A., Magica, R., Takeda, Y., Turunen, M.

Number of pages: 3

Pages: 211-213

Publication date: 22 Sep 2015

#### **Host publication information**

Title of host publication: ACADEMICMINDTREK 2015 - Proceedings of the 19th International Academic Mindtrek Conference

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450339483

ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Science Applications

Keywords: Aesthetics, Art, Augmented reality, Design, Games, Mixed reality, Software design, Theatre, User experience

DOIs:

10.1145/2818187.2818287

URLs:

<http://www.scopus.com/inward/record.url?scp=84962875980&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84962875980

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **OASIS deck of cards - House of colleagues: A playful**

A research experiment to facilitate playful interaction and community learning within an academic organization of about 170 employees was conducted. A 2-player card game including 61 'staff character cards' and 39 question cards was implemented to be played by the relatively new community. The game period, including supporting events, ran for 5 weeks. After the experiment 59 staff members responded to an online survey on play experiences. The results showed that ways of participation and means of play are more diverse in a work community context than as they are specified in the game rules. More emphasis should be set on framing the game and supporting it as a continuous activity to become a playful practice in the work community. An academic community has inherent contextual prerequisites that need to be addressed in order for a playful practice to gain traction as a means for community building.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact)

Contributors: Nummenmaa, T., Kultima, A., Kankainen, V., Savolainen, S., Syvänen, A., Alha, K., Mäyrä, F.

Number of pages: 8

Pages: 2-9

Publication date: 22 Sep 2015

#### **Host publication information**

Title of host publication: ACADEMICMINDTREK 2015 - Proceedings of the 19th International Academic Mindtrek Conference

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450339483

ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Science Applications

Keywords: Academia, Adult play, Attitudes towards play, Card game, Community, Design, Play at work, Playfulness, University

DOIs:

10.1145/2818187.2818296

URLs:

<http://www.scopus.com/inward/record.url?scp=84962803762&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84962803762

### **Haptic feedback of gaze gestures with glasses: Localization accuracy and effectiveness**

Wearable devices including smart eyewear require new interaction methods between the device and the user. In this paper, we describe our work on the combined use of eye tracking for input and haptic (touch) stimulation for output with eyewear. Input with eyes can be achieved by utilizing gaze gestures which are predefined patterns of gaze movements identified as commands. The frame of the eyeglasses offers three natural contact points with the wearer's skin for haptic stimulation. The results of two user studies reported in this paper showed that stimulation moving between the contact points was easy for users to localize, and that the stimulation has potential to make the use of gaze gestures more efficient.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), University of Tampere

Contributors: Rantala, J., Kangas, J., Isokoski, P., Akkil, D., Špakov, O., Raisamo, R.

Number of pages: 8

Pages: 855-862

Publication date: 7 Sep 2015

#### **Host publication information**

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Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450335751

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software

Keywords: Gaze gestures, Gaze tracking, Haptic stimulation, Haptics, Pervasive computing, Smart eyewear, Smart glasses, Wearable computing

DOIs:

10.1145/2800835.2804334

URLs:

<http://www.scopus.com/inward/record.url?scp=84962523895&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84962523895

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Augmenting Technology Trees: Automation and Tool Support**

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Mathematics, Research group: MAT Computer Science and Applied Logics

Contributors: Heinimäki, T. J., Elomaa, T.

Number of pages: 8

Pages: 68-75

Publication date: Sep 2015

#### **Host publication information**

Title of host publication: Proceedings of the Seventh International Conference on Virtual Worlds and Games for Serious Applications (VS-Games 2015)

Publisher: IEEE

ISBN (Print): 978-1-4799-8101-4

ISBN (Electronic): 978-1-4799-8102-1

ASJC Scopus subject areas: Software

DOIs:

10.1109/VS-GAMES.2015.7295765

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Software evolution and time series volatility: An empirical exploration**

The paper presents the first empirical study to examine econometric time series volatility modeling in the software evolution context. The econometric volatility concept is related to the conditional variance of a time series rather than the conditional mean targeted in conventional regression analysis. The software evolution context is motivated by relating these variance characteristics to the proximity of operating system releases, the theoretical hypothesis being that volatile



characteristics increase nearby new milestone releases. The empirical experiment is done with a case study of FreeBSD. The analysis is carried out with 12 time series related to bug tracking, development activity, and communication. A historical period from 1995 to 2011 is covered under a daily sampling frequency. According to the results the time series dataset contains visible volatility characteristics, but these cannot be explained by the time windows around the six observed major FreeBSD releases. The paper consequently contributes to the software evolution research field with new methodological ideas, as well as with both positive and negative empirical results.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Managing digital industrial transformation (mDIT), University of Turku, Department of Information Technology

Contributors: Ruohonen, J., Hyrynsalmi, S., Leppänen, V.

Number of pages: 10

Pages: 56-65

Publication date: 30 Aug 2015

#### Host publication information

Title of host publication: 14th International Workshop on Principles of Software Evolution, IWPSE 2015 - Proceedings

Volume: 30-Aug-2015

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9781450338165

ASJC Scopus subject areas: Software, Computational Theory and Mathematics, Modelling and Simulation, Theoretical Computer Science

Keywords: ARIMA, Code churn, Conditional variance, FreeBSD, GARCH, Software evolution, Time series analysis, Volatility

DOIs:

10.1145/2804360.2804367

Source: Scopus

Source ID: 84958599161

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Mobiscool: 1<sup>st</sup> workshop on mobile, social and culturally oriented learning

There are two simultaneous transformative changes occurring in Education: the use of mobile and tablet devices for accessing educational content, and the rise of the MOOCs. Happening independently and in parallel are significant advances in interaction technologies through smartphones and tablets, and the rise in the use of social-media and social-network analytics in several domains. Given the extent of personal context that is available on the mobile device, how can the education experience be personalised, made social, and tailored to the cultural context of the learner? The goal of this proposal is twofold: (a) To understand the usage, and student behaviour in this new environment (MOOCs and mobile devices) and (b) To design experiments and implement them to make these new tools more effective by tailoring them to the individual student's personal, social and cultural settings and preferences.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), IBM Research, Aalborg University

Contributors: Nanavati, A. A., Rajput, N., Turunen, M., Knoche, H., Rehm, M.

Number of pages: 4

Pages: 1187-1190

Publication date: 24 Aug 2015

#### Host publication information

Title of host publication: MobileHCI 2015 - Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450336536

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Information Systems, Software

Keywords: Augmented reality, Behaviour, Culture, Education, MOOCs, Multimedia, Social media, Social network analysis, User experience

DOIs:

10.1145/2786567.2795402

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<http://www.scopus.com/inward/record.url?scp=84962791832&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84962791832

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Scinet: Interactive intent modeling for information discovery**

Current search engines offer limited assistance for exploration and information discovery in complex search tasks. Instead, users are distracted by the need to focus their cognitive efforts on finding navigation cues, rather than selecting relevant information. Interactive intent modeling enhances the human information exploration capacity through computational modeling, visualized for interaction. Interactive intent modeling has been shown to increase task-level information seeking performance by up to 100%. In this demonstration, we showcase SciNet, a system implementing interactive intent modeling on top of a scientific article database of over 60 million documents.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), Aalto University, School of Management (JKK), University of Helsinki

Contributors: Ruotsalo, T., Peltonen, J., Eugster, M. J. A., Glowacka, D., Reijonen, A., Jacucci, G., Myllymäki, P., Kaski, S.

Number of pages: 2

Pages: 1043-1044

Publication date: 9 Aug 2015

#### **Host publication information**

Title of host publication: SIGIR 2015 - Proceedings of the 38th International ACM SIGIR Conference on Research and Development in Information Retrieval

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450336215

ASJC Scopus subject areas: Information Systems, Software

Keywords: Intent modeling, Interactive information retrieval, Personalization, Visual information seeking

DOIs:

10.1145/2766462.2767863

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Source: Scopus

Source ID: 84953776151

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Collaborative filtering based on group coordinates for smoothing and directional sharpening**

Groups of mutually similar image blocks are the key element in nonlocal image processing. In this work, the spatial coordinates of grouped blocks are leveraged in two distinct parts of the transform-domain collaborative filtering within the BM3D algorithm. First, we introduce an adaptive 1-D transform for 3-D collaborative filtering based on sampling 2-D smooth functions at the positions of grouped blocks. This adaptive transform is applied for improved decorrelation of the 2-D spectra of the grouped blocks. Second, we propose a directional sharpening procedure whose strength varies adaptively according to the relative orientation of the transform basis functions with respect to the group coordinates. Experiments confirm the efficacy of the proposed adaptations, for denoising as well as for sharpening of noisy images.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Signal and Image Restoration-RST, Research area: Signal and Information Processing, Signal Processing Research Community (SPRC)

Contributors: Azzari, L., Foi, A.

Number of pages: 5

Pages: 1573-1577

Publication date: 4 Aug 2015

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Publisher: IEEE

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ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: adaptive transforms, BM3D, collaborative filtering, denoising, sharpening

Electronic versions:

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DOIs:

10.1109/ICASSP.2015.7178235

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201704041247>

Source: Scopus

Source ID: 84946074037

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Enhancing class discrimination in Kernel Discriminant Analysis**

In this paper, we propose an optimization scheme aiming at optimal nonlinear data projection, in terms of Fisher ratio maximization. To this end, we formulate an iterative optimization scheme consisting of two processing steps: optimal data projection calculation and optimal class representation determination. Compared to the standard approach employing the class mean vectors for class representation, the proposed optimization scheme increases class discrimination in the reduced-dimensionality feature space. We evaluate the proposed method in standard classification problems, as well as on the classification of human actions and face, and show that it is able to achieve better generalization performance, when compared to the standard approach.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 5

Pages: 1926-1930

Publication date: 4 Aug 2015

#### **Host publication information**

Title of host publication: ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

Article number: 7178306

ISBN (Print): 9781467369978

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: Kernel Discriminant Analysis, Nonlinear data projection, Optimized Class Representation

DOIs:

10.1109/ICASSP.2015.7178306

Source: Scopus

Source ID: 84946088724

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Exemplar-based speech enhancement for deep neural network based automatic speech recognition**

Deep neural network (DNN) based acoustic modelling has been successfully used for a variety of automatic speech recognition (ASR) tasks, thanks to its ability to learn higher-level information using multiple hidden layers. This paper investigates the recently proposed exemplar-based speech enhancement technique using coupled dictionaries as a pre-processing stage for DNN-based systems. In this setting, the noisy speech is decomposed as a weighted sum of atoms in an input dictionary containing exemplars sampled from a domain of choice, and the resulting weights are applied to a coupled output dictionary containing exemplars sampled in the short-time Fourier transform (STFT) domain to directly obtain the speech and noise estimates for speech enhancement. In this work, settings using input dictionary of exemplars sampled from the STFT, Mel-integrated magnitude STFT and modulation envelope spectra are evaluated. Experiments performed on the AURORA-4 database revealed that these pre-processing stages can improve the performance of the DNN-HMM-based ASR systems with both clean and multi-condition training.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Audio research group, Signal Processing Research Community (SPRC), KU Leuven

Contributors: Baby, D., Gemmeke, J. F., Virtanen, T., Van Hamme, H.

Number of pages: 5

Pages: 4485-4489

Publication date: 4 Aug 2015

#### **Host publication information**

Title of host publication: ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

ISBN (Print): 9781467369978

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: coupled dictionaries, deep neural networks, modulation envelope, non-negative matrix factorisation, speech enhancement

DOIs:

10.1109/ICASSP.2015.7178819

Source: Scopus

Source ID: 84946079930

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Exploiting subclass information in one-class support vector machine for video summarization**

In this paper, we propose a method for video summarization based on human activity description. We formulate this problem as the one of automatic video segment selection based on a learning process that employs salient video segment paradigms. For this one-class classification problem, we introduce a novel variant of the One-Class Support Vector Machine (OC-SVM) classifier that exploits subclass information in the OC-SVM optimization problem, in order to jointly minimize the data dispersion within each subclass and determine the optimal decision function. We evaluate the proposed approach in three Hollywood movies, where the performance of the proposed SOC-SVM algorithm is compared with that of the OC-SVM. Experimental results denote that the proposed approach is able to outperform OC-SVM-based video segment selection.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki

Contributors: Mygdalis, V., Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 5

Pages: 2259-2263

Publication date: 4 Aug 2015

#### **Host publication information**

Title of host publication: ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings

Volume: 2015-August

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

ISBN (Print): 9781467369978

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: One class classification, Subclass One-Class SVM, Supervised Video Summarization

DOIs:

10.1109/ICASSP.2015.7178373

Source: Scopus

Source ID: 84945586271

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Low-complexity robust DOA estimation**

We propose a low complexity method for estimating direction of arrival (DOA) when the positions of the array sensors are affected by errors with known magnitude bound. This robust DOA method is based on solving an optimization problem whose solution is obtained in two stages. First, the problem is relaxed and the corresponding power estimation has an expression similar to that of standard beamforming. If the relaxed solution does not satisfy the magnitude bound, an approximation is made by projection. Unlike other robust DOA methods, no eigenvalue decomposition is necessary and the complexity is similar to that of MVDR. For low and medium SNR, the proposed method competes well with more complex methods and is clearly better than MVDR.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Algebraic and Algorithmic Methods in Signal Processing AAMSP, Signal Processing Research Community (SPRC), Dept. of Automatic Control and Computers, University Politehnica of Bucharest

Contributors: Dumitrescu, B., Rusu, C., Tabus, I., Astola, J.

Number of pages: 5

Pages: 2794-2798

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ISBN (Print): 9781467369978

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: direction of arrival, optimization, robustness, spectral power density

DOIs:

10.1109/ICASSP.2015.7178480

Source: Scopus

Source ID: 84946064969

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Low-Latency Sound-Source-Separation using Non-Negative Matrix Factorisation with Coupled Analysis and Synthesis Dictionaries

For real-time or close to real-time applications, sound source separation can be performed on-line, where new frames of incoming data for a mixture signal are processed as they arrive, at very low delay. We propose an approach which generates the separation filters for short synthesis frames to achieve low latency source separation, based on a compositional model mixture of the audio to be separated. Filter parameters are derived from a longer temporal context than the current processing frame through use of a longer analysis frame. A pair of dictionaries are used, one for analysis and one for reconstruction. With this approach we are able to increase separation performance at low latencies whilst retaining the low-latency provided by the use of short synthesis frames. The proposed data handling scheme and parameters can be adjusted to achieve real-time performance, given sufficient computational power. Low-latency output allows a human listener to use the results of such a separation scheme directly, without a perceptible delay. With the proposed method, separated source-to-distortion ratios (SDRs) can be improved by over 1 dB for latencies below 20 ms, without any affect on latency.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Audio research group, Signal Processing Research Community (SPRC)

Contributors: Barker, T., Virtanen, T., Pontoppidan, N. H.

Number of pages: 5

Pages: 241-245

Publication date: 4 Aug 2015

### Host publication information

Title of host publication: 2015 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)

Publisher: IEEE

ISBN (Print): 9781467369978

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: low-latency, NMF, Non-negative matrix factorisation, real-time, source separation

DOIs:

10.1109/ICASSP.2015.7177968

URLs:

[http://www.cs.tut.fi/~barkert/Publications\\_files/ICASSP2015\\_TomBarker\\_Preprint.pdf](http://www.cs.tut.fi/~barkert/Publications_files/ICASSP2015_TomBarker_Preprint.pdf) (Preprint)

Source: Scopus

Source ID: 84946043719

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Similarity induced group sparsity for non-negative matrix factorisation

Non-negative matrix factorisations are used in several branches of signal processing and data analysis for separation and classification. Sparsity constraints are commonly set on the model to promote discovery of a small number of dominant patterns. In group sparse models, atoms considered to belong to a consistent group are permitted to activate together, while activations across groups are suppressed, reducing the number of simultaneously active sources or other structures. Whereas most group sparse models require explicit division of atoms into separate groups without addressing their mutual relations, we propose a constraint that permits dynamic relationships between atoms or groups, based on any defined distance measure. The resulting solutions promote approximation with components considered similar to each other. Evaluation results are shown for speech enhancement and noise robust speech and speaker recognition.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Audio research group, Signal Processing Research Community (SPRC), Aalto University  
Contributors: Hurmalainen, A., Saeidi, R., Virtanen, T.  
Number of pages: 5  
Pages: 4425-4429  
Publication date: 4 Aug 2015

#### Host publication information

Title of host publication: ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

ISBN (Print): 9781467369978

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: group sparsity, non-negative matrix factorization, sparse representations, speaker recognition, speech recognition

DOIs:

10.1109/ICASSP.2015.7178807

Source: Scopus

Source ID: 84946089342

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Automatic image-based detection and inspection of paper fibres for grasping

An automatic computer vision algorithm that detects individual paper fibres from an image, assesses the possibility of grasping the detected fibres with microgrippers and detects the suitable grasping points is presented. The goal of the algorithm is to enable automatic fibre manipulation for mechanical characterisation, which has traditionally been slow manual work. The algorithm classifies the objects in images based on their morphology, and detects the proper grasp points from the individual fibres by applying given geometrical constraints. The authors test the ability of the algorithm to detect the individual fibres with 35 images containing more than 500 fibres in total, and also compare the graspability analysis and the calculated grasp points with the results of an experienced human operator with 15 images that contain a total of almost 200 fibres. The detection results are outstanding, with fewer than 1% of fibres missed. The graspability analysis gives sensitivity of 0.83 and specificity of 0.92, and the average distance between the grasp points of the human and the algorithm is 220  $\mu\text{m}$ . Also, the choices made by the algorithm are much more consistent than the human choices.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Automation Science and Engineering, Integrated Technologies for Tissue Engineering Research (ITTE)

Contributors: Hirvonen, J., Kallio, P.

Number of pages: 7

Pages: 588-594

Publication date: 1 Aug 2015

Peer-reviewed: Yes

#### Publication information

Journal: IET Computer Vision

Volume: 9

Issue number: 4

ISSN (Print): 1751-9632

Ratings:

Scopus rating (2015): CiteScore 2.3 SJR 0.3 SNIP 1.218

Original language: English

ASJC Scopus subject areas: Computer Vision and Pattern Recognition, Software

Electronic versions:

IET\_post\_print

DOIs:

10.1049/iet-cvi.2014.0416

URLs:

<http://urn.fi/URN:NBN:fi:tty-201603243758>

Source: Scopus

Source ID: 84938530267

Research output: Contribution to journal › Article › Scientific › peer-review

### **Exploring the Stability of Software with Time-Series Cross-Sectional Data**

The stability of software is a classical topic in software engineering. This research investigates stability of software architectures in terms of an object-oriented design principle presented by Robert C. Martin. The research approach is statistical: the design principle is evaluated with a time-series cross-sectional (TSCS) regression model. The empirical sample covers a release history from the Java library Vaadin. The empirical results establish that the design principle cannot be used to characterize the library. Besides delivering this negative empirical result, the research provides the necessary methodological background that is required to understand TSCS modeling.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Managing digital industrial transformation (mDIT), University of Turku, Department of Information Technology

Contributors: Ruohonen, J., Hyrynsalmi, S., Leppänen, V.

Number of pages: 7

Pages: 41-47

Publication date: 31 Jul 2015

#### **Host publication information**

Title of host publication: Proceedings - 2nd International Workshop on Software Architecture and Metrics, SAM 2015

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9781479919345

ASJC Scopus subject areas: Hardware and Architecture, Software

Keywords: panel data, software metrics, software stability

DOIs:

10.1109/SAM.2015.13

Source: Scopus

Source ID: 84946921946

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Mashing Up Software Issue Management, Development, and Usage Data**

Modern software development approaches rely extensively on tools. Motivated by practices such as continuous integration, deployment and delivery, these tools are used in a fashion where data are automatically accumulated in different databases as a side-effect of everyday development activities. In this paper we introduce an approach for software engineering data visualization as a mash up that combines data from issue management, software development and production use. The visualization can show to all stake holders how well continuous delivery is realized in the project. The visualization clearly shows the time spent to specify and develop the features as well the length of the delivery cycle. Further more the visualization shows how much work is unfinished and waiting for delivery. This can help the development team to decrease the amount of unfinished work and by that help them to keep up in continuous delivery mind set. In addition to development data usage of the features is also visualized.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Software engineering, Intelligent dexterity for secure networked infrastructure and applications (IDSNIA), Managing digital industrial transformation (mDIT), Solita Plc.

Contributors: Mattila, A., Lehtonen, T., Terho, H., Mikkonen, T., Systä, K.

Number of pages: 4

Pages: 26-29

Publication date: 24 Jul 2015

#### **Host publication information**

Title of host publication: 2015 IEEE/ACM 2nd International Workshop on Rapid Continuous Software Engineering (RCoSE)

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

ISBN (Print): 9781479919345

ASJC Scopus subject areas: Software, Strategy and Management

Keywords: Continuous Delivery, Information Visualization, Software Analytics

DOIs:

10.1109/RCoSE.2015.12

Source: Scopus

Source ID: 84945956781

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Four patterns for internal startups**

In this paper, we describe patterns that are meant for founding internal startups in a larger company. The patterns are part of a larger pattern language for software startup companies. The patterns presented here cover four main parts of an internal startup's life cycle starting from idea creation by enabling innovation with 20 Rule. The second pattern introduces an incubator phase, where the idea is validated to have a sensible problem and solution. This optimally leads to the creation of an internal startup, where resources are allocated to concretize the idea. With restricted resources such as a limited time, the internal startup may find a new Product-Market fit and offer a validated business opportunity for the parent company. This is concluded by the Exit decision by the parent company and ends the internal startup's life cycle.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Software engineering

Contributors: Leppänen, M., Hokkanen, L.

Publication date: 8 Jul 2015

#### **Host publication information**

Title of host publication: Proceedings of the 20th European Conference on Pattern Languages of Programs, EuroPLoP 2015

Publisher: ACM

Article number: a5

ISBN (Electronic): 9781450338479

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Internal startup, Lean startup, Organization, Organizational patterns, Patterns

DOIs:

10.1145/2855321.2855327

Source: Scopus

Source ID: 84982784052

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Three patterns for user involvement in startups**

Creating products in software startups consists of a great deal of uncertainty combined with little resources. Rapid validation of created solutions with the potential customers is essential to startups. However, often startups lack people with skills needed for the validation. We present three patterns that help in involving users to gain meaningful feedback and learning. First, the feedback has to be gotten from the right people and the right questions have to be asked. Furthermore, if the feedback is collected with a prototype, often called a Minimum Viable Product, users should be able to give feedback of the actual idea, not to any roughness caused by the immaturity and the prototypishness of the product.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Software engineering

Contributors: Hokkanen, L., Leppänen, M.

Publication date: 8 Jul 2015

#### **Host publication information**

Title of host publication: Proceedings of the 20th European Conference on Pattern Languages of Programs, EuroPLoP 2015

Publisher: ACM

Article number: a51

ISBN (Electronic): 9781450338479

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Lean, Startups, User experience

DOIs:

10.1145/2855321.2855373

Source: Scopus

Source ID: 84982794686

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Railway fastener inspection by real-time machine vision**

In this paper, a real-time railway fastener detection system using a high-speed laser range finder camera is presented. First, an extensive analysis of various methods based on pixel-wise and histogram similarities are conducted on a specific railway route. Then, a fusing stage is introduced which combines least correlated approaches also considering the



performance upgrade after fusing. Then, the resulting method is tested on a larger database collected from a different railway route. After observing repeated successes, the method is implemented on NI LabVIEW and run real-time with a high-speed 3-D camera placed under a railway carriage designed for railway quality inspection.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Video, Middle East Technical University, Electrical and Electronics Engineering Department

Contributors: Aytekin, C., Rezaeitabar, Y., Dogru, S., Ulusoy, I.

Number of pages: 7

Pages: 1101-1107

Publication date: 1 Jul 2015

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Transactions on Systems, Man, and Cybernetics: Systems

Volume: 45

Issue number: 7

ISSN (Print): 1083-4427

Ratings:

Scopus rating (2015): CiteScore 6.1 SJR 1.273 SNIP 2.189

Original language: English

ASJC Scopus subject areas: Computer Science Applications, Human-Computer Interaction, Software, Control and Systems Engineering, Electrical and Electronic Engineering

Keywords: High-speed laser range finder, railway fastener detection, railway inspection

DOIs:

10.1109/TSMC.2014.2388435

URLs:

<http://www.scopus.com/inward/record.url?scp=84932638036&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84932638036

Research output: Contribution to journal > Article > Scientific > peer-review

#### A time-optimal bounded velocity path-following controller for generic Wheeled Mobile Robots

This paper, as a generalization of our previous works, presents a unified time-optimal path-following controller for Wheeled Mobile Robots (WMRs). Unlike other path-following controllers, we solve the path-following problem for all common categories of WMRs such as car-like, differential, omnidirectional, all wheels steerable and others. We show that the insertion of our path-following controller into the kinematic and non-holonomic constraints of the wheels, simplifies the otherwise impenetrable constraints, resulting in explicit monotonic functions between the velocity of the base and that of the wheels. Based on this foundation, we present a closed-form solution that keeps all the wheels' steering and driving velocities within their corresponding pre-specified bounds. Simulation data and experimental results from executing the controller in a real-time environment demonstrate the efficacy of the method.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Intelligent Hydraulics and Automation, Research group: Mobile manipulation, Research group: Field robotics and control

Contributors: Oftadeh, R., Ghabcheloo, R., Mattila, J.

Number of pages: 8

Pages: 676-683

Publication date: 29 Jun 2015

#### Host publication information

Title of host publication: 2015 IEEE International Conference on Robotics and Automation (ICRA), 26-30 May 2015, Seattle, WA

Publisher: Institute of Electrical and Electronics Engineers IEEE

ISBN (Print): 978-1-4799-6923-4

ASJC Scopus subject areas: Software, Artificial Intelligence, Control and Systems Engineering, Electrical and Electronic Engineering

DOIs:

10.1109/ICRA.2015.7139252

URLs:

<http://www.scopus.com/inward/record.url?scp=84938244580&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84938244580

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Collaborative cloud-based management of home networks**

Future home networks are expected to become extremely sophisticated, yet only the most technically adept persons are equipped with skills to manage them. In this paper, we provide a novel solution as to how complex smart home networks can be collaboratively managed with the assistance of operators and third party experts. Our solution rests in separating the management and control functionalities of the home access points and routers, away from the actual connectivity, traffic forwarding and routing operations within the home network. By so doing, we present a novel REST-based architecture in which the management of the home network can be hosted in an entirely separate, external cloud-based infrastructure, which models the network within the home as a resource graph.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Information security, Tampere University of Technology

Contributors: Silverajan, B., Luoma, J., Vajaranta, M., Itäpuro, R.

Number of pages: 4

Pages: 786-789

Publication date: 29 Jun 2015

#### **Host publication information**

Title of host publication: Proceedings of the 2015 IFIP/IEEE International Symposium on Integrated Network Management, IM 2015

Publisher: IEEE

ISBN (Print): 9783901882760

ASJC Scopus subject areas: Software, Computer Science Applications, Computer Networks and Communications

Keywords: Cloud, Homenet, IoT, Network Management

DOIs:

10.1109/INM.2015.7140376

Source: Scopus

Source ID: 84942601939

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Electroplated nickel microspring and low-friction precision linear slider: A novel micro-force sensing tool**

This paper introduces a novel micro-force sensing approach utilizing an electroplated nickel microspring and a precision linear slider (PLS) for micro-tensile testing applications. After investigating the effects of friction forces in a PLS, an electroplated nickel microspring is designed, fabricated and integrated into the PLS, and the proposed micro-force sensor concept is validated through experimental results. The microspring fabricated in this paper is limited to forces up to 6 mN with the average sensitivity of 36.63  $\mu\text{N}/\mu\text{m}$ . It is shown that the friction forces introduce uncertainties only to the forces less than 500  $\mu\text{N}$ . The proposed approach allows the fabrication of micro-force sensors for the force ranges of up to tens of Millinewtons for different applications.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Automation Science and Engineering, Integrated Technologies for Tissue Engineering Research (ITTE), Key Laboratory for Thin Film and Microfabrication Technology, Research Institute of Micro/Nano Science and Technology, Ministry of Education China

Contributors: Saketi, P., Wangyang, P., Li, H., Wang, Q., Kallio, P.

Number of pages: 6

Pages: 2679-2684

Publication date: 29 Jun 2015

#### **Host publication information**

Title of host publication: 2015 IEEE International Conference on Robotics and Automation (ICRA), 26-30 May 2015, Seattle, WA

ISBN (Print): 9781479969241

ASJC Scopus subject areas: Software, Artificial Intelligence, Control and Systems Engineering, Electrical and Electronic Engineering

DOIs:

10.1109/ICRA.2015.7139561

URLs:

<http://www.scopus.com/inward/record.url?scp=84938220720&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84938220720

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Novel pairwise coupled kinematic solution for algebraic angular acceleration estimation of serial link manipulators**

We consider low-noise angular acceleration estimation for multi-axis robotic manipulators. The proposed model uses pairwise coupled inertial measurements across a section of the kinematic chain, which is reduced to a single rigid body. Experimental validation is built upon compact low-power micro-electro-mechanical (MEMS) components, installed on a full-scale heavy-duty mobile manipulator. While the model itself has a built-in mechanism for common-mode disturbance rejection, an adaptive transversal filter is devised for a further improvement. The results indicate a 40-80 fold suppression of high-frequency perturbations with respect to a baseline motion derivative, the discrete difference. As inertial sensors require no mechanical contact to rotating axes and the number of parameters is kept low, the model is easily applicable to motion control feedback of typical heavy-duty manipulators.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: MMDM, Department of Intelligent Hydraulics and Automation, Research group: Mobile manipulation, Research area: Information Technology for Biology and Health, Research area: Intelligence in Machines, Research area: Signal and Information Processing, Signal Processing Research Community (SPRC)

Contributors: Vihonen, J., Honkakorpi, J., Mattila, J., Visa, A.

Number of pages: 6

Pages: 809-814

Publication date: 29 Jun 2015

#### **Host publication information**

Title of host publication: 2015 IEEE International Conference on Robotics and Automation (ICRA)

Publisher: Institute of Electrical and Electronics Engineers IEEE

ISBN (Print): 978-1-4799-6923-4

ASJC Scopus subject areas: Software, Artificial Intelligence, Control and Systems Engineering, Electrical and Electronic Engineering

DOIs:

10.1109/ICRA.2015.7139271

URLs:

<http://www.scopus.com/inward/record.url?scp=84938217097&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

ORG=sgn,0.5

ORG=iha,0.5

Source: Scopus

Source ID: 84938217097

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Optimal sensing via multi-armed bandit relaxations in mixed observability domains**

Sequential decision making under uncertainty is studied in a mixed observability domain. The goal is to maximize the amount of information obtained on a partially observable stochastic process under constraints imposed by a fully observable internal state. An upper bound for the optimal value function is derived by relaxing constraints. We identify conditions under which the relaxed problem is a multi-armed bandit whose optimal policy is easily computable. The upper bound is applied to prune the search space in the original problem, and the effect on solution quality is assessed via simulation experiments. Empirical results show effective pruning of the search space in a target monitoring domain.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Automation Science and Engineering, Research area: Dynamic Systems

Contributors: Lauri, M., Ritala, R.

Number of pages: 6

Pages: 4807-4812

Publication date: 29 Jun 2015

#### **Host publication information**

Title of host publication: 2015 IEEE International Conference on Robotics and Automation (ICRA), 26-30 May 2015, Seattle, WA  
Volume: 2015-June  
ISBN (Print): 978-1-4799-6923-4  
ASJC Scopus subject areas: Software, Artificial Intelligence, Control and Systems Engineering, Electrical and Electronic Engineering  
Electronic versions:  
ICRA15\_1071\_FI  
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10.1109/ICRA.2015.7139867  
URLs:  
<http://urn.fi/URN:NBN:fi:tyy-201605033926>  
Source: Scopus  
Source ID: 84938230088  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **A comparison of security assurance support of agile software development methods**

Agile methods increase the speed and reduce the cost of software projects; however, they have been criticized for lack of documentation, traditional quality control, and, most importantly, lack of security assurance - mostly due to their informal and self-organizing approach to software development. This paper clarifies the requirements for security assurance by using an evaluation framework to analyze the compatibility of established agile security development methods: XP, Scrum and Kanban, combined with Microsoft SDL security framework, against Finland's established national security regulation (Vahti). We also analyze the selected methods based on their role definitions, and provide some avenues for future research.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Managing digital industrial transformation (mDIT), University of Turku, Department of Information Technology  
Contributors: Rindell, K., Hyrynsalmi, S., Leppänen, V.  
Number of pages: 8  
Pages: 61-68  
Publication date: 25 Jun 2015

#### **Host publication information**

Title of host publication: Computer Systems and Technologies - 16th International Conference, CompSysTech 2015: Proceedings  
Volume: 1008  
Publisher: Association for Computing Machinery  
ISBN (Electronic): 9781450333573  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: DESMET, Kanban, Scrum, SDL, Secure agile development, Security assurance, Vahti, XP  
DOIs:  
10.1145/2812428.2812431  
Source: Scopus  
Source ID: 84957689583  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Information retrieval approach to meta-visualization**

Visualization is crucial in the first steps of data analysis. In visual data exploration with scatter plots, no single plot is sufficient to analyze complicated high-dimensional data sets. Given numerous visualizations created with different features or methods, meta-visualization is needed to analyze the visualizations together. We solve how to arrange numerous visualizations onto a meta-visualization display, so that their similarities and differences can be analyzed. Visualization has recently been formalized as an information retrieval task; we extend this approach, and formalize meta-visualization as an information retrieval task whose performance can be rigorously quantified and optimized. We introduce a machine learning approach to optimize the meta-visualization, based on an information retrieval perspective: two visualizations are similar if the analyst would retrieve similar neighborhoods between data samples from either visualization. Based on the approach, we introduce a nonlinear embedding method for meta-visualization: it optimizes locations of visualizations on a display, so that visualizations giving similar information about data are close to each other. In experiments we show such meta-visualization outperforms alternatives, and yields insight into data in several case studies.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Research Community on Data-to-Decision (D2D), Aalto University  
Contributors: Peltonen, J., Lin, Z.  
Number of pages: 41  
Pages: 189-229  
Publication date: 1 May 2015  
Peer-reviewed: Yes

#### Publication information

Journal: Machine Learning  
Volume: 99  
Issue number: 2  
ISSN (Print): 0885-6125  
Ratings:  
Scopus rating (2015): CiteScore 5.2 SJR 1.257 SNIP 2.054  
Original language: English  
ASJC Scopus subject areas: Software, Artificial Intelligence  
Keywords: Meta-visualization, Neighbor embedding, Nonlinear dimensionality reduction  
DOIs:  
10.1007/s10994-014-5464-x  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84939887799&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84939887799  
Research output: Contribution to journal › Article › Scientific › peer-review

#### Glance awareness and gaze interaction in smartwatches

Smartwatches are widely available and increasingly adopted by consumers. The most common way of interacting with smartwatches is either touching a screen or pressing buttons on the sides. However, such techniques require using both hands. We propose glance awareness and active gaze interaction as alternative techniques to interact with smartwatches. We will describe an experiment conducted to understand the user preferences for visual and haptic feedback on a "glance" at the wristwatch. Following the glance, the users interacted with the watch using gaze gestures. Our results showed that user preferences differed depending on the complexity of the interaction. No clear preference emerged for complex interaction. For simple interaction, haptics was the preferred glance feedback modality. Copyright is held by the author/owner(s).

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Augmented Human Activities (AHA), Tampere Unit for Computer-Human Interaction (TAUCHI)  
Contributors: Akkil, D., Kangas, J., Rantala, J., Isokoski, P., Špakov, O., Raisamo, R.  
Number of pages: 6  
Pages: 1271-1276  
Publication date: 18 Apr 2015

#### Host publication information

Title of host publication: CHI 2015 - Extended Abstracts Publication of the 33rd Annual CHI Conference on Human Factors in Computing Systems: Crossings  
Volume: 18  
Publisher: Association for Computing Machinery  
ISBN (Electronic): 9781450331463  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software  
Keywords: Gaze input, Haptic feedback, Wearable computing  
DOIs:  
10.1145/2702613.2732816  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84954204642&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84954204642  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Intentstreams: Smart parallel search streams for branching exploratory search

The user's understanding of information needs and the information available in the data collection can evolve during an exploratory search session. Search systems tailored for well-defined narrow search tasks may be suboptimal for

exploratory search where the user can sequentially refine the expressions of her information needs and explore alternative search directions. A major challenge for exploratory search systems design is how to support such behavior and expose the user to relevant yet novel information that can be difficult to discover by using conventional query formulation techniques. We introduce IntentStreams, a system for exploratory search that provides interactive query refinement mechanisms and parallel visualization of search streams. The system models each search stream via an intent model allowing rapid user feedback. The user interface allows swift initiation of alternative and parallel search streams by direct manipulation that does not require typing. A study with 13 participants shows that IntentStreams provides better support for branching behavior compared to a conventional search system.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), University of Helsinki, Aalto University, School of Management (JKK)

Contributors: Andolina, S., Klouche, K., Peltonen, J., Hoque, M., Ruotsalo, T., Cabral, D., Klami, A., Głowacka, D., Floréen, P., Jacucci, G.

Number of pages: 6

Pages: 300-305

Publication date: 18 Mar 2015

#### Host publication information

Title of host publication: IUI 2015 - Proceedings of the 20th ACM International Conference on Intelligent User Interfaces

Volume: 2015-January

Publisher: Association for Computing Machinery

ISBN (Electronic): 9781450333061

ASJC Scopus subject areas: Software, Human-Computer Interaction

Keywords: Information exploration, Parallel browsing, User interface design

DOIs:

10.1145/2678025.2701401

URLs:

<http://www.scopus.com/inward/record.url?scp=84939638219&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84939638219

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### On the kernel Extreme Learning Machine classifier

In this paper, we discuss the connection of the kernel versions of the ELM classifier with infinite Single-hidden Layer Feedforward Neural networks and show that the original ELM kernel definition can be adopted for the calculation of the ELM kernel matrix for two of the most common activation functions, i.e., the RBF and the sigmoid functions. In addition, we show that a low-rank decomposition of the kernel matrix defined on the input training data can be exploited in order to determine an appropriate ELM space for input data mapping. The ELM space determined from this process can be subsequently used for network training using the original ELM formulation. Experimental results denote that the adoption of the low-rank decomposition-based ELM space determination leads to enhanced performance, when compared to the standard choice, i.e., random input weights generation.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 7

Pages: 11-17

Publication date: 1 Mar 2015

Peer-reviewed: Yes

#### Publication information

Journal: Pattern Recognition Letters

Volume: 54

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2015): CiteScore 5.1 SJR 0.95 SNIP 2.002

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Extreme learning machine, Infinite networks, Single-hidden layer networks

DOIs:

10.1016/j.patrec.2014.12.003

URLs:

<http://www.scopus.com/inward/record.url?scp=84920068822&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84920068822

Research output: Contribution to journal › Article › Scientific › peer-review

### **The highways and country roads to continuous deployment**

As part of a Finnish research program, researchers interviewed 15 information and communications technology companies to determine the extent to which the companies adopted continuous deployment. They also aimed to find out why continuous deployment is considered beneficial and what the obstacles are to its full adoption. The benefits mentioned the most often were the ability to get faster feedback, the ability to deploy more often to keep customers satisfied, and improved quality and productivity. Despite understanding the benefits, none of the companies adopted a fully automatic deployment pipeline. The companies also had higher continuous-deployment capability than what they practiced. In many cases, they consciously chose to not aim for full continuous deployment. Obstacles to full adoption included domain-imposed restrictions, resistance to change, customer desires, and developers' skill and confidence.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Pervasive Computing, Research area: Software engineering, Aalto University, University of Helsinki

Contributors: Leppänen, M., Mäkinen, S., Pagels, M., Eloranta, V., Itkonen, J., Mäntylä, M. V., Männistö, T.

Number of pages: 9

Pages: 64-72

Publication date: 1 Mar 2015

Peer-reviewed: Yes

### **Publication information**

Journal: IEEE Software

Volume: 32

Issue number: 2

ISSN (Print): 0740-7459

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Original language: English

ASJC Scopus subject areas: Software

Keywords: continuous delivery, continuous deployment, continuous integration, software development, software engineering, thematic analysis

DOIs:

10.1109/MS.2015.50

URLs:

<http://www.scopus.com/inward/record.url?scp=84925158464&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84925158464

Research output: Contribution to journal › Article › Scientific › peer-review

### **The MOBISERV-AIIA eating and drinking multi-view database for vision-based assisted living**

Assisted living has a particular social importance in most developed societies, due to the increased life expectancy of the general population and the ensuing ageing problems. It has also importance for the provision of improved home care in cases of disabled persons or persons suffering from certain diseases that have high social impact. In this context, the development of computer vision systems capable to identify human eating and drinking activity can be really useful in order to prevent undernourishment/malnutrition and dehydration in a smart home environment targeting to extend independent living of older persons in the early stage of dementia. In this paper, we first describe the human centered interface specifications and implementations for such a system, which can be supported by ambient intelligence and robotic technologies. We, subsequently, describe a multi-view eating and drinking activity recognition database that has been created in order to facilitate research towards this direction. The database has been created by using four cameras in order to produce multi-view videos, each depicting one of twelve persons having a meal, resulting to a database size equal to 59.68 hours in total. Various types of meals have been recorded, i.e., breakfast, lunch and fast food. Moreover, the persons have different sizes, clothing and are of different sex. The database has been annotated in a frame base in terms of person ID and activity class. We hope that such a database will serve as a benchmark data set for computer vision researchers in order to devise methods targeting to this important application.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), School of Dentistry, Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Marami, E., Tefas, A., Pitas, I., Lyroudia, K.

Number of pages: 20

Pages: 254-273

Publication date: 1 Mar 2015

Peer-reviewed: Yes

### Publication information

Journal: Journal of Information Hiding and Multimedia Signal Processing

Volume: 6

Issue number: 2

ISSN (Print): 2073-4212

Ratings:

Scopus rating (2015): CiteScore 2.6 SJR 0.414 SNIP 1.483

Original language: English

ASJC Scopus subject areas: Computer Vision and Pattern Recognition, Software

Keywords: Activity recognition, Multiview video database, Nutrition assistance, Smart home environment

Source: Scopus

Source ID: 84911457722

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### LTE indoor MIMO performances field measurements

Long-term evolution (LTE) and multiple input multiple output (MIMO) have earned reputations to be a cutting-edge technology, which can boost significantly wireless communication performances. The paper aims at providing LTE MIMO performances in indoor environments and, therefore, guidelines for network operators can be proposed. Medium access control throughput (MAC TP) and some system parameters in LTE network that are linked with MAC TP, such as Channel Quality Indicator (CQI), Modulation and Coding Scheme (MCS), Ranking Indicator (RI), Pre-coding Matrix Indicator (PMI), as well as MIMO utilization, are analysed. Effects of indoor propagation, Line of Sight (LoS), No-line of Sight (NLoS), strong and weak signal levels on Signal to Noise Ratio (SNR) strength and MIMO utilization are clarified. In this paper, the performances of MIMO transmission mode over transmit diversity (TxDiv, Multiple Input-Single Output-MISO) and single antenna (Single Input Multiple Output-SIMO) modes are also analyzed and compared at overall manner and at channel-specific manners.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Tampere University of Technology, Department of Electronics and Communications Engineering, Department of Electronics and Communication Engineering, Electrical and Electronics Engineering Department, Department of Electric-Electronics Engineering, Ho Chi Minh City University of Technology, Industrial University of Ho Chi Minh City, Ho Chi Minh City University of Food Industry

Contributors: Nguyen-Thanh, D., Le-Tien, T., Bui-Thu, C., Le-Thanh, T.

Number of pages: 6

Pages: 84-89

Publication date: 17 Feb 2015

### Host publication information

Title of host publication: International Conference on Advanced Technologies for Communications

Publisher: IEEE

ISBN (Print): 9781479969555

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software

Keywords: Field measurements, LTE, MIMO, MISO, OFDM, Rayleigh channel, Rician channel

DOIs:

10.1109/ATC.2014.7043361

### Bibliographical note

INT=elt,"Nguyen-Thanh, Duc"

Research output: [Chapter in Book/Report/Conference proceeding](#) > [Conference contribution](#) > [Scientific](#) > [peer-review](#)

### Adaptive spatial resolution selection for stereoscopic video compression with MV-HEVC: A frequency based approach

One approach for stereoscopic video compression is to down sample the content prior to encoding and up sample it to the original spatial resolution after decoding. In this study it is shown that the ratio by which the content should be rescaled is



sequence dependent. Hence, a frequency based method is introduced enabling fast and accurate estimation of the best down sampling ratio for different stereoscopic video clips. It is shown that exploiting this approach can bring 3.38% delta bitrate reduction over five camera-captured sequences.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Video, Research Community on Data-to-Decision (D2D), Nokia

Contributors: Aflaki, P., Hannuksela, M. M., Gabbouj, M.

Number of pages: 4

Pages: 267-270

Publication date: 5 Feb 2015

#### **Host publication information**

Title of host publication: 2014 IEEE International Symposium on Multimedia, ISM 2014, 10-12 Dec. 2014, Taichung

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

ISBN (Print): 9781479943111

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Vision and Pattern Recognition, Human-Computer Interaction, Software, Media Technology

Keywords: frequency power spectrum, MVC, objective quality metrics, resolution adjustment

DOIs:

10.1109/ISM.2014.11

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Salient event detection in basketball mobile videos**

Modern smartphones have become the most popular means for recording videos. In fact, thanks to their portability, smartphones allow for recording anything and at any moment of our everyday life. One common occasion is represented by sport happenings, where people often record their favourite team or players. Automatic analysis of such videos is important for enabling applications such as automatic organization, browsing and summarization of the content. This paper proposes novel algorithms for the detection of salient events in videos recorded at basketball games. The novel approach consists of jointly analyzing visual data and magnetometer data. The magnetometer data provides information about the horizontal orientation of the camera. The proposed joint analysis allows for a reduced number of false positives and for a reduced computational complexity. The algorithms are tested on data captured during real basketball games. The experimental results clearly show the advantages of the proposed approach.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Video, Research Community on Data-to-Decision (D2D), Nokia Technologies

Contributors: Cricri, F., Mate, S., Curcio, I. D. D., Gabbouj, M.

Number of pages: 8

Pages: 63-70

Publication date: 5 Feb 2015

#### **Host publication information**

Title of host publication: Proceedings - 2014 IEEE International Symposium on Multimedia, ISM 2014

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

Article number: 7032995

ISBN (Print): 978-1-4799-4312-8

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Computer Vision and Pattern Recognition, Human-Computer Interaction, Software, Media Technology

Keywords: Basketball, detection, event, mobile, video

DOIs:

10.1109/ISM.2014.67

#### **Bibliographical note**

EXT="Curcio, Igor D D"

EXT="Mate, Sujeet"

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Fault tolerant control architecture design for mobile manipulation in scientific facilities**

This paper describes one of the challenging issues implied by scientific infrastructures on a mobile robot cognition architecture. For a generally applicable cognition architecture, we study the dependencies and logical relations between several tasks and subsystems. The overall view of the software modules is described, including their relationship with a

fault management module that monitors the consistency of the data flow among the modules. The fault management module is the solution of the deliberative architecture for the single point failures, and the safety anchor is the reactive solution for the faults by redundant equipment. In addition, a hardware architecture is proposed to ensure safe robot movement as a redundancy for the cognition of the robot. The method is designed for a four-wheel steerable (4WS) mobile manipulator (iMoro) as a case study.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Intelligent Hydraulics and Automation, Research group: Mobile manipulation, Research group: Field robotics and control, Field robotics for efficient work sites (FIRE)

Contributors: M. Aref, M., Oftadeh, R., Ghabcheloo, R., Mattila, J.

Publication date: 29 Jan 2015

Peer-reviewed: Yes

#### Publication information

Journal: international Journal of Advanced Robotic Systems

Volume: 12

Issue number: 4

ISSN (Print): 1729-8806

Ratings:

Scopus rating (2015): CiteScore 2.1 SJR 0.346 SNIP 0.932

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Science Applications

Keywords: Architecture design, Autonomous vehicle drive, Cognition, Mobile robot, Remote handling

DOIs:

10.5772/60038

URLs:

<http://www.scopus.com/inward/record.url?scp=84923377541&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84923377541

Research output: Contribution to journal > Article > Scientific > peer-review

#### Classification of iPSC colony images using hierarchical strategies with support vector machines

In this preliminary research we examine the suitability of hierarchical strategies of multi-class support vector machines for classification of induced pluripotent stem cell (iPSC) colony images. The iPSC technology gives incredible possibilities for safe and patient specific drug therapy without any ethical problems. However, growing of iPSCs is a sensitive process and abnormalities may occur during the growing process. These abnormalities need to be recognized and the problem returns to image classification. We have a collection of 80 iPSC colony images where each one of the images is pre-labeled by an expert to class bad, good or semigood. We use intensity histograms as features for classification and we evaluate histograms from the whole image and the colony area only having two datasets. We perform two feature reduction procedures for both datasets. In classification we examine how different hierarchical constructions effect the classification. We perform thorough evaluation and the best accuracy was around 54% obtained with the linear kernel function. Between different hierarchical structures, in many cases there are no significant changes in results. As a result, intensity histograms are a good baseline for the classification of iPSC colony images but more sophisticated feature extraction and reduction methods together with other classification methods need to be researched in future.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electronics and Communications Engineering, Research group: Computational Biophysics and Imaging Group, BioMediTech, Augmented Human Activities (AHA), Integrated Technologies for Tissue Engineering Research (ITTE), University of Tampere, Univ Tampere, University of Tampere, BioMediTech, BMT FM5

Contributors: Joutsijoki, H., Rasku, J., Haponen, M., Baldin, I., Gizatdinova, Y., Paci, M., Saarikoski, J., Varpa, K., Siirtola, H., Ávalos-Salguero, J., Iltanen, K., Laurikkala, J., Penttinen, K., Hyttinen, J., Aalto-Setälä, K., Juhola, M.

Number of pages: 7

Pages: 86-92

Publication date: 13 Jan 2015

#### Host publication information

Title of host publication: IEEE SSCI 2014 - 2014 IEEE Symposium Series on Computational Intelligence - CIDM 2014: 2014 IEEE Symposium on Computational Intelligence and Data Mining, Proceedings

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

Article number: 7008152

ISBN (Print): 9781479945191

ASJC Scopus subject areas: Artificial Intelligence, Information Systems, Signal Processing, Software

DOIs:

10.1109/CIDM.2014.7008152

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Image database TID2013: Peculiarities, results and perspectives**

This paper describes a recently created image database, TID2013, intended for evaluation of full-reference visual quality assessment metrics. With respect to TID2008, the new database contains a larger number (3000) of test images obtained from 25 reference images, 24 types of distortions for each reference image, and 5 levels for each type of distortion. Motivations for introducing 7 new types of distortions and one additional level of distortions are given; examples of distorted images are presented. Mean opinion scores (MOS) for the new database have been collected by performing 985 subjective experiments with volunteers (observers) from five countries (Finland, France, Italy, Ukraine, and USA). The availability of MOS allows the use of the designed database as a fundamental tool for assessing the effectiveness of visual quality. Furthermore, existing visual quality metrics have been tested with the proposed database and the collected results have been analyzed using rank order correlation coefficients between MOS and considered metrics. These correlation indices have been obtained both considering the full set of distorted images and specific image subsets, for highlighting advantages and drawbacks of existing, state of the art, quality metrics. Approaches to thorough performance analysis for a given metric are presented to detect practical situations or distortion types for which this metric is not adequate enough to human perception. The created image database and the collected MOS values are freely available for downloading and utilization for scientific purposes.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Computational Imaging-CI, Research group: Algebraic and Algorithmic Methods in Signal Processing AAMSP, Signal Processing Research Community (SPRC), National Aerospace University, Dept of Transmitters, Receivers and Signal Processing, University of Rennes 1 - IETR, Media Communications Lab, USC Viterbi School of Engineering

Contributors: Ponomarenko, N., Jin, L., Ieremeiev, O., Lukin, V., Egiazarian, K., Astola, J., Vozel, B., Chehdi, K., Carli, M., Battisti, F., Jay Kuo, C. C.

Number of pages: 21

Pages: 57-77

Publication date: 1 Jan 2015

Peer-reviewed: Yes

### **Publication information**

Journal: Signal Processing: Image Communication

Volume: 30

ISSN (Print): 0923-5965

Ratings:

Scopus rating (2015): CiteScore 4 SJR 0.532 SNIP 1.413

Original language: English

ASJC Scopus subject areas: Computer Vision and Pattern Recognition, Signal Processing, Software, Electrical and Electronic Engineering

Keywords: Image denoising, Image lossy compression, Image visual quality metrics

DOIs:

10.1016/j.image.2014.10.009

URLs:

<http://www.scopus.com/inward/record.url?scp=84919839405&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84919839405

Research output: Contribution to journal › Article › Scientific › peer-review

### **PaaSword: A holistic data privacy and security by design framework for cloud services**

The valuable transformation of organizations that adopt cloud computing is indisputably accompanied by a number of security threats that should be considered. In this paper, we outline significant security challenges presented when migrating to a cloud environment and propose PaaSword—a novel holistic, data privacy and security by design, framework that aspires to alleviate them. The envisaged framework intends to maximize and fortify the trust of individual, professional and corporate users to cloud services. Specifically, PaaSword involves a context-aware security model, the necessary policies enforcement and governance mechanisms along with a physical distribution, encryption and query middleware, aimed at facilitating the implementation of secure and transparent cloud-based applications.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: National Technical University of Athens, Security Lab, SICS, Ubitech Ltd., Karlsruhe Institute of Technology, Insitute for Technical Physics, Germany, CAS Software AG, South East European Research Centre  
Contributors: Verginadis, Y., Michalas, A., Gouvas, P., Schiefer, G., Hübsch, G., Paraskakis, I.

Number of pages: 8

Pages: 206-213

Publication date: 1 Jan 2015

### Host publication information

Title of host publication: CLOSER 2015 - 5th International Conference on Cloud Computing and Services Science, Proceedings

Publisher: SCITEPRESS

ISBN (Electronic): 9789897581045

ASJC Scopus subject areas: Software

Keywords: Cloud Computing, Context-aware Security, Data Privacy, Security by Design, Symmetric Searchable Encryption

Source: Scopus

Source ID: 84969792485

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Social behavior in bacterial nanonetworks: Challenges and opportunities

Molecular communication holds the promise to enable communication between nanomachines with a view to increasing their functionalities and opening up new possible applications. Due to some of the biological properties, bacteria have been proposed as a possible information carrier for molecular communication, and the corresponding communication networks are known as bacterial nanonetworks. The biological properties include the ability for bacteria to mobilize between locations and carry the information encoded in deoxyribonucleic acid molecules. However, similar to most organisms, bacteria have complex social properties that govern their colony. These social characteristics enable the bacteria to evolve through various fluctuating environmental conditions by utilizing cooperative and non-cooperative behaviors. This article provides an overview of the different types of cooperative and non-cooperative social behavior of bacteria. The challenges (due to non-cooperation) and the opportunities (due to cooperation) these behaviors can bring to the reliability of communication in bacterial nanonetworks are also discussed. Finally, simulation results on the impact of bacterial cooperative social behavior on the end-to-end reliability of a single-link bacterial nanonetwork are presented. The article concludes by highlighting the potential future research opportunities in this emerging field.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, Wireless Communications and Positioning (WICO), University of Manitoba

Contributors: Hasan, M., Hossain, E., Balasubramaniam, S., Koucheryavy, Y.

Number of pages: 9

Pages: 26-34

Publication date: 1 Jan 2015

Peer-reviewed: Yes

### Publication information

Journal: IEEE Network

Volume: 29

Issue number: 1

Article number: 7018200

ISSN (Print): 0890-8044

Ratings:

Scopus rating (2015): CiteScore 7.9 SJR 1.107 SNIP 2.903

Original language: English

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Information Systems, Software

DOIs:

10.1109/MNET.2015.7018200

Source: Scopus

Source ID: 84921862364

Research output: Contribution to journal › Article › Scientific › peer-review

### Analytical model in discrete time for cross-layer video communication over LTE

Since video traffic is resource intensive, it is a challenging issue to stream video over low bandwidth networks, whereas video communication over LTE becomes an open research topic nowadays due to LTE's high throughput capabilities.

Indeed, video transmission requires low delay, and wireless channel is time-varying, which result in a scenario when a layer-separated design is replaced by a Cross-Layer Adaptation (CLA) principle. In this paper an efficient analytical model that evaluates the behavior of the downlink LTE channel with CLA is presented. To the best of our knowledge, this is the first time an analytical model using CLA principle has been devised that covers both the transmission process from the eNB to the User Equipment (UE) at the first phase and video decoding process at the UE at the second phase. In order to ensure the cross-layer adaptation in the model, the arrival rate varies based on the received video request, whereas the service probability changes according to the channel quality indicator sent from the UE. In the experimental part the analysis of the main performance measures found from the stationary distribution is conducted.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Video, Research Community on Data-to-Decision (D2D), Department of Telecommunication Systems, Peoples' Friendship University of Russia

Contributors: Efimushkina, T., Gabbouj, M., Samuylov, K.

Number of pages: 13

Pages: 345-357

Publication date: 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Automatic Control and Computer Sciences

Volume: 48

Issue number: 6

ISSN (Print): 0146-4116

Ratings:

Scopus rating (2015): CiteScore 0.4 SJR 0.184 SNIP 0.561

Original language: English

ASJC Scopus subject areas: Signal Processing, Software, Control and Systems Engineering

Keywords: cross-layer adaptation, DASH, downlink, LTE, OFDMA, queuing system, stationary distribution

DOIs:

10.3103/S0146411614060029

Source: Scopus

Source ID: 84920176216

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

#### **Cultural influence on online community use: A cross-cultural study on online exercise diary users of three nationalities**

This study investigates the influence of culture on the use of a website intended for tracking exercise activities. The data was collected using an online survey with 258 respondents from three national backgrounds: Germany, the USA and Spain. In the analysis, the focus was on determining whether users' cultural background impacts their use and perception of the site, especially as concerns social networking and the sharing of content. The Spanish were most interested in social networking, collaboration and sharing content with others, whereas the German participants were the least interested in these activities. The applicability of Hofstede's cultural theory in the explanation of differences between national cultures in online community use is discussed.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Pervasive Computing, University of Tampere

Contributors: Malinen, S., Nurkka, P.

Number of pages: 17

Pages: 153-169

Publication date: 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Web Based Communities

Volume: 11

Issue number: 2

ISSN (Print): 1477-8394

Ratings:

Scopus rating (2015): CiteScore 1.4 SJR 0.268 SNIP 0.406

Original language: English

ASJC Scopus subject areas: Computer Networks and Communications, Software, Education, Communication

Keywords: Cross-cultural research, Health and wellness applications, Online communities, SNSs, Social network sites

DOIs:

10.1504/IJWBC.2015.068539

URLs:

<http://www.scopus.com/inward/record.url?scp=84927129737&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

EXT="Malinen, Sanna"

Source: Scopus

Source ID: 84927129737

Research output: Contribution to journal › Article › Scientific › peer-review

### **Designing an Unobtrusive Analytics Framework for Monitoring Java Applications**

In software development, attention has recently been placed on understanding users and their interactions with systems. User studies, practices such as A/B testing, and frameworks such as Google Analytics that gather data on production use have become common approaches in particular in the context of the Web, where it is easy to perform frequent updates as new needs emerge. However, when considering installable desktop applications, the situation gets more complex. While analytics facilities are still needed, they should address business logic, not generic traffic as is the case with many web sites. Moreover, analytics should be unobtrusive, and not have a high impact on the evolution of the actual application; thus, analytics should be treated as an add-on, as the target system may already exist. Finally, the instrumentation of features that are observed should be easy and flexible, but the provided mechanisms should be expressive enough for many use cases. In this paper, we examine different alternatives for implementing such monitoring mechanisms, and report results from an experiment with Vaadin, a web framework based on Java and Google Web Toolkit, GWT.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: Software engineering

Contributors: Suonsyrjä, S., Mikkonen, T.

Number of pages: 16

Pages: 160-175

Publication date: 2015

### **Host publication information**

Title of host publication: Software Measurement : 25th International Workshop on Software Measurement and 10th International Conference on Software Process and Product Measurement, IWSM-Mensura 2015, Kraków, Poland, October 5–7, 2015, Proceedings

Volume: 230

Publisher: Springer International Publishing

Editors: Kobyliński, A., Czarnacka-Chrobot, B., Świerczek, J.

ISBN (Print): 978-3-319-24284-2

ISBN (Electronic): 978-3-319-24285-9

### **Publication series**

Name: Lecture Notes in Business Information Processing

Publisher: Springer

ASJC Scopus subject areas: Electrical and Electronic Engineering, Software

Keywords: software engineering, software development, case study, software usage data, software analytics

DOIs:

10.1007/978-3-319-24285-9\_11

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Distant speech separation using predicted time-frequency masks from spatial features**

Speech separation algorithms are faced with a difficult task of producing high degree of separation without containing unwanted artifacts. The time-frequency (T-F) masking technique applies a real-valued (or binary) mask on top of the signal's spectrum to filter out unwanted components. The practical difficulty lies in the mask estimation. Often, using efficient masks engineered for separation performance leads to presence of unwanted musical noise artifacts in the separated signal. This lowers the perceptual quality and intelligibility of the output. Microphone arrays have been long studied for processing of distant speech. This work uses a feed-forward neural network for mapping microphone array's spatial features into a T-F mask. Wiener filter is used as a desired mask for training the neural network using speech examples in simulated setting. The T-F masks predicted by the neural network are combined to obtain an enhanced separation mask that exploits the information regarding interference between all sources. The final mask is applied to the delay-and-sum beamformer (DSB) output. The algorithm's objective separation capability in conjunction with the separated speech intelligibility is tested with recorded speech from distant talkers in two rooms from two distances. The results show improvement in instrumental measure for intelligibility and frequency-weighted SNR over complex-valued non-negative matrix factorization (CNMF) source separation approach, spatial sound source separation, and conventional

beamforming methods such as the DSB and minimum variance distortionless response (MVDR).

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Audio research group

Contributors: Pertilä, P., Nikunen, J.

Number of pages: 10

Pages: 97-106

Publication date: 2015

Peer-reviewed: Yes

#### Publication information

Journal: Speech Communication

Volume: 68

ISSN (Print): 0167-6393

Ratings:

Scopus rating (2015): CiteScore 4.1 SJR 0.49 SNIP 1.612

Original language: English

ASJC Scopus subject areas: Modelling and Simulation, Computer Science Applications, Computer Vision and Pattern Recognition, Software, Communication, Linguistics and Language, Language and Linguistics

Keywords: Beamforming, Microphone arrays, Neural networks, Speech separation, Time-frequency masking

DOIs:

10.1016/j.specom.2015.01.006

Source: Scopus

Source ID: 84923277715

Research output: Contribution to journal > Article > Scientific > peer-review

#### Dynamic text presentation in print interpreting - An eye movement study of reading behaviour

Print interpreting supports people with a hearing disability by giving them access to spoken language. In print interpreting, the interpreter types the spoken text in real time for the hard-of-hearing client to read. This results in dynamic text presentation. An eye movement study was conducted to compare two types of dynamic text presentation formats in print interpreting: letter-by-letter and word-by-word. Gaze path analysis with 20 hearing participants showed different types of reading behaviour during reading of two pieces of text in these two presentation formats. Our analysis revealed that the text presentation format has a significant effect on reading behaviour. Rereading and regressions occurred significantly more often with the word-by-word format than with the letter-by-letter format. We also found a significant difference between the number of regressions starting at the words that end a sentence and that of regressions starting at all other words. The frequency of rereading was significantly higher for incorrectly typed or abbreviated words than for the other words. Analysis of the post-test questionnaire found almost equal acceptance of the word-by-word and letter-by-letter formats by the participants. A follow-up study with 18 hard-of-hearing participants showed a similar trend in results. The findings of this study highlight the importance of developing print interpreting tools that allow the interpreter and the client to choose the options that best facilitate the communication. They also bring up the need to develop new eye movement metrics for analysing the reading of dynamic text, and provide first results on a new dynamic presentation context.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Augmented Human Activities (AHA), School of Management (JKK)

Contributors: Sharmin, S., Špakov, O., Rähä, K. J.

Number of pages: 14

Pages: 17-30

Publication date: 2015

Peer-reviewed: Yes

#### Publication information

Journal: International Journal of Human-Computer Studies

Volume: 78

ISSN (Print): 1071-5819

Ratings:

Scopus rating (2015): CiteScore 4.4 SJR 0.666 SNIP 1.739

Original language: English

ASJC Scopus subject areas: Human Factors and Ergonomics, Software, Education, Engineering(all), Human-Computer Interaction, Hardware and Architecture

Keywords: Dynamic text presentation, Eye movements, Print interpreting, Reading, Regressions

DOIs:

10.1016/j.ijhcs.2015.01.010

URLs:

<http://www.scopus.com/inward/record.url?scp=84923618729&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84923618729

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### Majorization-minimization for manifold embedding

Nonlinear dimensionality reduction by manifold embedding has become a popular and powerful approach both for visualization and as preprocessing for predictive tasks, but more efficient optimization algorithms are still crucially needed. Majorization-Minimization (MM) is a promising approach that monotonically decreases the cost function, but it remains unknown how to tightly majorize the manifold embedding objective functions such that the resulting MM algorithms are efficient and robust. We propose a new MM procedure that yields fast MM algorithms for a wide variety of manifold embedding problems. In our majorization step, two parts of the cost function are respectively upper bounded by quadratic and Lipschitz surrogates, and the resulting upper bound can be minimized in closed form. For cost functions amenable to such QL-majorization, the MM yields monotonic improvement and is efficient: In experiments, the newly developed MM algorithms outperformed five state-of-the-art optimization approaches in manifold embedding tasks.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aalto University

Contributors: Yang, Z., Peltonen, J., Kaski, S.

Number of pages: 10

Pages: 1088-1097

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: Journal of Machine Learning Research

Volume: 38

ISSN (Print): 1532-4435

Ratings:

Scopus rating (2015): CiteScore 4.5 SJR 1.431 SNIP 2.032

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Software, Statistics and Probability, Artificial Intelligence

URLs:

<http://www.scopus.com/inward/record.url?scp=84954311496&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84954311496

Research output: [Contribution to journal](#) > [Article](#) > [Scientific](#) > [peer-review](#)

### On constructibility and unconstructibility of LTS operators from other LTS operators

An LTS operator can be constructed from a set of LTS operators up to an equivalence if and only if there is an LTS expression that only contains operators from the set and whose result is equivalent to the result of the operator. In this publication this idea is made precise in the context where each LTS has an alphabet of its own and the operators may depend on the alphabets. Then the extent to which LTS operators are constructible is studied. Most, if not all, established LTS operators have the property that each trace of the result arises from the execution of no more than one trace of each of its argument LTSs, and similarly for infinite traces. All LTS operators that have this property and satisfy some other rather weak regularity properties can be constructed from parallel composition and hiding up to the equivalence that compares the alphabets, traces, and infinite traces of the LTSs. Furthermore, a collection of other miscellaneous constructibility and unconstructibility results is presented.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Mathematics, Regulation of learning and active learning methods (REALMEE)

Contributors: Valmari, A.

Number of pages: 28

Pages: 207-234

Publication date: 2015

Peer-reviewed: Yes

### Publication information



Journal: Acta Informatica

Volume: 52

Issue number: 2-3

ISSN (Print): 0001-5903

Ratings:

Scopus rating (2015): CiteScore 1.7 SJR 0.421 SNIP 0.736

Original language: English

ASJC Scopus subject areas: Computer Networks and Communications, Information Systems, Software

Electronic versions:

AVActaInf2015

DOIs:

10.1007/s00236-015-0217-2

URLs:

<http://urn.fi/URN:NBN:fi:tty-201606064226>

Source: Scopus

Source ID: 84925463574

Research output: Contribution to journal › Article › Scientific › peer-review

### Quality measures for improving technology trees

The quality of technology trees in digital games can be improved by adjusting their structural and quantitative properties. Therefore, there is a demand for recognizing and measuring such properties. Part of the process can be automated; there are properties measurable by computers, and analyses based on the results (and visualizations of them) may help to produce significantly better technology trees, even practically without extra workload for humans. In this paper, we introduce useful technology tree properties and novel measuring features implemented into our software tool for manipulating technology trees.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Mathematics, Research group: MAT Computer Science and Applied Logics

Contributors: Heinimäki, T. J., Elomaa, T.

Number of pages: 10

Publication date: 2015

Peer-reviewed: Yes

### Publication information

Journal: International Journal of Computer Games Technology

Volume: 2015

Article number: 975371

ISSN (Print): 1687-7047

Ratings:

Scopus rating (2015): CiteScore 1 SJR 0.204 SNIP 0.366

Original language: English

ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Graphics and Computer-Aided Design

DOIs:

10.1155/2015/975371

URLs:

<http://www.scopus.com/inward/record.url?scp=84929378426&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84929378426

Research output: Contribution to journal › Article › Scientific › peer-review

### Subjective evaluation of Super Multi-View compressed contents on high-end light-field 3D displays

Super Multi-View (SMV) video content is composed of tens or hundreds of views that provide a light-field representation of a scene. This representation allows a glass-free visualization and eliminates many causes of discomfort existing in current available 3D video technologies. Efficient video compression of SMV content is a key factor for enabling future 3D video services. This paper first compares several coding configurations for SMV content and several inter-view prediction structures are also tested and compared. The experiments mainly suggest that large differences in coding efficiency can be observed from one configuration to another. Several ratios for the number of coded and synthesized views are compared, both objectively and subjectively. It is reported that view synthesis significantly affects the coding scheme. The amount of views to skip highly depends on the sequence and on the quality of the associated depth maps. Reported ranges of bitrates required to obtain a good quality for the tested SMV content are realistic and coherent with future 4. K/8. K needs. The reliability of the PSNR metric for SMV content is also studied. Objective and subjective results show that PSNR is able to reflect increase or decrease in subjective quality even in the presence of synthesized views. However,

depending on the ratio of coded and synthesized views, the order of magnitude of the effective quality variation is biased by PSNR. Results indicate that PSNR is less tolerant to view synthesis artifacts than human viewers. Finally, preliminary observations are initiated. First, the light-field conversion step does not seem to alter the objective results for compression. Secondly, the motion parallax does not seem to be impacted by specific compression artifacts. The perception of the motion parallax is only altered by variations of the typical compression artifacts along the viewing angle, in cases where the subjective image quality is already low. To the best of our knowledge, this paper is the first to carry out subjective experiments and to report results of SMV compression for light-field 3D displays. It provides first results showing that improvement of compression efficiency is required, as well as depth estimation and view synthesis algorithms improvement, but that the use of SMV appears realistic according to next generation compression technology requirements.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Orange Labs, Holografika Kft., Pámany Peter Katolikus Egyetem

Contributors: Dricot, A., Jung, J., Cagnazzo, M., Pesquet, B., Dufaux, F., Kovács, P., Adhikarla, V. K.

Pages: 369–385

Publication date: 2015

Peer-reviewed: Yes

#### Publication information

Journal: Signal Processing: Image Communication

Volume: 39

Issue number: Part B

ISSN (Print): 0923-5965

Ratings:

Scopus rating (2015): CiteScore 4 SJR 0.532 SNIP 1.413

Original language: English

ASJC Scopus subject areas: Computer Vision and Pattern Recognition, Signal Processing, Software, Electrical and Electronic Engineering

Keywords: 3D, Light-field, Subjective evaluation, Super Multi-View, Video coding, Video compression

DOIs:

10.1016/j.image.2015.04.012

Source: Scopus

Source ID: 84947865722

Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

#### Schoolchildren's user experiences on a physical exercise game utilizing lighting and audio

Motivated by the troubling news on decreased exercise amount and increased obesity among children and adolescents, we investigated the possibilities of interactive lighting technology in encouraging children to participate in physical exercise in schools. We have created a story-driven physical exercise game based on light and sound utilizing a reasonably priced technological setup. The game has been evaluated with several groups of schoolchildren during physical education classes. The results show that a physical exercise game enhanced with lighting and audio keeps schoolchildren motivated both mentally and physically even after several playtimes. In subjective evaluations, participants still found the story of the game interesting after three playtimes, and were eager to exercise this way again.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Augmented Human Activities (AHA), Mathematical modelling with wide societal impact (MathImpact), University of Tampere

Contributors: Keskinen, T., Hakulinen, J., Turunen, M., Heimonen, T., Sand, A., Paavilainen, J., Parviainen, J., Yrjänäinen, S., Mäyrä, F., Okkonen, J., Raisamo, R.

Number of pages: 10

Pages: 475-484

Publication date: 1 Dec 2014

Peer-reviewed: Yes

#### Publication information

Journal: Entertainment Computing

Volume: 5

Issue number: 4

ISSN (Print): 1875-9521

Ratings:

Scopus rating (2014): CiteScore 2.2 SJR 0.404 SNIP 1.424

Original language: English

ASJC Scopus subject areas: Software, Human-Computer Interaction

Keywords: Exergaming, Interactive lighting, Physical education, Schoolchildren, Storytelling, User experience

DOIs:

10.1016/j.entcom.2014.08.009

URLs:

<http://www.scopus.com/inward/record.url?scp=84912526011&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84912526011

Research output: Contribution to journal › Article › Scientific › peer-review

### **Goofy Mus, grumpy Mur and dirty Muf: Talking playful seats with personalities**

The article discusses the concept of MurMur Moderators, talking playful seats designed to facilitate playful atmosphere and creativity at office environments. The concept of MurMur Moderators consists of five different personalities, grumpy Mur, goofy Mus, mellow Muh, sensitive Mut and shy Mum. The article describes the experiences and reactions to two personalities, Mus and Mur. Further, a sixth personality, Muf, consisting of rejected, provocative features is detailed. Consequently, the paper discusses play preferences, affordances and thresholds in connection to adult play. These will be the focus of future research by the authors.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact)

Contributors: Kultima, A., Nummenmaa, T., Tyni, H., Alha, K., Mayra, F.

Publication date: 11 Nov 2014

#### **Host publication information**

Title of host publication: ACE 2014 - 11th Advances in Computer Entertainment Technology Conference, Workshops Proceedings

Volume: 11-14-November-2014

Publisher: Association for Computing Machinery

Article number: a9

ISBN (Electronic): 9781450333146

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Adult play, Interactive furniture, Narrative, Personae, Playful office

DOIs:

10.1145/2693787.2693790

URLs:

<http://www.scopus.com/inward/record.url?scp=84962580216&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84962580216

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Information wall: Evaluation of a gesture-controlled public display**

Public displays that allow users to interact with them through mid-air gestures are still relatively rare, as many applications rely on touch-based interaction. This paper introduces Information Wall, a gesture-controlled public information display that provides multi-user access to contextually relevant local information using remote pointing and mid-air gestures. The application has been studied in two settings: a lab-based user study and several short-term deployments. Based on our results, we present practical guidelines for gesture-controlled public display design.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA)

Contributors: Mäkelä, V., Heimonen, T., Luhtala, M., Turunen, M.

Number of pages: 4

Pages: 228-231

Publication date: 11 Nov 2014

#### **Host publication information**

Title of host publication: ACE 2014 - 11th Advances in Computer Entertainment Technology Conference, Proceedings

Volume: 2014-November

Publisher: Association for Computing Machinery

ISBN (Electronic): 9781450329453, 9781450331852, 9781450333047

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Gestures, Mid-air pointing, Pervasive displays, Public displays, User study

DOIs:

10.1145/2677972.2677998

URLs:

<http://www.scopus.com/inward/record.url?scp=84943142256&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84943142256

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Body-touching: An embodied interaction technique for health information systems in developing regions**

We present a study of using embodied health information system for developing regions focusing on users not familiar with technology. We designed and developed a health information system with two gesture-based selection techniques: pointing to a screen and touching one's own body part. We evaluated the prototype in user study with 37 semi-literate and literate participants. Our results indicate a clear preference (76%) for touching in the healthcare domain. Based on our observations and user feedback, we present four design guidelines for developing embodied systems for the developing world: designing bodycentric interaction to overcome literacy and technological proficiency barriers, addressing the misconceptions of system behaviors with users not familiar with technology, understanding effects of cultural constraints on interaction, and utilizing interactive virtual avatars to connect with the users.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), IBM Research, Indian Institute of Technology

Contributors: Sharma, S., Srivastava, S., Sorathia, K., Hakulinen, J., Heimonen, T., Turunen, M., Rajput, N.

Number of pages: 8

Pages: 49-56

Publication date: 4 Nov 2014

#### **Host publication information**

Title of host publication: MINDTREK 2014 - Proceedings of the 18th International Academic MindTrek Conference: "Media Business, Management, Content and Services"

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450330060

ASJC Scopus subject areas: Computer Science Applications, Human-Computer Interaction, Software

Keywords: Body-centric interaction, Embodied interaction, gesture-based interaction, HCI4D, Health information systems, Information access

DOIs:

10.1145/2676467.2676514

URLs:

<http://www.scopus.com/inward/record.url?scp=84964053943&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84964053943

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **DYNAMO sound engine - Exploring the aesthetics of dynamic sound interactions**

This paper outlines the design and development process of the Dynamic Audio Motion (Dynamo) concept. The Dynamo audio engine was developed for driving dynamic sound interaction states via custom made finite state machine. Further, a generative sound design approach was employed for creating sonic and musical structures. Designed dynamic sound interactions were tested in an embodied information wall application with endusers. During the testing situation, end-users engaged in a reflective creation process providing valuable insight of their experiences of using the system. In this paper we present key questions driving the research, theoretical background, research approach, an audio engine development process, and end-user research activities. The results indicate that dynamic sound interactions supported people's personal, emotional, and creative needs in the design context.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA)

Contributors: Luhtala, M., Heimonen, T., Mäkelä, V., Keskinen, T., Turunen, M., Saarinen, S.

Number of pages: 8

Pages: 159-166

Publication date: 4 Nov 2014

#### Host publication information

Title of host publication: MINDTREK 2014 - Proceedings of the 18th International Academic MindTrek Conference: "Media Business, Management, Content and Services"

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450330060

ASJC Scopus subject areas: Computer Science Applications, Human-Computer Interaction, Software

Keywords: Aesthetic experience, Artistic interfaces, Dynamic sound interaction, Multimodal interaction, Musicalization, Procedural sound design, Sonic interaction design

DOIs:

10.1145/2676467.2676522

URLs:

<http://www.scopus.com/inward/record.url?scp=84963995207&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84963995207

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Email intensity, productivity and control in the knowledge worker's performance on the desktop

Experiencing stress, disturbing interruptions, loss of ability to concentrate, hurry and challenges to meet tight deadlines at work are very common in working life. At the same time, while variety of digital communication channels like instant messaging, video calls and social networking sites are getting more popular in working life, email is still intensively utilized work communication media. The goal of the empirical field study analyzing daily desktop computing of knowledge workers was to analyze association between email intensity in work time spending and subjectively experienced quality of work performance. It was found that while intensive email use does not impair subjectively experienced productivity, it may harm ability to concentrate, may increase forgetfulness and inability to solve problems at work effectively. Copyright is held by the owner/author(s). Publication rights licensed to ACM.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), University of Tampere

Contributors: Franssila, H., Okkonen, J., Savolainen, R.

Number of pages: 4

Pages: 19-22

Publication date: 4 Nov 2014

#### Host publication information

Title of host publication: MINDTREK 2014 - Proceedings of the 18th International Academic MindTrek Conference: "Media Business, Management, Content and Services"

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450330060

ASJC Scopus subject areas: Computer Science Applications, Human-Computer Interaction, Software

Keywords: Email intensity, Knowledge work, Measurement, Productivity, Work performance

DOIs:

10.1145/2676467.2676513

URLs:

<http://www.scopus.com/inward/record.url?scp=84964078815&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84964078815

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Games and energy: Profiling power usage during play

Computer gaming is a globally growing industry, with hundreds of millions of gaming-capable computers consuming an ever increasing amount of energy. Several of the world's most popular computer games tend to make a heavy use of computers' central processing units and/or graphics processing units. When such games execute on typical computers, for much of the time those components are kept in high energy-consuming states, regardless of what is happening in the game. We analyze this pattern of energy usage and we assess the scope for economizing on energy. The results presented also give insight into the energy implications of the hardware platform and operating systems used for hosting such games. We use the results to provide practical suggestions to both the industry and the gamers. Copyright is held by the owner/author(s). Publication rights licensed to ACM.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact), European Organization for Nuclear Research

Contributors: Salmela, J. M., Thanisch, P., Sotamaa, O., Niemi, T.

Number of pages: 8

Pages: 192-199

Publication date: 4 Nov 2014

#### Host publication information

Title of host publication: MINDTREK 2014 - Proceedings of the 18th International Academic MindTrek Conference: "Media Business, Management, Content and Services"

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450330060

ASJC Scopus subject areas: Computer Science Applications, Human-Computer Interaction, Software

Keywords: Computer games, Energy measurement

DOIs:

10.1145/2676467.2676488

URLs:

<http://www.scopus.com/inward/record.url?scp=84963995284&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84963995284

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### MurMur Moderators, the talking playful seats

In this article we present the concept of MurMur Moderators, talking playful seats facilitating playful atmosphere and creativity at office environments. The article describes the design and technological composition of our first prototype, and our experiences exposing the concept to audiences at two science fairs in Italy (2013) and Finland (2014). This research has served as an informative pilot study, consequently directing our focus to the ways the accompanying narrative brings additional design value to the interactive seats. Our goal with the fairs was to investigate what are the preliminary audience reactions for the high level concept and how people interact with the initial prototype. The feedback was used for generating further ideas for ambient play and furniture-as-a-service, some of which carries on to future research and second prototype of the seat.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact)

Contributors: Nummenmaa, T., Kultima, A., Tyni, H., Alha, K.

Number of pages: 7

Pages: 231-237

Publication date: 4 Nov 2014

#### Host publication information

Title of host publication: MINDTREK 2014 - Proceedings of the 18th International Academic MindTrek Conference: "Media Business, Management, Content and Services"

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 9781450330060

ASJC Scopus subject areas: Computer Science Applications, Human-Computer Interaction, Software

Keywords: Arduino, Audio feedback, Design research, Diy, Game studies, Internet of things, Playful furniture, Raspberry pi

DOIs:

10.1145/2676467.2676505

URLs:

<http://www.scopus.com/inward/record.url?scp=84964027379&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84964027379

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Discriminant Bag of Words based representation for human action recognition

In this paper we propose a novel framework for human action recognition based on Bag of Words (BoWs) action representation, that unifies discriminative codebook generation and discriminant subspace learning. The proposed framework is able to, naturally, incorporate several (linear or non-linear) discrimination criteria for discriminant BoWs-based action representation. An iterative optimization scheme is proposed for sequential discriminant BoWs-based action representation and codebook adaptation based on action discrimination in a reduced dimensionality feature space where action classes are better discriminated. Experiments on five publicly available data sets aiming at different application scenarios demonstrate that the proposed unified approach increases the codebook discriminative ability providing

enhanced action classification performance.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 8

Pages: 185-192

Publication date: 1 Nov 2014

Peer-reviewed: Yes

#### Publication information

Journal: Pattern Recognition Letters

Volume: 49

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2014): CiteScore 4.3 SJR 0.73 SNIP 2.131

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Bag of Words, Codebook learning, Discriminant learning

DOIs:

10.1016/j.patrec.2014.07.011

Source: Scopus

Source ID: 84907347636

Research output: Contribution to journal › Article › Scientific › peer-review

#### Kernel reference discriminant analysis

Linear Discriminant Analysis (LDA) and its nonlinear version Kernel Discriminant Analysis (KDA) are well-known and widely used techniques for supervised feature extraction and dimensionality reduction. They determine an optimal discriminant space for (non)linear data projection based on certain assumptions, e.g. on using normal distributions (either on the input or in the kernel space) for each class and employing class representation by the corresponding class mean vectors. However, there might be other vectors that can be used for classes representation, in order to increase class discrimination in the resulted feature space. In this paper, we propose an optimization scheme aiming at the optimal class representation, in terms of Fisher ratio maximization, for nonlinear data projection. Compared to the standard approach, the proposed optimization scheme increases class discrimination in the reduced-dimensionality feature space and achieves higher classification rates in publicly available data sets.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 7

Pages: 85-91

Publication date: 1 Nov 2014

Peer-reviewed: Yes

#### Publication information

Journal: Pattern Recognition Letters

Volume: 49

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2014): CiteScore 4.3 SJR 0.73 SNIP 2.131

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Kernel Discriminant Analysis, Kernel Spectral Regression, Optimized class representation

DOIs:

10.1016/j.patrec.2014.06.013

Source: Scopus

Source ID: 84904957982

Research output: Contribution to journal › Article › Scientific › peer-review

### **Effects of directional haptic and non-speech audio cues in a cognitively demanding navigation task**

Existing car navigation systems require visual or auditory attention. Providing the driver with directional cues could potentially increase safety. We conducted an experiment comparing directional haptic and non-speech audio cues to visual cueing in a navigation task. Participants (N=16) drove the Lane Change Test simulator with different navigational cues. The participants were to recognize the directional cue (left or right) by responding as fast as possible using a tablet. Reaction times and errors were measured. The participants were also interviewed about the different cues and filled up the NASA-TLX questionnaire. The results showed that in comparison to visual cues all the other cues were reacted to significantly faster. Haptic only cueing resulted in the most errors, but it was evaluated as the most pleasant and the least physically demanding. The results suggest that non-visual cueing could improve safety. Copyright is held by the owner/author(s).

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), School of Management (JKK)

Contributors: Nukarinen, T., Raisamo, R., Farooq, A., Evreinov, G., Surakka, V.

Number of pages: 4

Pages: 61-64

Publication date: 26 Oct 2014

#### **Host publication information**

Title of host publication: Proceedings of the NordiCHI 2014: The 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 1595930361, 9781450325424

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: Car navigation, Directional cues, Haptic stimuli, Tactile displays

DOIs:

10.1145/2639189.2639231

URLs:

<http://www.scopus.com/inward/record.url?scp=84911368322&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84911368322

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Effects of haptic feedback on gaze based auto scrolling**

Eye tracking enables automatic scrolling based on natural viewing behavior. We were interested in the effects of haptic feedback on gaze behavior and user experience. We conducted an experiment where haptic feedback was used to forewarn the reader that their gaze had entered an active scrolling area. Results show no statistical differences between conditions with or without haptic feedback on task time or gaze behavior. However, user experience varied a lot. Some participants were not able to associate the haptics and the scrolling. Those who understood the connection found the haptic feedback useful. Further research is required to find out a delay between the forewarning and the start of scrolling that is short enough to make the association but yet long enough to support the feeling of control and enjoyable user experience. Copyright is held by the owner/author(s).

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), School of Management (JKK)

Contributors: Käksi, K., Špakov, O., Majaranta, P., Kangas, J.

Number of pages: 4

Pages: 947-950

Publication date: 26 Oct 2014

#### **Host publication information**

Title of host publication: Proceedings of the NordiCHI 2014: The 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 1595930361, 9781450325424

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: Eye tracking, Gaze input, Haptics, Vibrotactile feedback

DOIs:

10.1145/2639189.2670247



URLs:

<http://www.scopus.com/inward/record.url?scp=84911380351&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84911380351

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Gaze-contingent scrolling and reading patterns**

An automatic technique that scrolls the window content while the user is reading the text in the window has been implemented. Scrolling is triggered by gaze moving outside the reader's preferred reading zone. The reading patterns instigated by automatic scrolling are analyzed both quantitatively and using gaze path visualizations. Automatic scrolling is shown to result in smooth reading activity.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA)

Contributors: Rähkä, K. J., Sharmin, S.

Number of pages: 4

Pages: 65-68

Publication date: 26 Oct 2014

#### **Host publication information**

Title of host publication: Proceedings of the NordiCHI 2014: The 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 1595930361, 9781450325424

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: Analysis of reading, Gaze-based scrolling

DOIs:

10.1145/2639189.2639242

URLs:

<http://www.scopus.com/inward/record.url?scp=84911385620&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84911385620

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Human-technology choreographies: Re-thinking body, movement and space in interaction design**

Bodily movements have traditionally had mostly instrumental value in interaction design. However, movements can also be given a central role in understanding behaviour and in designing technology for humans. This workshop is aiming at taking a fresh, movement-oriented look at the design and evaluation of technology in a wide variety of contexts. Copyright is held by the owner/author(s).

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Jyväskylän yliopisto, School of Management (JKK)

Contributors: Pirhonen, A., Parviainen, J., Tuuri, K., Turunen, M., Heimonen, T.

Number of pages: 4

Pages: 841-844

Publication date: 26 Oct 2014

#### **Host publication information**

Title of host publication: Proceedings of the NordiCHI 2014: The 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 1595930361, 9781450325424

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: Choreography, Embodiment, Interaction design, Lived space

DOIs:

10.1145/2639189.2654843

URLs:

<http://www.scopus.com/inward/record.url?scp=84911381050&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84911381050

### Seniors and text messaging on mobile touchscreen phones

We studied how senior citizens write and send text messages on their own mobile phone and two touchscreen smartphones. Each participant participated in three training sessions and wrote messages with three phones. We found that the range of text entry performance among seniors is large. Average text entry rate in entering a 34 character test phrase was only 3.5 wpm. Further work to improve text messaging user interfaces for older un-skilled users is clearly needed. Copyright is held by the owner/author(s).

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Korea Advanced Institute of Science and Technology (KAIST)

Contributors: Övermark, R., Isokoski, P., Ovaska, S.

Number of pages: 4

Pages: 967-970

Publication date: 26 Oct 2014

#### Host publication information

Title of host publication: Proceedings of the NordiCHI 2014: The 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational

Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 1595930361, 9781450325424

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: Learning, Mobile phone, Older adult, Text messaging, Touchscreen

DOIs:

10.1145/2639189.2670252

URLs:

<http://www.scopus.com/inward/record.url?scp=84911409889&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84911409889

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### The fuzzy front end of experience design

The basic idea behind Experience Design approach is that before ideating the solution, you define what experience to design for. This is a critical point in a design process, because the experience goal needs to be appropriate for the target context of use, in line with the brand experience, and meaningful to truly engage users. In the early phases of the experience design process, in the fuzzy front end, there are several sources that can guide experience goal setting. One important way is empathic understanding of the users' world and stepping into the users' shoes, but there are also other sources of insight and inspiration for setting the experiential goals such as brand promise, technology and societal trends as well as mere vision of renewal. In this workshop, we aim to collect examples of the fuzzy front end of the experience design process and analyze how the different sources of insight and inspiration influence experience goal setting. Copyright is held by the owner/author(s).

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Research area: User experience, Augmented Human Activities (AHA), Aalto University, VTT Technical Research Centre of Finland, School of Arts, Design and Architecture

Contributors: Kaasinen, E., Väättäjä, H., Karvonen, H., Lu, Y.

Number of pages: 4

Pages: 797-800

Publication date: 26 Oct 2014

#### Host publication information

Title of host publication: Proceedings of the NordiCHI 2014: The 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational

Place of publication: New York, NY

Publisher: ACM

ISBN (Print): 978-1-4503-2542-4

#### Publication series

Name: Nordic conference on human-computer interaction

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: Experience design, User experience, UX goals

DOIs:

10.1145/2639189.2654829

URLs:

<http://www.scopus.com/inward/record.url?scp=84911441640&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

Contribution: organisation=tie,FACT1=1<br/>Portfolio EDEND: 2014-12-31<br/>Publisher name: ACM

Source: researchoutputwizard

Source ID: 632

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Using gaze gestures with haptic feedback on glasses**

Wearable computing devices are gradually becoming common, and head-mounted devices such as Google Glass are already available. These devices present new interaction challenges as the devices are usually small in size, and also the usage environment sets limitations on the available interaction modalities. One potential interaction method could be to use gaze for input and haptics for output with a head-worn device. We built a demonstration system to show how gaze gestures could be used to control a simple information application together with head area haptic feedback for gesture confirmation. The demonstration and experiences of early user studies have shown that users perceive such an input-output combination useful. Copyright is held by the owner/author(s).

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), School of Management (JKK)

Contributors: Kangas, J., Akkil, D., Rantala, J., Isokoski, P., Majaranta, P., Raisamo, R.

Number of pages: 4

Pages: 1047-1050

Publication date: 26 Oct 2014

### **Host publication information**

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Publisher: Association for Computing Machinery, Inc

ISBN (Electronic): 1595930361, 9781450325424

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: Gaze gestures, Gaze input, Haptics, Vibrotactile feedback, Wearable computing

DOIs:

10.1145/2639189.2670272

URLs:

<http://www.scopus.com/inward/record.url?scp=84911444165&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84911444165

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Estimating software development effort based on phases**

Software development effort estimation is a very important issue in software engineering and several models have been defined to this end. In this paper, we carry out an empirical study on the estimation of software development effort broken down by phase, so that estimation can be used along the software development lifecycle. More specifically, our goal is twofold. At any given point in the software development lifecycle, we estimate the effort needed for the next phase. Also, we estimate the effort for the remaining part of the software development process. Our empirical study is based on historical data from the ISBSG database. The results show a set of statistically significant correlations between: (1) the effort spent in one phase and the effort spent in the following one, (2) the effort spent in a phase and the remaining effort, (3) the cumulative effort up to the current phase and the remaining effort. However, the results also show that these estimation models come with different degrees of goodness of fit. Finally, including further information, such as the functional size, does not significantly improve estimation quality.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Università degli Studi Dell'Insubria, Former organisation of the author

Contributors: Lenarduzzi, V., Morasca, S., Taibi, D.

Number of pages: 4

Pages: 305-308

Publication date: 17 Oct 2014

### Host publication information

Title of host publication: Proceedings - 40th Euromicro Conference Series on Software Engineering and Advanced Applications, SEAA 2014

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9781479957941

ASJC Scopus subject areas: Software

Keywords: data driven estimation, isbsg, software estimation

DOIs:

10.1109/SEAA.2014.54

URLs:

<http://www.scopus.com/inward/record.url?scp=84916600691&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84916600691

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Process configuration framework tool

Organizations considering the adoption of new methods, techniques, or tools often face the problem of how to evaluate these systematically, thoroughly, and completely. In this work we present the Process Configuration Framework Tool, a web application based on the Reference Technology platform and aimed at helping organizations find empirical evidence in a specific context. These results will help decision makers to easily find existing methods, techniques, and tools in the appropriate context and make decisions based on empirical evidence.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Fraunhofer IESE, Liebherr-Aerospace, Former organisation of the author

Contributors: Diebold, P., Dieudonne, L., Taibi, D.

Number of pages: 2

Pages: 389-390

Publication date: 17 Oct 2014

### Host publication information

Title of host publication: Proceedings - 40th Euromicro Conference Series on Software Engineering and Advanced Applications, SEAA 2014

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9781479957941

ASJC Scopus subject areas: Software

Keywords: process improvement, process selection

DOIs:

10.1109/SEAA.2014.28

URLs:

<http://www.scopus.com/inward/record.url?scp=84916613315&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84916613315

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Patterns for controlling chaos in a startup

A growing trend in industrial software engineering is that new software products and information services are developed under conditions of notable uncertainty. This is especially visible in startup enterprises which aim at new kinds of products and services in rapidly changing social web, where potential customers can quickly adopt new behavior. Special characteristics of the startups are lack of resources and funds, and startups may need to change direction fast. All these affect the software engineering practices used in the startups. Unfortunately almost 90 percent of all startups fail and goes bankrupt. There are probably indefinite numbers of reasons why startups fail. Failure might be caused by wrongly chosen software engineering practices or inconsiderate decision making. While there is no recipe for success, we argue that good practices that can help on the way to success can be identified from successful startups. In this paper, we present two patterns that startups can consider when entering the growth phase of the lifecycle.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing

Contributors: Eloranta, V.

Number of pages: 8

Pages: 1-8

Publication date: 10 Apr 2014

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Volume: 2014-April  
Publisher: Association for Computing Machinery  
ISBN (Print): 9781450326605

#### Publication series

Name: ACM International Conference Proceeding Series  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Lean start-up, Organizational patterns, Patterns, Software engineering, Start-up  
DOIs:  
10.1145/2676680.2676682  
Source: Scopus  
Source ID: 84940028558  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Two patterns for minimizing human resources in a startup

In this paper, we describe two patterns that are part of a larger pattern language for software startup companies. These two particular patterns help startup companies to focus on the essential; the product itself and keeping their team intact and productive. In this way, the startup may operate with a sustainable team size.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Pervasive Computing, Research area: Software engineering  
Contributors: Leppänen, M.  
Publication date: 10 Apr 2014

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Publisher: ACM  
Article number: 4  
ISBN (Print): 9781450326605  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Lean startup, Organization, Organizational patterns, Patterns, Software engineering, Software product, Team  
DOIs:  
10.1145/2676680.2676686  
Source: Scopus  
Source ID: 84940021370  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Prediction models and techniques for Open Source Software projects: A systematic literature review

Open Source Software (OSS) is currently a widely adopted approach to developing and distributing software. For effective adoption of OSS, fundamental knowledge of project development is needed. This often calls for reliable prediction models to simulate project evolution and to envision project future. These models provide help in supporting preventive maintenance and building quality software. This paper reports on a systematic literature survey aimed at the identification and structuring of research that offer prediction models and techniques in analyzing OSS projects. In this review, we systematically selected and reviewed 52 peer reviewed articles that were published between January, 2000 and March, 2013. The study outcome provides insight in what constitutes the main contributions of the field, identifies gaps and opportunities, and distills several important future research directions.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Pervasive Computing, Chalmers and University of Gothenburg  
Contributors: Syeed, M. M. M., Hammouda, I., Systä, T.  
Number of pages: 39  
Pages: 1-39  
Publication date: 1 Apr 2014  
Peer-reviewed: Yes

### Publication information

Journal: International Journal of Open Source Software and Processes

Volume: 5

Issue number: 2

ISSN (Print): 1942-3926

Ratings:

Scopus rating (2014): CiteScore 0.8 SJR 0.28 SNIP 0.291

Original language: English

ASJC Scopus subject areas: Software

Keywords: Fault prediction, Open Source Software, OSS community, Prediction, Systematic literature review

DOIs:

10.4018/ijossp.2014040101

URLs:

<http://www.scopus.com/inward/record.url?scp=84924346193&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

EXT="Hammouda, Imed"

Source: Scopus

Source ID: 84924346193

Research output: Contribution to journal > Article > Scientific > peer-review

### Optimizing spatial and temporal reuse in wireless networks by decentralized partially observable markov decision processes

The performance of medium access control (MAC) depends on both spatial locations and traffic patterns of wireless agents. In contrast to conventional MAC policies, we propose a MAC solution that adapts to the prevailing spatial and temporal opportunities. The proposed solution is based on a decentralized partially observable Markov decision process (DEC-POMDP), which is able to handle wireless network dynamics described by a Markov model. A DEC-POMDP takes both sensor noise and partial observations into account, and yields MAC policies that are optimal for the network dynamics model. The DEC-POMDP MAC policies can be optimized for a freely chosen goal, such as maximal throughput or minimal latency, with the same algorithm. We make approximate optimization efficient by exploiting problem structure: the policies are optimized by a factored DEC-POMDP method, yielding highly compact state machine representations for MAC policies. Experiments show that our approach yields higher throughput and lower latency than CSMA/CA based comparison methods adapted to the current wireless network configuration.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aalto University, Asparrow Ltd, Helsinki Institute for Information Technology

Contributors: Pajarinen, J., Hottinen, A., Peltonen, J.

Number of pages: 14

Pages: 866-879

Publication date: Apr 2014

Peer-reviewed: Yes

### Publication information

Journal: IEEE Transactions on Mobile Computing

Volume: 13

Issue number: 4

Article number: 6482133

ISSN (Print): 1536-1233

Ratings:

Scopus rating (2014): CiteScore 7.5 SJR 1.192 SNIP 3.51

Original language: English

ASJC Scopus subject areas: Software, Computer Networks and Communications, Electrical and Electronic Engineering

Keywords: decentralized POMDP, medium access control, multi-agent planning, Spatial reuse, wireless network

DOIs:

10.1109/TMC.2013.39

URLs:

<http://www.scopus.com/inward/record.url?scp=84897873909&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84897873909

Research output: Contribution to journal > Article > Scientific > peer-review

### **System integration for real-time mobile manipulation**

Mobile manipulators are one of the most complicated types of mechatronics systems. The performance of these robots in performing complex manipulation tasks is highly correlated with the synchronization and integration of their low-level components. This paper discusses in detail the mechatronics design of a four wheel steered mobile manipulator. It presents the manipulator's mechanical structure and electrical interfaces, designs low-level software architecture based on embedded PC-based controls, and proposes a systematic solution based on code generation products of MATLAB and Simulink. The remote development environment described here is used to develop real-time controller software and modules for the mobile manipulator under a POSIX-compliant, real-time Linux operating system. Our approach enables developers to reliably design controller modules that meet the hard real-time constraints of the entire low-level system architecture. Moreover, it provides a systematic framework for the development and integration of hardware devices with various communication mediums and protocols, which facilitates the development and integration process of the software controller. © 2014 The Author(s). Licensee InTech.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Tampere University of Technology, Department of Intelligent Hydraulics and Automation, Research group:

Mobile manipulation, Research group: Field robotics and control, Field robotics for efficient work sites (FIRE)

Contributors: Oftadeh, R., Aref, M. M., Ghabcheloo, R., Mattila, J.

Publication date: 28 Mar 2014

Peer-reviewed: Yes

### **Publication information**

Journal: international Journal of Advanced Robotic Systems

Volume: 11

Issue number: 1

Article number: 51

ISSN (Print): 1729-8806

Ratings:

Scopus rating (2014): CiteScore 1.4 SJR 0.297 SNIP 0.768

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Science Applications

Keywords: Autonomous vehicles, Mechatronic design, Mobile manipulators, Real-time systems

DOIs:

10.5772/58467

URLs:

<http://www.scopus.com/inward/record.url?scp=84897565578&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2014-05-30<br/>Publisher name: InTech Open Access Publisher

Source: researchoutputwizard

Source ID: 1179

Research output: Contribution to journal › Article › Scientific › peer-review

### **A computational approach to construct a multivariate complete graph invariant**

In this paper, we present a computational approach for finding complete graph invariants. Specifically, we generate exhaustive sets of connected, non-isomorphic graphs with 9 and 10 vertices and demonstrate that a 97-dimensional multivariate graph invariant is capable to distinguish each of the non-isomorphic graphs. Furthermore, in order to tame the computational complexity of the problem caused by the vast number of graphs, e.g., involving over 10 million networks with 10 vertices, we suggest a low-dimensional, iterative procedure that is based on highly discriminative individual graph invariants. We show that also this computational approach leads to a perfect discrimination. Overall, our numerical results prove the existence of such graph invariants for networks with 9 and 10 vertices. Furthermore, we show that our iterative approach has a polynomial time complexity.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), 6060 Hall in Tyrol, Computational Biology and Machine Learning, Queen's University, Belfast, Northern Ireland

Contributors: Dehmer, M., Emmert-Streib, F., Grabner, M.

Number of pages: 9

Pages: 200-208

Publication date: 1 Mar 2014

Peer-reviewed: Yes

### Publication information

Journal: Information Sciences

Volume: 260

ISSN (Print): 0020-0255

Ratings:

Scopus rating (2014): CiteScore 7.4 SJR 2.226 SNIP 3.198

Original language: English

ASJC Scopus subject areas: Artificial Intelligence, Software, Control and Systems Engineering, Theoretical Computer Science, Computer Science Applications, Information Systems and Management

Keywords: Information inequality, Quantitative graph theory, Random network model, Statistics

DOIs:

10.1016/j.ins.2013.11.008

URLs:

<http://www.scopus.com/inward/record.url?scp=84891738883&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84891738883

Research output: Contribution to journal > Article > Scientific > peer-review

### Developing novel multimodal interaction techniques for touchscreen in-vehicle infotainment systems

Haptics has been an integral part of multimodal systems in Human Computer Interaction (HCI). The ability to touch and sense virtual components of any system has long been the holy grail of HCI, which is particularly useful in mission critical environments where other modalities are weakened by environmental noise. Haptics also compliments most modalities of interaction by reinforcing the intimate and personal aspect of interaction. Haptics becomes much more important in environments that prove to be far too noisy for audio feedback. The driving environment is one such area, which the addition of haptics is not just additive, but critical in HCI. However, most of the research on haptic feedback in the car has been conducted using vibro-tactile feedback. In this paper, we present a system in which we have developed a novel haptic feedback environment using pneumatic and vibrotactile technologies, to facilitate in car communication, using the In-vehicle Infotainment System. Our aim was to build on the user haptic perception and experience the advance multimodal interaction system by utilizing available feedback techniques in, in-car interaction. The qualitative results of our study show that haptic feedback has great potential for safety and communication use, but the difficulty in interpreting haptic signals requires additional translation means ('semantic linkages'), to support the right interpretation of the haptic information.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA)

Contributors: Farooq, A., Evreinov, G., Raisamo, R., Mäkinen, E., Nukarinen, T., Majeed, A. A.

Number of pages: 11

Pages: 32-42

Publication date: 2 Feb 2014

### Host publication information

Title of host publication: ICOSST 2014 - 2014 International Conference on Open Source Systems and Technologies, Proceedings

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7029317

ISBN (Electronic): 9781479920549

ASJC Scopus subject areas: Computer Science Applications, Software

Keywords: haptic feedback, human computer interaction, In-Vehicle Infotainment Systems, Multimodal Interaction, pneumatic feedback, tactile/vibro-tactile feedback

DOIs:

10.1109/ICOSST.2014.7029317

URLs:

<http://www.scopus.com/inward/record.url?scp=84946688361&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84946688361

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Haptic user interface enhancement system for touchscreen based interaction: A novel system for multimodal interaction with touchscreen interfaces

Touchscreens are becoming a more attractive interaction technology in our daily lives and they are quickly replacing most of the conventional user interface controls. The ability to continuously modify and reconfigure screen contacts is a valuable



feature in any device, especially in mobile devices like smartphones and tablets, where every inch matters. Perhaps the most inviting aspect of touchscreens is their ability to detect gestures and recognize human activities. Unlike externally static interfaces with a dedicated input device, such as a keypad with discrete well-defined keys; most touch sensitive displays are embodied as a flat, stiff and ridged screen surface. As a result, touch sensitive displays are breaking down and do not follow either ergonomic rules and standards nor physiological and psychological models/concepts of the afferent flow information processing. This, in turn, means that these systems diminish perceptual and intuitive haptic feedback which hinders and sometime limits user interaction. This paper defines a Haptic User Interface Enhancement System (UIES) that transforms the conventionally flat and stiff touchscreen surfaces into a haptically adaptive interaction hub which is not only able to provide generic vibrotactile stimulation for conformational haptic feedback but is able to guide the user through onscreen User Interface controls via kinetic feedback cues which includes components of forces and torques applied dynamically in the place of contact to the fingertips.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Augmented Human Activities (AHA)  
Contributors: Farooq, A., Evreinov, G., Raisamo, R., Majeed, A. A.  
Number of pages: 7  
Pages: 25-31  
Publication date: 2 Feb 2014

#### Host publication information

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Publisher: Institute of Electrical and Electronics Engineers Inc.  
Article number: 7029316  
ISBN (Electronic): 9781479920549  
ASJC Scopus subject areas: Computer Science Applications, Software  
Keywords: Haptics, kinesthetic feedback, Multimodal Interaction, Touchscreen Interaction, Vibrotactile  
DOIs:  
10.1109/ICOSST.2014.7029316  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84946686310&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84946686310  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Symbol diversification of linux binaries

In this paper, we advocate large-scale diversification as a method to protect operating systems and render malicious programs ineffective. The idea is to diversify all the indirect library entry points to the system calls on a specific computer. As a result, it becomes very difficult for a piece of malware to access resources. The diversification of indirect system call entry points in operating system libraries is unique for each computer. Therefore, a piece of malware no longer works on several computers and becomes incompatible with their environment. We also present a concrete diversification tool and results on successful diversification. We conclude that despite some challenges, our tool can successfully diversify symbols in binaries and associated libraries in order to protect the system from attacks.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Managing digital industrial transformation (mDIT), Turun Yliopisto/Turun Biomateriaalikeskus, University of Turku, Department of Information Technology  
Contributors: Lauren, S., Maki, P., Rauti, S., Hosseinzadeh, S., Hyrynsalmi, S., Leppanen, V.  
Number of pages: 6  
Pages: 74-79  
Publication date: 30 Jan 2014

#### Host publication information

Title of host publication: 2014 World Congress on Internet Security, WorldCIS 2014  
Publisher: Institute of Electrical and Electronics Engineers Inc.  
ISBN (Electronic): 9781908320421  
ASJC Scopus subject areas: Computer Networks and Communications, Software  
DOIs:  
10.1109/WorldCIS.2014.7028170  
Source: Scopus  
Source ID: 84949926860

### **Domain based storage protection with secure access control for the cloud**

Cloud computing has evolved from a promising concept to one of the fastest growing segments of the IT industry. However, many businesses and individuals continue to view cloud computing as a technology that risks exposing their data to unauthorized users. We introduce a data confidentiality and integrity protection mechanism for Infrastructure-as-a-Service (IaaS) clouds, which relies on trusted computing principles to provide transparent storage isolation between IaaS clients. We also address the absence of reliable data sharing mechanisms, by providing an XML-based language framework which enables clients of IaaS clouds to securely share data and clearly define access rights granted to peers. The proposed improvements have been prototyped as a code extension for a popular cloud platform.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: SICS  
Contributors: Paladi, N., Michalas, A., Gehrmann, C.  
Number of pages: 8  
Pages: 35-42  
Publication date: 1 Jan 2014

#### **Host publication information**

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Publisher: Association for Computing Machinery  
ISBN (Print): 9781450328050  
ASJC Scopus subject areas: Software  
Keywords: cloud computing, IaaS, security, storage protection  
DOIs:  
10.1145/2600075.2600082  
Source: Scopus  
Source ID: 84902766965  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **The lord of the sense: A privacy preserving reputation system for participatory sensing applications**

Electronic devices we use on a daily basis collect sensitive information without preserving user's privacy. In this paper, we propose the lord of the sense (LotS), a privacy preserving reputation system for participatory sensing applications. Our system maintains the privacy and anonymity of information with the use of cryptographic techniques and combines voting approaches to support users' reputation. Furthermore, LotS maintains accountability by tracing back a misbehaving user while maintaining k-anonymity. A detailed security analysis is presented with the current advantages and disadvantages of our system.

#### **General information**

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Organisations: Security Lab, SICS, City University London  
Contributors: Michalas, A., Komninos, N.  
Publication date: 1 Jan 2014

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Publisher: Institute of Electrical and Electronics Engineers Inc.  
Article number: 6912480  
ISBN (Electronic): 9781479942787  
ASJC Scopus subject areas: Software, Signal Processing, Mathematics(all), Computer Science Applications, Computer Networks and Communications  
Keywords: Anonymity, Distributed Sensing, Participatory Sensing, Privacy, Reputation Systems, Security, Urban Sensing  
DOIs:  
10.1109/ISCC.2014.6912480  
Source: Scopus  
Source ID: 84908199099  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Controlled experiments comparing fault-tree-based safety analysis techniques**

The capability to model dynamic aspects of safety-critical systems, such as sequence or stochastic dependence of events, is one important requirement for safety analysis techniques. State Event Fault Tree Analysis, Dynamic Fault Tree Analysis, and Fault Tree Analysis combined with Markov Chains Analysis have been developed to fulfill these requirements, but

they are still not widely accepted and used in practice. In order to investigate the reasons behind this low usage, we conducted two controlled experiments. The goal of the experiments was to analyze and compare applicability and efficiency in State Event Fault Tree analysis versus Dynamic Fault Tree Analysis and Fault Tree Analysis combined with Markov Chains Analysis. The results of both experiments show that, notwithstanding the power of State Event Fault Tree Analysis, Dynamic Fault Tree Analysis is rated by participants as more applicable and is more efficient compared to State Event Fault Tree Analysis, which, in turn, is rated as more applicable but is less efficient than Fault Tree Analysis combined with Markov Chains Analysis. Two of the reasons investigated are the complexity of the notations used and the lack of tool support. Based on these results, we suggest strategies for enhancing State Event Fault Tree Analysis to overcome its weaknesses and increase its applicability and efficiency in modeling dynamic aspects of safety-critical systems.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University of Kaiserslautern, Former organisation of the author

Contributors: Mouaffo, A., Taibi, D., Jamboti, K.

Publication date: 2014

#### **Host publication information**

Title of host publication: 18th International Conference on Evaluation and Assessment in Software Engineering, EASE 2014

Publisher: Association for Computing Machinery (ACM)

Article number: a46

ISBN (Print): 9781450324762

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Controlled experiment, Dynamic fault tree, Fault tree analysis, Markov chain, Safety-analysis, Safety-critical systems, State event fault tree

DOIs:

10.1145/2601248.2601255

URLs:

<http://www.scopus.com/inward/record.url?scp=84905483353&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84905483353

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Data-driven stream mining systems for computer vision**

In this chapter, we discuss the state of the art and future challenges in adaptive stream mining systems for computer vision. Adaptive stream mining in this context involves the extraction of knowledge from image and video streams in real-time, and from sources that are possibly distributed and heterogeneous. With advances in sensor and digital processing technologies, we are able to deploy networks involving large numbers of cameras that acquire increasing volumes of image data for diverse applications in monitoring and surveillance. However, to exploit the potential of such extensive networks for image acquisition, important challenges must be addressed in efficient communication and analysis of such data under constraints on power consumption, communication bandwidth, and end-to-end latency. We discuss these challenges in this chapter, and we also discuss important directions for research in addressing such challenges using dynamic, data-driven methodologies.

#### **General information**

Publication status: Published

MoE publication type: A3 Part of a book or another research book

Organisations: Signal Processing Research Community (SPRC), University of Maryland, Electrical Engineering Department, University of California, Los Angeles (UCLA)

Contributors: Bhattacharyya, S. S., Van Der Schaar, M., Atan, O., Tekin, C., Sudusinghe, K.

Number of pages: 16

Pages: 249-264

Publication date: 2014

#### **Host publication information**

Title of host publication: Advances in Computer Vision and Pattern Recognition

Volume: 68

Publisher: SPRINGER-VERLAG LONDON LTD

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Name: Advances in Computer Vision and Pattern Recognition

Volume: 68

ISSN (Print): 21916586

ISSN (Electronic): 21916594

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Artificial Intelligence  
DOIs:

10.1007/978-3-319-09387-1\_12

URLs:

<http://www.scopus.com/inward/record.url?scp=84984919867&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84984919867

Research output: Chapter in Book/Report/Conference proceeding › Chapter › Scientific › peer-review

### **Gaze gestures and haptic feedback in mobile devices**

Anticipating the emergence of gaze tracking capable mobile devices, we are investigating the use of gaze as an input modality in handheld mobile devices. We conducted a study of combining gaze gestures with vibrotactile feedback. Gaze gestures were used as an input method in a mobile device and vibrotactile feedback as a new alternative way to give confirmation of interaction events. Our results show that vibrotactile feedback significantly improved the use of gaze gestures. The tasks were completed faster and rated easier and more comfortable when vibrotactile feedback was provided.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), School of Management (JKK)

Contributors: Kangas, J., Akkil, D., Rantala, J., Isokoski, P., Majaranta, P., Raisamo, R.

Number of pages: 4

Pages: 435-438

Publication date: 2014

#### **Host publication information**

Title of host publication: CHI 2014: One of a CHIInd - Conference Proceedings, 32nd Annual ACM Conference on Human Factors in Computing Systems

Publisher: Association for Computing Machinery

ISBN (Print): 9781450324731

ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Graphics and Computer-Aided Design

Keywords: Gaze interaction, Gaze tracking, Haptic feedback

DOIs:

10.1145/2556288.2557040

URLs:

<http://www.scopus.com/inward/record.url?scp=84900413921&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84900413921

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Glasses with haptic feedback of gaze gestures**

We introduce eyeglasses that present haptic feedback when using gaze gestures for input. The glasses utilize vibrotactile actuators to provide gentle stimulation to three locations on the user's head. We describe two initial user studies that were conducted to evaluate the easiness of recognizing feedback locations and participants' preferences for combining the feedback with gaze gestures. The results showed that feedback from a single actuator was the easiest to recognize and also preferred when used with gaze gestures. We conclude by presenting future use scenarios that could benefit from gaze gestures and haptic feedback.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), School of Management (JKK)

Contributors: Rantala, J., Isokoski, P., Kangas, J., Raisamo, R., Akkil, D.

Number of pages: 6

Pages: 1597-1602

Publication date: 2014

#### **Host publication information**

Title of host publication: CHI EA 2014: One of a ChiNd - Extended Abstracts, 32nd Annual ACM Conference on Human Factors in Computing Systems

Publisher: Association for Computing Machinery

ISBN (Print): 9781450324748

ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software  
Keywords: Gaze gestures, Gaze input, Haptics, Vibrotactile feedback, Wearable computing

DOIs:

10.1145/2559206.2581163

URLs:

<http://www.scopus.com/inward/record.url?scp=84900557759&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84900557759

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Head movement and facial expressions as game input

This study aimed to develop and test a hands-free video game that utilizes information on the player's real-time face position and facial expressions as intrinsic elements of a gameplay. Special focus was given to investigating the user's subjective experiences in utilizing computer vision input in the game interaction. The player's goal was to steer a drunken character home as quickly as possible by moving their head. Additionally, the player could influence the behavior of game characters by using the facial expressions of frowning and smiling. The participants played the game with computer vision and a conventional joystick and rated the functionality of the control methods and their emotional and game experiences. The results showed that although the functionality of the joystick steering was rated higher than that of the computer vision method, the use of head movements and facial expressions enhanced the experiences of game playing in many ways. The participants rated playing with the computer vision technique as more entertaining, interesting, challenging, immersive, and arousing than doing so with a joystick. The results suggested that a high level of experienced arousal in the case of computer vision-based interaction may be a key factor for better experiences of game playing.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Augmented Human Activities (AHA)

Contributors: Ilves, M., Gizatdinova, Y., Surakka, V., Vankka, E.

Number of pages: 10

Pages: 147-156

Publication date: 2014

Peer-reviewed: Yes

### Publication information

Journal: Entertainment Computing

Volume: 5

Issue number: 3

ISSN (Print): 1875-9521

Ratings:

Scopus rating (2014): CiteScore 2.2 SJR 0.404 SNIP 1.424

Original language: English

ASJC Scopus subject areas: Software, Human-Computer Interaction

Keywords: Camera-based video game, Computer vision, Emotion, Face detection and tracking, Facial expression classification, Gameplay experience

DOIs:

10.1016/j.entcom.2014.04.005

URLs:

<http://www.scopus.com/inward/record.url?scp=84901983211&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84901983211

Research output: Contribution to journal › Article › Scientific › peer-review

### IntentRadar: Search user interface that anticipates user's search intents

We introduce IntentRadar, an interactive search user interface that anticipates user's search intents by estimating them from user interaction. The estimated intents are represented as keywords and visualized on a radial layout that organizes the keywords as directions in the information space. IntentRadar assists users to direct their search by allowing to target relevance feedback on keywords by manipulating the position of the keywords on the radar. The system then learns and visualizes improved estimates of intents and retrieves documents corresponding to the present search intent estimate. IntentRadar has been shown to significantly improve users' task performance and the quality of retrieved information without compromising task execution time.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), Aalto University, University of Helsinki

Contributors: Ruotsalo, T., Peltonen, J., Eugster, M. J. A., Glowacka, D., Reijonen, A., Jacucci, G., Myllymäki, P., Kaski, S.

Number of pages: 4

Pages: 455-458

Publication date: 2014

#### Host publication information

Title of host publication: CHI EA 2014: One of a ChiNd - Extended Abstracts, 32nd Annual ACM Conference on Human Factors in Computing Systems

Publisher: Association for Computing Machinery

ISBN (Print): 9781450324748

ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software

Keywords: Intent modeling, Interactive information retrieval, Search user interfaces, Visualization

DOIs:

10.1145/2559206.2574807

URLs:

<http://www.scopus.com/inward/record.url?scp=84900560093&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84900560093

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Layers of user expectations of future technologies: An early framework

User's expectations are identified as a factor affecting the actual user experience in human-computer interaction.

Considering the context of emerging and future technologies, users' expectations can become increasingly diverse, especially in terms of where they stem from. This paper presents an early framework for understanding different layers of expectations that people might have of technologies in the near future: for example, 'desires' and 'social and societal norms'. The framework provides understanding of the spectrum of user expectations and what different aspects of them could be identified in user inquiries and evaluations. For concretization and credibility of this work-in-progress framework, examples from recent research on user expectations of mobile augmented reality are provided.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Pervasive Computing, Augmented Human Activities (AHA)

Contributors: Olsson, T.

Number of pages: 6

Pages: 1957-1962

Publication date: 2014

#### Host publication information

Title of host publication: CHI EA 2014: One of a ChiNd - Extended Abstracts, 32nd Annual ACM Conference on Human Factors in Computing Systems

Publisher: Association for Computing Machinery

ISBN (Print): 9781450324748

ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software

Keywords: Anticipation, Emerging technologies, Expectation, Framework, Quality, User experience, User studies

DOIs:

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URLs:

<http://www.scopus.com/inward/record.url?scp=84900561033&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84900561033

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Low-Power Reconfigurable Miniature Sensor Nodes for Condition Monitoring

Wireless sensor networks (WSNs) are being deployed at an escalating rate for various application fields. The ever growing number of application areas requires a diverse set of algorithms with disparate processing needs. WSNs also need to adapt to prevailing energy conditions and processing requirements. The preceding reasons rule out the use of a single fixed design. Instead, a general purpose design that can rapidly be adapted to different conditions and requirements is desired. In lieu of the traditional inflexible wireless sensor node consisting of a separate micro-controller, radio transceiver, sensor array and energy storage, we propose a unified rapidly reconfigurable miniature sensor node, implemented with a transport triggered architecture processor on a low-power Flash FPGA. To our knowledge, this is the first study of its kind. The proposed approach does not solely concentrate on energy efficiency but a high emphasis is also put on the ease of development perspective. Power consumption and silicon area usage comparison based on solutions implemented using

our novel rapid design approach for wireless sensor nodes are performed. The comparison is performed between 16-bit fixed point, 16-bit floating point and 32-bit floating point implementations. The implemented processors and algorithms are intended for rolling bearing condition monitoring, but can be fully extended for other applications as well.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing Research Community (SPRC), Univ of Oulu, Dept. of Computer Science and Engineering

Contributors: Nyländen, T., Boutellier, J., Nikunen, K., Hannuksela, J., Silvén, O.

Number of pages: 21

Pages: 3-23

Publication date: 2014

Peer-reviewed: Yes

#### **Publication information**

Journal: International Journal of Parallel Programming

Volume: 43

Issue number: 1

ISSN (Print): 0885-7458

Ratings:

Scopus rating (2014): CiteScore 1.5 SJR 0.256 SNIP 1.046

Original language: English

ASJC Scopus subject areas: Theoretical Computer Science, Software, Information Systems

Keywords: Application specific processors, Transport triggered architecture, Wireless sensor networks

DOIs:

10.1007/s10766-013-0302-5

URLs:

<http://www.scopus.com/inward/record.url?scp=84921701379&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84921701379

Research output: Contribution to journal › Article › Scientific › peer-review

#### **Minimum Variance Extreme Learning Machine for human action recognition**

In this paper we propose an algorithm for Single-hidden Layer Feedforward Neural networks training. Based on the observation that the learning process of such networks can be considered to be a non-linear mapping of the training data to a high-dimensional feature space, followed by a data projection process to a low-dimensional space where classification is performed by a linear classifier, we extend the Extreme Learning Machine (ELM) algorithm in order to exploit the training data dispersion in its optimization process. The proposed Minimum Variance Extreme Learning Machine classifier is evaluated in human action recognition, where we compare its performance with that of other ELM-based classifiers, as well as the kernel Support Vector Machine classifier.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 5

Pages: 5427-5431

Publication date: 2014

#### **Host publication information**

Title of host publication: ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings

Publisher: The Institute of Electrical and Electronics Engineers, Inc.

Article number: 6854640

ISBN (Print): 9781479928927

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: Classification, Extreme Learning Machine, Human Action Recognition, Single-hidden Layer Feedforward Neural networks

DOIs:

10.1109/ICASSP.2014.6854640

Source: Scopus

Source ID: 84905233232

### **Models for mobile application maintenance based on update history**

Good software development and particularly maintenance practices form an important factor for success in software business. If one wants to constantly produce new successful releases of the applications, a proper efficient software maintenance process is the key. In this work, we study data from mobile application maintenance to understand and conceptualize how mobile application maintenance takes place. Based on the data on release history, we deduce different mobile application maintenance models from the perspectives of maintenance scheduling and maintenance requirements.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Research Community on Data-to-Decision (D2D)  
Contributors: Li, X., Zhang, Z., Nummenmaa, J.  
Number of pages: 6  
Pages: 212-217  
Publication date: 2014

#### **Host publication information**

Title of host publication: ENASE 2014 - Proceedings of the 9th International Conference on Evaluation of Novel Approaches to Software Engineering  
Publisher: SCITEPRESS  
ISBN (Print): 9789897580307  
ASJC Scopus subject areas: Software  
Keywords: Maintenance model, Mobile application, Software maintenance, Software release  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84902333180&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84902333180  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **On application of rational Discrete Short Time Fourier Transform in epileptic seizure classification**

This work deals with an adaptive and localized time-frequency representation of time-series signals based on rational functions. The proposed rational Discrete Short Time Fourier Transform (DSTFT) is used for extracting discriminative features in EEG data. We take the advantages of bagging ensemble learning and Alternating Decision Tree (ADTree) classifier to detect the seizure segments in presence of seizure-free segments. The effectiveness of different rational systems is compared with the classical Short Time Fourier Transform (STFT). The comparative study demonstrates that Malmquist-Takenaka rational system outperforms STFT while it can provide a tunable time-frequency representation of the EEG signals and less Mean Square Error (MSE) in the inverse transform. © 2014 IEEE.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Department of Signal Processing, Research group: Video, Tampere University of Technology, Research Community on Data-to-Decision (D2D), Eötvös Loránd University  
Contributors: Kovács, P., Samiee, K., Gabbouj, M.  
Number of pages: 5  
Pages: 5839-5843  
Publication date: 2014

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Place of publication: Piscataway  
Publisher: IEEE  
Article number: 6854723  
ISBN (Print): 978-1-4799-2892-7  
ISBN (Electronic): 978-1-4799-2893-4

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Name: IEEE International Conference on Acoustics, Speech and Signal Processing  
Publisher: IEEE  
ISSN (Print): 1520-6149  
ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering  
Keywords: EEG time series, Malmquist-Takenaka system, rational functions, seizure classification



DOIs:

10.1109/ICASSP.2014.6854723

URLs:

<http://www.scopus.com/inward/record.url?scp=84905251337&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

Contribution: organisation=sgn,FACT1=1<br/>Portfolio EDEND: 2014-06-26

Source: researchoutputwizard

Source ID: 800

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Opportunities and Challenges of Mobile Applications as "Tickets-to-Talk": A Scenario-Based User Study**

This paper presents a scenario-based user study of mobile application concepts that would encourage interaction between people within close proximity. The scenarios demonstrate three themes of digital tickets-to-talk: informing who and what are around, augmenting self-expression, and online interaction encouraging physical interaction. Our interview study explored the opportunities and challenges of such applications in developing into further face-to-face interactions between strangers. Tickets that are related to activities that convey a solid intention that would lead to practical collaboration, such as playing sports or studying together, have the best potential to advance to meaningful face-to-face interaction. Augmenting selfexpression and online interaction encouraging physical interaction were found to have potential to create curiosity but seen less credible by our 42 interview participants to motivate face-to-face interaction between strangers. We conclude by discussing the potential of each theme of ticket-to-talk based on our findings as well as related literature.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Pervasive Computing, Augmented Human Activities (AHA)

Contributors: Jarusriboonchai, P., Olsson, T., Ojala, J., Väänänen-Vainio-Mattila, K.

Number of pages: 9

Pages: 89-97

Publication date: 2014

#### **Host publication information**

Title of host publication: Proceedings of the 13th International Conference on Mobile and Ubiquitous Multimedia, MUM2014, November 25-28, 2014, Melbourne, Australia

Place of publication: New York, NY

Publisher: ACM

ISBN (Print): 978-1-4503-3304-7

#### **Publication series**

Name: International conference on mobile and ubiquitous multimedia

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Awareness system, Co-located interaction, Faceto-face interaction, Mobile technology, Scenarios, Storyboards , User experience, User study

DOIs:

10.1145/2677972.2677993

URLs:

<http://www.scopus.com/inward/record.url?scp=84943175665&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

Contribution: organisation=tie,FACT1=1<br/>Portfolio EDEND: 2014-12-31<br/>Publisher name: ACM

Source: researchoutputwizard

Source ID: 575

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Optimal neighborhood preserving visualization by Maximum satisfiability**

We present a novel approach to low-dimensional neighbor embedding for visualization, based on formulating an information retrieval based neighborhood preservation cost function as Maximum satisfiability on a discretized output display. The method has a rigorous interpretation as optimal visualization based on the cost function. Unlike previous lowdimensional neighbor embedding methods, our formulation is guaranteed to yield globally optimal visualizations, and does so reasonably fast. Unlike previous manifold learning methods yielding global optima of their cost functions, our cost function and method are designed for low-dimensional visualization where evaluation and minimization of visualization errors are crucial. Our method performs well in experiments, yielding clean embeddings of datasets where a stateof-the-art comparison method yields poor arrangements. In a real-world case study for semi-supervised WLAN signal mapping in buildings we outperform state-of-the-art methods.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), Aalto University, University of Helsinki

Contributors: Bunte, K., Järvisalo, M., Berg, J., Myllymäki, P., Peltonen, J., Kaski, S.

Number of pages: 7

Pages: 1694-1700

Publication date: 2014

### Host publication information

Title of host publication: Proceedings of the National Conference on Artificial Intelligence

Volume: 3

Publisher: AI Access Foundation

ISBN (Electronic): 9781577356790

ASJC Scopus subject areas: Software, Artificial Intelligence

URLs:

<http://www.scopus.com/inward/record.url?scp=84908213640&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84908213640

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Optimization equivalence of divergences improves neighbor embedding

Visualization methods that arrange data objects in 2D or 3D layouts have followed two main schools, methods oriented for graph layout and methods oriented for vectorial embedding. We show the two previously separate approaches are tied by an optimization equivalence, making it possible to relate methods from the two approaches and to build new methods that take the best of both worlds. In detail, we prove a theorem of optimization equivalences between  $\beta$ - And  $\gamma$ -, as well as  $\alpha$ - And Rényi-divergences through a connection scalar. Through the equivalences we represent several nonlinear dimensionality reduction and graph drawing methods in a generalized stochastic neighbor embedding setting, where information divergences are minimized between similarities in input and output spaces, and the optimal connection scalar provides a natural choice for the tradeoff between attractive and repulsive forces. We give two ex-amples of developing new visualization methods through the equivalences: 1) We develop weighted symmetric stochastic neighbor embedding (ws-SNE) from Elastic Embedding and analyze its benefits, good performance for both vectorial and network data; in experiments ws-SNE has good performance across data sets of different types, whereas comparison methods fail for some of the data sets; 2) we develop a  $\gamma$ - divergence version of a Poly Log layout method; the new method is scale invariant in the output space and makes it possible to efficiently use large-scale smoothed neighborhoods.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), Aalto University, University of Helsinki

Contributors: Yang, Z., Peltonen, J., Kaski, S.

Number of pages: 32

Pages: 1808-1839

Publication date: 2014

### Host publication information

Title of host publication: 31st International Conference on Machine Learning, ICML 2014

Volume: 2

Publisher: International Machine Learning Society (IMLS)

ISBN (Electronic): 9781634393973

ASJC Scopus subject areas: Artificial Intelligence, Computer Networks and Communications, Software

URLs:

<http://www.scopus.com/inward/record.url?scp=84919948041&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84919948041

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Software architectures for implementing achievement badges - Practical experiences

There are multiple commercial and non-commercial products available to integrate gamification aspects to existing services. Some of these are platform dependent whilst others are more general purpose. Commercial systems come with some problems - for example, lack of control and privacy issues. To avoid these problems, we created two iterations of badge systems and tested both of them on large courses (ca. 300 students each). In this paper, we present these systems and evaluate their merits and flaws. Based on our experiences, we present design principles on how to implement badge systems to existing online learning environments.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Regulation of learning and active learning methods (REALMEE), Aalto University, Department of Computer Science and Eng.

Contributors: Haaranen, L., Hakulinen, L., Ihantola, P., Korhonen, A.

Number of pages: 6

Pages: 41-46

Publication date: 2014

### Host publication information

Title of host publication: Proceedings - 2014 International Conference on Teaching and Learning in Computing and Engineering, LATICE 2014

Publisher: IEEE COMPUTER SOCIETY PRESS

Article number: 6821826

ISBN (Print): 9781479935918

ASJC Scopus subject areas: Software

Keywords: Achievement badges, Automated assessment, Gamification, System design

DOIs:

10.1109/LaTiCE.2014.16

URLs:

<http://www.scopus.com/inward/record.url?scp=84903453777&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84903453777

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Special Issue on Embedded Computer Systems: Architectures, Modeling and Simulation

#### General information

Publication status: Published

MoE publication type: C2 Edited books

Organisations: Department of Pervasive Computing, University of Victoria, Canada, Department of Electrical and Computer Engineering,, Queen's University, Belfast, Northern Ireland, Leibniz-Universität Hannover, Queen's University Belfast, University of Victoria

Contributors: McAllister, J., Guevorkian, D., Jeschke, H., Sima, M.

Publication date: 2014

Peer-reviewed: Yes

#### Publication information

Journal: International Journal of Parallel Programming

Volume: 43

Issue number: 1

ISSN (Print): 0885-7458

Ratings:

Scopus rating (2014): CiteScore 1.5 SJR 0.256 SNIP 1.046

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Theoretical Computer Science

DOIs:

10.1007/s10766-014-0321-x

Source: Scopus

Source ID: 84939892152

Research output: Contribution to journal > Special issue > Scientific > peer-review

### The usability of text entry systems now and in the future

Text entry is an active and growing research domain. Our SIG serves three purposes. First, to strengthen the text entry community by bringing text entry researchers working in the human-computer interaction, natural language processing and augmentative and alternative communication communities together in one room. Second, to promote CHI as a natural and compelling focal point for all kinds of text entry research. Third, to follow-up on and broaden the discussions that emerged from two previous text entry workshops held at CHI [3, 4] by engaging in dialog to identify obstacles for success and formalizing procedures for measuring progress in the field of text entry.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Georgia Institute of Technology, University of Glasgow, Max Planck Institute for Informatics, University of Strathclyde, Montana Tech., University of St Andrews, University of Dundee  
Contributors: Clawson, J., Isokoski, P., Brewster, S., Oulasvirta, A., Dunlop, M., Vertanen, K., Kristensson, P. O., Waller, A.

Number of pages: 4

Pages: 1139-1142

Publication date: 2014

#### Host publication information

Title of host publication: CHI EA 2014: One of a ChiNd - Extended Abstracts, 32nd Annual ACM Conference on Human Factors in Computing Systems

Publisher: Association for Computing Machinery

ISBN (Print): 9781450324748

ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software

Keywords: Accessibility, Augmentative and alternative communication, Internationalization, Text entry

DOIs:

10.1145/2559206.2559217

Source: Scopus

Source ID: 84900546037

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Automated design of networks of transport-triggered architecture processors using dynamic dataflow programs

Modern embedded systems show a clear trend towards the use of Multiprocessor System-on-Chip (MPSoC) architectures in order to handle the performance and power consumption constraints. However, the design and validation of dedicated MPSoCs is an extremely hard and expensive task due to their complexity. Thus, the development of automated design processes is of highest importance to satisfy the time-to-market pressure of embedded systems. This paper proposes an automated co-design flow based on the high-level language-based approach of the Reconfigurable Video Coding framework. The designer provides the application description in the RVC-CAL dataflow language, after which the presented co-design flow automatically generates a network of heterogeneous processors that can be synthesized on FPGA chips. The synthesized processors are Very Long Instruction Word-style processors. Such a methodology permits the rapid design of a many-core signal processing system which can take advantage of all levels of parallelism. The toolchain functionality has been demonstrated by synthesizing an MPEG-4 Simple Profile video decoder to two different FPGA boards. The decoder is realized into 18 processors that decode QCIF resolution video at 45 frames per second on a 50 MHz FPGA clock frequency. The results show that the given application can take advantage of every level of parallelism.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing Research Community (SPRC), Universite de Rennes, CSE Department, Univ of Oulu, UBL

Contributors: Yviquel, H., Boutellier, J., Raulet, M., Casseau, E.

Number of pages: 8

Pages: 1295-1302

Publication date: Nov 2013

Peer-reviewed: Yes

#### Publication information

Journal: Signal Processing: Image Communication

Volume: 28

Issue number: 10

ISSN (Print): 0923-5965

Ratings:

Scopus rating (2013): CiteScore 3.2 SJR 0.407 SNIP 1.301

Original language: English

ASJC Scopus subject areas: Software, Signal Processing, Computer Vision and Pattern Recognition, Electrical and Electronic Engineering

Keywords: Co-design, Dataflow programming, Multi-Processor System-on-Chip (MPSoC), Reconfigurable Video Coding (RVC), Transport-Trigger Architecture (TTA)

DOIs:

10.1016/j.image.2013.08.013

URLs:

<http://www.scopus.com/inward/record.url?scp=84888203042&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84888203042

### **Configurable, resource-optimized FFT architecture for OFDM communication**

In this paper, we present a designer-configurable, resource efficient FPGA architecture for OFDM system implementation. Our design achieves a significant improvement in resource efficiency for a given data rate. This efficiency improvement is achieved through careful analysis of how FFT computation is performed within the context of OFDM systems, and streamlining memory management and control logic based on this analysis. In particular, our OFDM-targeted FFT design eliminates redundant buffer memory, and simplifies control logic to save FPGA resources. We have synthesized and tested our design using the Xilinx ISE 13.4 synthesis tool, and compared the results with the Xilinx FFT v7.1, which is a widely used commercial FPGA IP core. We have demonstrated that our design provides at least 8.8% enhancement in terms of resource efficiency compared to Xilinx FFT v7.1 when it is embedded within the same OFDM configuration.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing Research Community (SPRC), University of Maryland, Agilent Technologies, Department of Electrical and Computer Engineering

Contributors: Cho, I., Shen, C. C., Tachwali, Y., Hsu, C. J., Bhattacharyya, S. S.

Number of pages: 5

Pages: 2746-2750

Publication date: 18 Oct 2013

#### **Host publication information**

Title of host publication: 2013 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2013 - Proceedings

Article number: 6638156

ISBN (Print): 9781479903566

ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering

Keywords: FFT, FPGA, OFDM, Resource

DOIs:

10.1109/ICASSP.2013.6638156

URLs:

<http://www.scopus.com/inward/record.url?scp=84890522532&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84890522532

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Programmable lowpower implementation of the HEVC Adaptive Loop Filter**

The Adaptive Loop Filter (ALF) is a subjective and objective image quality improving filter in the High Efficiency Video Coding standard (HEVC). The ALF has shown to be computationally complex and its complexity has been reduced during the HEVC development process. In the HEVC TestModel HM-7.0 ALF is a 9×7 cross + 3×3 square shaped filter. This paper presents a programmable application specific instruction processor for the ALF. The proposed processor processes 1920×1080p luminance frames at 30 frames per second, when operated at a clock frequency of 311MHz. Low power consumption and a low gate count make the proposed processor suitable for embedded devices. The processor program code is written in pure C-language, which allows versatile use of the circuit and updates to the filter functionality without modifying the processor design. To the authors' best knowledge this is the first programmable solution for ALF on embedded devices.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing Research Community (SPRC), Univ of Oulu, Dept. of Computer Science and Engineering

Contributors: Hautala, I., Boutellier, J., Hannuksela, J.

Number of pages: 5

Pages: 2664-2668

Publication date: 18 Oct 2013

#### **Host publication information**

Title of host publication: 2013 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2013 - Proceedings

Article number: 6638139

ISBN (Print): 9781479903566

ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering

Keywords: Adaptive filters, Coprocessors, Video signal processing

DOIs:

10.1109/ICASSP.2013.6638139

URLs:

<http://www.scopus.com/inward/record.url?scp=84890508061&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84890508061

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **An evaluation of the virtual curvature with the StickGrip haptic device: A case study**

Dynamic simulation of distance to the physical surface could promote the development of new inexpensive tools for blind and visually impaired users. The StickGrip is a haptic device comprised of the Wacom pen input device added with a motorized penholder. The goal of the research presented in this paper was to assess the accuracy and usefulness of the new pen-based interaction technique when the position and displacement of the penholder in relation to the pen tip provided haptic feedback to the user about the distance to the physical or virtual surface of interaction. The aim was to examine how accurately people are able (1) to align the randomly deformed virtual surfaces to the flat surface and (2) to adjust the number of surface samples having a randomly assigned curvature to the template having the given curvature and kept fixed. These questions were approached by measuring both the values of the adjusted parameters and the parameters of the human performance, such as a ratio between inspection time and control time spent by the participants to complete the matching task with the use of the StickGrip device. The test of the pen-based interaction technique was conducted in the absence of visual feedback when the subject could rely on the proprioception and kinesthetic sense. The results are expected to be useful for alternative visualization and interaction with complex topographic and mathematical surfaces, artwork, and modeling.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Augmented Human Activities (AHA)

Contributors: Evreinova, T. V., Evreinov, G., Raisamo, R.

Number of pages: 13

Pages: 161-173

Publication date: Jun 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Universal Access in the Information Society

Volume: 12

Issue number: 2

ISSN (Print): 1615-5289

Ratings:

Scopus rating (2013): CiteScore 2.6 SJR 0.513 SNIP 1.516

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Computer Networks and Communications, Human-Computer Interaction

Keywords: Curved surface, Kinesthetic feedback, Pen-based interaction, StickGrip haptic device

DOIs:

10.1007/s10209-012-0273-0

URLs:

<http://www.scopus.com/inward/record.url?scp=84878407340&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84878407340

Research output: Contribution to journal › Article › Scientific › peer-review

### **Multi-view action recognition based on action volumes, fuzzy distances and cluster discriminant analysis**

In this paper, we present a view-independent action recognition method exploiting a low computational-cost volumetric action representation. Binary images depicting the human body during action execution are accumulated in order to produce the so-called action volumes. A novel time-invariant action representation is obtained by exploiting the circular shift invariance property of the magnitudes of the Discrete Fourier Transform coefficients. The similarity of an action volume with representative action volumes is exploited in order to map it to a lower-dimensional feature space that preserves the action class properties. Discriminant learning is, subsequently, employed for further dimensionality reduction and action class discrimination. By using such an action representation, the proposed approach performs fast action recognition. By combining action recognition results coming from different view angles, high recognition rates are obtained. The proposed method is extended to interaction recognition, i.e., to human action recognition involving two persons. The proposed approach is evaluated on a publicly available action recognition database using experimental settings simulating situations that may appear in real-life applications, as well as on a new nutrition support action

recognition database.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 13

Pages: 1445-1457

Publication date: Jun 2013

Peer-reviewed: Yes

### Publication information

Journal: Signal Processing

Volume: 93

Issue number: 6

ISSN (Print): 0165-1684

Ratings:

Scopus rating (2013): CiteScore 5.1 SJR 0.909 SNIP 2.244

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Control and Systems Engineering, Software, Signal Processing, Computer Vision and Pattern Recognition

Keywords: Action recognition, Action volumes, Cluster discriminant analysis, Fuzzy vector quantization

DOIs:

10.1016/j.sigpro.2012.08.015

Source: Scopus

Source ID: 84875267100

Research output: Contribution to journal > Article > Scientific > peer-review

### Indirect measurement of the vascular endothelial glycocalyx layer thickness in human submucosal capillaries with a plug-in for ImageJ

**Background:** The thickness of vascular endothelial glycocalyx layer can be measured indirectly during a spontaneous leukocyte passage from oral submucosal capillaries in humans. The subsequent differences in red blood cell (RBC) column widths, before a spontaneous white blood cell passage (pre-WBC) and after a spontaneous WBC passage (post-WBC) can be used in off-line analysis to measure glycocalyx thickness:  $[\text{pre-WBC width} - \text{post-WBC width}]/2$ . We created and validated a semi-automatic plug-in for ImageJ to measure the endothelial glycocalyx layer thickness. **Methods:** Video clips presenting human sublingual microvasculature were created with a side-stream dark field imaging device. Spontaneous leukocyte passages in capillaries were analyzed from video clips with ImageJ. The capillary glycocalyx layer thickness was measured by the indirect approach with two manual and two semi-automatic methods. **Results:** There were no statistically significant differences between glycocalyx layer thicknesses measured with different methods, even though small inter-method differences in RBC column thicknesses could be detected. Inter-rater differences were systematically smaller with both semi-automatic methods. Intra-rater coefficient of variation [CV] (95% CI) was largest when measurements were made completely manually [9.2% (8.4-10.0)], but improved significantly with automatic image enhancement prior to manual measurement [7.2% (6.4-8.0)]. CV could be improved further when using semi-automatic analysis with an in-frame median filter radius of 1 pixel [5.8% (5.0-6.6)], or a median filter radius of 2 pixels [4.3% (3.5-5.1)]. **Conclusions:** Semi-automatic analysis of glycocalyx decreased the intra-rater CV and the inter-rater differences compared to the manual method. On average, each of the four methods yielded equal results for the glycocalyx thickness. Being the only feasible bed side method in most clinical scenarios, indirect measurement of glycocalyx thickness with orthogonal polarization spectral imaging or side-stream dark field imaging device and our plug-in can advance the study of glycocalyx layer pathology in man.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Helsinki University Central Hospital, University of Helsinki, Uppsala University, Tampere University Hospital

Contributors: Liuhanen, S., Sallisalmi, M., Pettilä, V., Oksala, N., Tenhunen, J.

Number of pages: 10

Pages: 38-47

Publication date: Apr 2013

Peer-reviewed: Yes

### Publication information

Journal: Computer Methods and Programs in Biomedicine

Volume: 110  
Issue number: 1  
ISSN (Print): 0169-2607  
Ratings:

Scopus rating (2013): CiteScore 3.4 SJR 0.628 SNIP 1.459

Original language: English

ASJC Scopus subject areas: Computer Science Applications, Software, Health Informatics

Keywords: Endothelial surface layer, Glycocalyx, Imagej, Open source, Side-stream dark field

DOIs:

10.1016/j.cmpb.2012.10.019

URLs:

<http://www.scopus.com/inward/record.url?scp=84875094399&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84875094399

Research output: Contribution to journal › Article › Scientific › peer-review

### **High-performance and low-energy buffer mapping method for multiprocessor DSP systems**

When implementing digital signal processing (DSP) applications onto multiprocessor systems, one significant problem in the viewpoints of performance is the memory wall. In this paper, to help alleviate the memory wall problem, we propose a novel, high-performance buffer mapping policy for SDF-represented DSP applications on bus-based multiprocessor systems that support the shared-memory programming model. The proposed policy exploits the bank concurrency of the DRAM main memory system according to the analysis of hierarchical parallelism. Energy consumption is also a critical parameter, especially in battery-based embedded computing systems. In this paper, we apply a synchronization back-off scheme on the top of the proposed high-performance buffer mapping policy to reduce energy consumption. The energy saving is attained by minimizing the number of non-essential synchronization transactions. We measure throughput and energy consumption on both synthetic and real benchmarks. The simulation results show that the proposed buffer mapping policy is very useful in terms of performance, especially in memory-intensive applications where the total execution time of computational tasks is relatively small compared to that of memory operations. In addition, the proposed synchronization back-off scheme provides a reduction in the number of synchronization transactions without degrading performance, which results in system energy saving.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing Research Community (SPRC), Georgia Institute of Technology, Department of ECE and Institute for Advanced Computer Studies, University of Maryland

Contributors: Lee, D., Wolf, M., Bhattacharyya, S. S.

Publication date: Mar 2013

Peer-reviewed: Yes

### **Publication information**

Journal: ACM Transactions on Embedded Computing Systems

Volume: 12

Issue number: 3

Article number: 82

ISSN (Print): 1539-9087

Ratings:

Scopus rating (2013): CiteScore 1.7 SJR 0.307 SNIP 0.982

Original language: English

ASJC Scopus subject areas: Software, Hardware and Architecture

Keywords: Bank concurrency, DRAM main memory systems, Multiprocessor DSP systems, SDF

DOIs:

10.1145/2442116.2442132

URLs:

<http://www.scopus.com/inward/record.url?scp=84878495064&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84878495064

Research output: Contribution to journal › Article › Scientific › peer-review

### **'Aie-studio' - A pragmatist aesthetic approach for procedural sound design**

This paper introduces the AIE-Studio (Audio Interfaces for Exploration), a modular dataflow patching library implemented with Pure Data. The AIE-Studio introduces new tools for procedural sound design through generative sonic and musical structures. Particular focus is on aesthetic experience. The designed modules allow versatile dataflow mapping through matrix routing system while also enabling the sound designer to influence generative processes of music creation. In



particular, The AIE-Studio was used to create generative sonic and musical material in an embodied game-like application. In this paper we present key questions driving the research, theoretical background, research approach and the main development activities .

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Augmented Human Activities (AHA)  
Contributors: Luhtala, M., Turunen, M., Hakulinen, J., Keskinen, T.  
Publication date: 2013

#### **Host publication information**

Title of host publication: Proceedings of the 8th Audio Mostly: A Conference on Interaction with Sound, AM 2013 - In Cooperation with ACM SIGCHI  
Publisher: Association for Computing Machinery  
Article number: 7  
ISBN (Print): 9781450326599  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Aesthetic experience, Artistic interfaces, Generative strategies, Procedural audio, Procedural sound design, Pure data, Sonic interaction design  
DOIs:  
10.1145/2544114.2544124  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84898834763&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84898834763  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **A lightweight many-to-many authentication protocol for near field communications**

In this paper the lightweight many-to-many authentication protocol, that uses Near Field Communications as a carrier technology is proposed. The solution works without any user interaction and can be applied for almost any data storage device: NFC or RFID tag, USB-flash drive, etc. The major novelty of the system is real-time encryption key generation algorithm. This approach doesn't require any computation power on the tag, trusted third parties or secure link between tag and information system. So far, the mentioned features transforms to significant advantages of the proposed solution, while compared to existing analogues: OAuth, Opacity and LMAP. At the same time, the integrity of key sequences is not guaranteed, that brings motivation for future research in the field.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Research group: Emerging Technologies for Nano-Bio-Info-Cogno, Department of Electronics and Communications Engineering, Wireless Communications and Positioning (WICO), Nano Communication Centre, Yaroslavl State University  
Contributors: Petrov, V., Komar, M., Koucheryavy, Y.  
Publication date: 2013

#### **Host publication information**

Title of host publication: Proceedings of the 2013 21st IEEE International Conference on Network Protocols, ICNP 2013  
Publisher: IEEE COMPUTER SOCIETY PRESS  
Article number: 6733633  
ISBN (Print): 9781479912704  
ASJC Scopus subject areas: Computer Networks and Communications, Software  
DOIs:  
10.1109/ICNP.2013.6733633  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84896795715&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84896795715  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **A movable immaterial volumetric display**

We have created a movable, limitedly volumetric "immaterial" display. Our prototype is the first mobile, hand-held fogscreen. It can show e.g., slices of volumetric objects when swept across mid-air. It is based on the patented FogScreen [Fogio 2013] technology. The previous FogScreen installations have been fixed set-ups, where the screen device and a

projector are typically rigged up, leaving space for the viewers to walk through the mid-air display. Also mid-air virtual reality and mid-air user interfaces have been implemented [DiVerdi et al. 2006, Rakkolainen et al. 2009]. 2013 Copyright held by the Owner/Author.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), University of Tampere

Contributors: Rakkolainen, I., Sand, A.

Publication date: 2013

#### Host publication information

Title of host publication: SIGGRAPH Asia 2013 Posters, SA 2013

Article number: 2

ISBN (Print): 9781450326346

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Software

DOIs:

10.1145/2542302.2542305

URLs:

<http://www.scopus.com/inward/record.url?scp=84890958524&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84890958524

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Checking visual data flow programs with finite process models

A visual data flow language (VDFL) allows graphical presentation of a computer program in the form of a directed graph, where data tokens travel through the arcs of the graph, and the vertices present e.g. the input token streams, calculations, comparisons, and conditionals. Amongst their benefits, VDFLs allow parallel computing and they are presumed to improve the quality of programming due to their intuitive readability. Thus, they are also suitable for computing education. However, the token-based computational model allowing parallel processing may make the programs more complicated than what they look. We propose a method for checking properties of VDFL programs using finite state processes (FSPs) using a commonly available labelled transition system analyser (LTSA) tool. The method can also be used to study different VDFL programming constructs for development or re-design of VDFLs. For our method, we have implemented a compiler that compiles a textual representation of a VDFL into FSPs.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), Mathematical modelling with wide societal impact (MathImpact), Ita-Suomen yliopisto

Contributors: Nummenmaa, J., Marttila-Kontio, M., Nummenmaa, T.

Number of pages: 14

Pages: 245-258

Publication date: 2013

#### Host publication information

Title of host publication: 13th Symposium on Programming Languages and Software Tools, SPLST 2013 - Proceedings

Publisher: University of Szeged

ISBN (Electronic): 9789633062289

ASJC Scopus subject areas: Computer Science Applications, Software

URLs:

<http://www.scopus.com/inward/record.url?scp=84923622331&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84923622331

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Dynamic action recognition based on dynemes and Extreme Learning Machine

In this paper, we propose a novel method that performs dynamic action classification by exploiting the effectiveness of the Extreme Learning Machine (ELM) algorithm for single hidden layer feedforward neural networks training. It involves data grouping and ELM based data projection in multiple levels. Given a test action instance, a neural network is trained by using labeled action instances forming the groups that reside to the test sample's neighborhood. The action instances involved in this procedure are, subsequently, mapped to a new feature space, determined by the trained network outputs. This procedure is performed multiple times, which are determined by the test action instance at hand, until only a single class is retained. Experimental results denote the effectiveness of the dynamic classification approach, compared to the static one, as well as the effectiveness of the ELM in the proposed dynamic classification setting.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 9

Pages: 1890-1898

Publication date: 2013

Peer-reviewed: Yes

### Publication information

Journal: Pattern Recognition Letters

Volume: 34

Issue number: 15

ISSN (Print): 0167-8655

Ratings:

Scopus rating (2013): CiteScore 4.8 SJR 0.768 SNIP 2.474

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Vision and Pattern Recognition, Signal Processing

Keywords: Activity recognition, Dynamic classification, Extreme Learning Machine, Fuzzy vector quantization

DOIs:

10.1016/j.patrec.2012.10.019

Source: Scopus

Source ID: 84885069818

Research output: Contribution to journal › Article › Scientific › peer-review

### Front-camera video recordings as emotion responses to mobile photos shared within close-knit groups

People use social-photography services to tell stories about themselves and to solicit responses from viewers. State-of-the-art services concentrate on textual comments, "Like" buttons, or similar means for viewers to give explicit feedback, but they overlook other, non-textual means. This paper investigates how emotion responses-as video clips captured by the front camera of a cell phone and used as tags for the individual photo viewed-can enhance photo-sharing experiences for close-knit groups. Our exploration was carried out with a mobile social-photography service called Social Camera. Four user groups (N=19) used the application for two to four weeks. The study's results support the value of using front-camera video recordings to glean emotion response. It supports lightweight phatic social interactions not possible with comments and "Like" buttons. Most users kept sharing emotion responses throughout the study. They typically shared the responses right after they saw a just-taken photo received from a remote partner. They used the responses to share their current contexts with others just as much as to convey nuanced feelings about a photo. We discuss the implications for future design and research.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Nokia

Contributors: Cui, Y., Kangas, J., Holm, J., Grassel, G.

Number of pages: 10

Pages: 981-990

Publication date: 2013

### Host publication information

Title of host publication: CHI 2013: Changing Perspectives, Conference Proceedings - The 31st Annual CHI Conference on Human Factors in Computing Systems

ISBN (Print): 9781450318990

ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Graphics and Computer-Aided Design

Keywords: Close-knit group, Co-presence, Emotion response, Feedback, Mobile, Social camera, Social photography

DOIs:

10.1145/2470654.2466125

URLs:

<http://www.scopus.com/inward/record.url?scp=84877935649&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84877935649

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Gestures and widgets: Performance in text editing on multi-touch capable mobile devices**

We describe the design and evaluation of a gestural text editing technique for touchscreen devices. The gestures are drawn on top of the soft keyboard and interpreted as commands for moving the caret, performing selections, and controlling the clipboard. Our implementation is an Android service that can be used in any text editing task on Android-based devices. We conducted an experiment to compare the gestural editing technique against the widget-based technique available on a smartphone (Samsung Galaxy II with Android 2.3.5). The results show a performance benefit of 13-24% for the gestural technique depending on the font size. Subjective feedback from the participants was also positive. Because the two editing techniques use different input areas, they can coexist on a device. This means that the gestural editing can be added on any soft keyboard without interfering with user experience for those users that choose not to use it.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Università di Salerno, Université de Lorraine

Contributors: Fuccella, V., Isokoski, P., Martin, B.

Number of pages: 10

Pages: 2785-2794

Publication date: 2013

#### **Host publication information**

Title of host publication: CHI 2013: Changing Perspectives, Conference Proceedings - The 31st Annual CHI Conference on Human Factors in Computing Systems

ISBN (Print): 9781450318990

ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software

Keywords: Android, Caret movement, Clipboard, Gestures, Text editing

DOIs:

10.1145/2470654.2481385

URLs:

<http://www.scopus.com/inward/record.url?scp=84877966468&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84877966468

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Guest editorial**

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: System-on-Chip for GNSS, Wireless Communications and Cyber-Physical Embedded Computing, Department of Electronics and Communications Engineering

Contributors: Ellervee, P., Nurmi, J.

Number of pages: 2

Pages: 430-431

Publication date: 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Microprocessors and Microsystems

Volume: 37

Issue number: 4-5

ISSN (Print): 0141-9331

Ratings:

Scopus rating (2013): CiteScore 1.6 SJR 0.225 SNIP 1.194

Original language: English

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software, Artificial Intelligence

DOIs:

10.1016/j.micpro.2013.05.002

Source: Scopus

Source ID: 84878614529

Research output: Contribution to journal › Article › Scientific › peer-review

### **How to study programming on mobile touch devices - Interactive Python code exercises**

Scaffolded learning tasks where programs are constructed from predefined code fragments by dragging and dropping them (i.e. Parsons problems) are well suited to mobile touch devices, but quite limited in their applicability. They do not adequately cater for different approaches to constructing a program. After studying solutions to automatically assessed programming exercises, we found out that many different solutions are composed of a relatively small set of mutually similar code lines. Thus, they can be constructed by using the drag-and-drop approach if only it was possible to edit some small parts of the predefined fragments. Based on this, we have designed and implemented a new exercise type for mobile devices that builds on Parsons problems and falls somewhere between their strict scaffolding and full-blown coding exercises. In these exercises, we can gradually fade the scaffolding and allow programs to be constructed more freely so as not to restrict thinking and limit creativity too much while still making sure we are able to deploy them to small-screen mobile devices. In addition to the new concept and the related implementation, we discuss other possibilities of how programming could be practiced on mobile devices.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Regulation of learning and active learning methods (REALMEE), Department of Computer Science and Eng., Aalto University

Contributors: Ihantola, P., Helminen, J., Karavirta, V.

Number of pages: 8

Pages: 51-58

Publication date: 2013

#### **Host publication information**

Title of host publication: Proceedings - 13th Koli Calling International Conference on Computing Education Research, Koli Calling 2013

ISBN (Print): 9781450324823

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: learning, mLearning, mobile learning, mobile touch devices, parsons problem, parsons puzzle, programming, Python, teaching

DOIs:

10.1145/2526968.2526974

URLs:

<http://www.scopus.com/inward/record.url?scp=84889570829&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84889570829

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Information retrieval perspective to meta-visualization**

In visual data exploration with scatter plots, no single plot is sufficient to analyze complicated high-dimensional data sets. Given numerous visualizations created with different features or methods, meta-visualization is needed to analyze the visualizations together. We solve how to arrange numerous visualizations onto a meta-visualization display, so that their similarities and differences can be analyzed. We introduce a machine learning approach to optimize the meta-visualization, based on an information retrieval perspective: Two visualizations are similar if the analyst would retrieve similar neighborhoods between data samples from either visualization. Based on the approach, we introduce a nonlinear embedding method for meta-visualization: it optimizes locations of visualizations on a display, so that visualizations giving similar information about data are close to each other.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aalto University

Contributors: Peltonen, J., Lin, Z.

Number of pages: 16

Pages: 165-180

Publication date: 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Journal of Machine Learning Research

Volume: 29

ISSN (Print): 1532-4435

Ratings:

Scopus rating (2013): CiteScore 6.2 SJR 1.235 SNIP 2.293

Original language: English

ASJC Scopus subject areas: Artificial Intelligence, Software, Control and Systems Engineering, Statistics and Probability

Keywords: Meta-visualization, Neighbor embedding, Nonlinear dimensionality reduction

URLs:

<http://www.scopus.com/inward/record.url?scp=84908485499&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84908485499

Research output: Contribution to journal › Article › Scientific › peer-review

### Long-term tracking through failure cases

Long term tracking of an object, given only a single instance in an initial frame, remains an open problem. We propose a visual tracking algorithm, robust to many of the difficulties which often occur in real-world scenes. Correspondences of edge-based features are used, to overcome the reliance on the texture of the tracked object and improve invariance to lighting. Furthermore we address long-term stability, enabling the tracker to recover from drift and to provide redetection following object disappearance or occlusion. The two-module principle is similar to the successful state-of-the-art long-term TLD tracker, however our approach extends to cases of low-textured objects. Besides reporting our results on the VOT Challenge dataset, we perform two additional experiments. Firstly, results on short-term sequences show the performance of tracking challenging objects which represent failure cases for competing state-of-the-art approaches. Secondly, long sequences are tracked, including one of almost 30000 frames which to our knowledge is the longest tracking sequence reported to date. This tests the re-detection and drift resistance properties of the tracker. All the results are comparable to the state-of-the-art on sequences with textured objects and superior on non-textured objects. The new annotated sequences are made publicly available.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), University of Surrey, Czech Technical University in Prague

Contributors: Lebeda, K., Hadfield, S., Matas, J., Bowden, R.

Number of pages: 8

Pages: 153-160

Publication date: 2013

### Host publication information

Title of host publication: Proceedings - 2013 IEEE International Conference on Computer Vision Workshops, ICCVW 2013

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 6755891

ISBN (Print): 9781479930227

ASJC Scopus subject areas: Software, Computer Vision and Pattern Recognition

Keywords: Computer vision, Edge, Line correspondence, Long-term tracking, Low texture, Visual tracking

DOIs:

[10.1109/ICCVW.2013.26](https://doi.org/10.1109/ICCVW.2013.26)

URLs:

<http://www.scopus.com/inward/record.url?scp=84897541648&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84897541648

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Mixed reality with multimodal head-mounted pico projector

Many kinds of displays can be used for augmented reality (AR). Multimodal head-mounted pico projector is a concept, which is little explored for AR. It opens new possibilities for wearable displays. In this paper we present our proof-of-concept prototype of a multimodal head-mounted pico projector. Our main contributions are the display concept and some usage examples for it.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), University of Tampere

Contributors: Sand, A., Rakkolainen, I.

Publication date: 2013

### Host publication information

Title of host publication: Proceedings of the Virtual Reality International Conference on Laval Virtual, VRIC 2013

Article number: 14

ISBN (Print): 9781450318754

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Augmented reality, Mixed reality, Multimodality, Pico projector, Wearable displays

DOIs:

10.1145/2466816.2466831

URLs:

<http://www.scopus.com/inward/record.url?scp=84882277921&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84882277921

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **On the optimal class representation in linear discriminant analysis**

Linear discriminant analysis (LDA) is a widely used technique for supervised feature extraction and dimensionality reduction. LDA determines an optimal discriminant space for linear data projection based on certain assumptions, e.g., on using normal distributions for each class and employing class representation by the mean class vectors. However, there might be other vectors that can represent each class, to increase class discrimination. In this brief, we propose an optimization scheme aiming at the optimal class representation, in terms of Fisher ratio maximization, for LDA-based data projection. Compared with the standard LDA approach, the proposed optimization scheme increases class discrimination in the reduced dimensionality space and achieves higher classification rates in publicly available data sets.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aristotle University of Thessaloniki, Department of Informatics

Contributors: Iosifidis, A., Tefas, A., Pitas, I.

Number of pages: 7

Pages: 1491-1497

Publication date: 2013

Peer-reviewed: Yes

### **Publication information**

Journal: IEEE Transactions on Neural Networks and Learning Systems

Volume: 24

Issue number: 9

ISSN (Print): 2162-237X

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Scopus rating (2013): CiteScore 9.4 SJR 2.33 SNIP 3.576

Original language: English

ASJC Scopus subject areas: Artificial Intelligence, Computer Networks and Communications, Computer Science Applications, Software

Keywords: Class representation, data projection, linear discriminant analysis (LDA), subspace learning

DOIs:

10.1109/TNNLS.2013.2258937

Source: Scopus

Source ID: 84882899597

Research output: Contribution to journal > Article > Scientific > peer-review

### **Power harvesting from microwave oven electromagnetic leakage**

In this paper, we considered the possibility of using electricity harvested from the microwave field leaked from commercial microwave ovens. Our experimental results showed that the leakage received by a dipole antenna was about 0 dBm (1 mW) at a point 5 cm in front of the door. A rectenna consisting of a dipole antenna and charge pump can convert the leaked microwave energy into a DC current. When a microwave oven is operated for 2 min, 9.98 mJ of energy was harvested. We demonstrated that this energy is sufficient for powering a digital cooking timer to count down for 3 min and beep for 2.5 s. The operation of other kitchen devices was also demonstrated.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, University of Tokyo

Contributors: Kawahara, Y., Bian, X., Shigeta, R., Vyas, R., Tentzeris, M. M., Asami, T.

Number of pages: 9

Pages: 373-381

Publication date: 2013

### Host publication information

Title of host publication: UbiComp 2013 - Proceedings of the 2013 ACM International Joint Conference on Pervasive and Ubiquitous Computing

ISBN (Print): 9781450317702

ASJC Scopus subject areas: Software

Keywords: Energy harvesting, Microwave oven, Wireless sensing

DOIs:

10.1145/2493432.2493500

URLs:

<http://www.scopus.com/inward/record.url?scp=84885220237&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84885220237

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Reading on-screen text with gaze-based auto-scrolling

Visual information on eye movements can be used to facilitate scrolling while one is reading on-screen text. We carried out an experiment to find preferred reading regions on the screen and implemented an automatic scrolling technique based on the preferred regions of each individual reader. We then examined whether manual and automatic scrolling have an effect on reading behaviour on the basis of eye movement metrics, such as fixation duration and fixation count. We also studied how different font sizes affect the eye movement metrics. Results of analysis of data collected from 24 participants indicated no significant difference between manual and automatic scrolling in reading behaviour. Preferred reading regions on the screen varied among the participants. Most of them preferred relatively short regions. A significant effect of font size on fixation count was found. Subjective opinions indicated that participants found automatic scrolling convenient to use.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA)

Contributors: Sharmin, S., Špakov, O., Rähkä, K. J.

Number of pages: 8

Pages: 24-31

Publication date: 2013

### Host publication information

Title of host publication: Proceedings of the 2013 Conference on Eye Tracking South Africa, ETSA 2013

ISBN (Print): 9781450321105

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: automatic scrolling, eye movements, fixation count, fixation duration, manual scrolling, reading, reading region

DOIs:

10.1145/2509315.2509319

URLs:

<http://www.scopus.com/inward/record.url?scp=84883884057&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84883884057

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Recording and analyzing in-browser programming sessions

In this paper, we report on the analysis of a novel type of automatically recorded detailed programming session data collected on a university-level web programming course. We present a method and an implementation of collecting rich data on how students learning to program edit and execute code and explore its use in examining learners' behavior. The data collection instrument is an in-browser Python programming environment that integrates an editor, an execution environment, and an interactive Python console and is used to deliver programming assignments with automatic feedback. Most importantly, the environment records learners' interaction within it. We have implemented tools for viewing these traces and demonstrate their potential in learning about the programming processes of learners and of benefiting computing education research and the teaching of programming.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Regulation of learning and active learning methods (REALMEE), Aalto University, Department of Computer Science and Eng.



Contributors: Helminen, J., Ihantola, P., Karavirta, V.  
Number of pages: 10  
Pages: 13-22  
Publication date: 2013

#### Host publication information

Title of host publication: Proceedings - 13th Koli Calling International Conference on Computing Education Research, Koli Calling 2013

ISBN (Print): 9781450324823

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: computer science education, computing education research, programming assignment, programming session, Python, web based programming environment

DOIs:

10.1145/2526968.2526970

URLs:

<http://www.scopus.com/inward/record.url?scp=84889581968&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84889581968

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### SIMPE: 8th workshop on speech and sound in mobile and pervasive environments

The SiMPE workshop series started in 2006 with the goal of enabling speech processing on mobile and embedded devices. The SiMPE 2012 workshop extended the notion of audio to non-speech "Sounds" and thus the expansion became "Speech and Sound". SiMPE 2010 and 2011 brought together researchers from the speech and the HCI communities. Speech User interaction in cars was a focus area in 2009. Multimodality got more attention in SiMPE 2008. In SiMPE 2007, the focus was on developing regions. With SiMPE 2013, the 8th in the series, we continue to explore the area of speech along with sound. Akin to language processing and text-to-speech synthesis in the voice-driven interaction loop, sensors can track continuous human activities such as singing, walking, or shaking the mobile phone, and non-speech audio can facilitate continuous interaction. The technologies underlying speech processing and sound processing are quite different and these communities have been working mostly independent of each other. And yet, for multimodal interactions on the mobile, it is perhaps natural to ask whether and how speech and sound can be mixed and used more effectively and naturally.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), IBM Research, Ita-Suomen yliopisto, University of Helsinki, Carnegie Mellon University, Aalborg University

Contributors: Nanavati, A. A., Rajput, N., Srivastava, S., Erkut, C., Jylhä, A., Rudnicky, A. I., Serafin, S., Turunen, M.

Number of pages: 4

Pages: 626-629

Publication date: 2013

#### Host publication information

Title of host publication: MobileHCI 2013 - Proceedings of the 15th International Conference on Human-Computer Interaction with Mobile Devices and Services

ISBN (Print): 9781450322737

ASJC Scopus subject areas: Human-Computer Interaction, Software

Keywords: mobile computing, sonic interaction, sound, sound and music computing, speech processing

DOIs:

10.1145/2493190.2499471

URLs:

<http://www.scopus.com/inward/record.url?scp=84883727754&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84883727754

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### The visual object tracking VOT2013 challenge results

Visual tracking has attracted a significant attention in the last few decades. The recent surge in the number of publications on tracking-related problems have made it almost impossible to follow the developments in the field. One of the reasons is that there is a lack of commonly accepted annotated data-sets and standardized evaluation protocols that would allow objective comparison of different tracking methods. To address this issue, the Visual Object Tracking (VOT) workshop was organized in conjunction with ICCV2013. Researchers from academia as well as industry were invited to participate in the first VOT2013 challenge which aimed at single-object visual trackers that do not apply pre-learned models of object

appearance (model-free). Presented here is the VOT2013 benchmark dataset for evaluation of single-object visual trackers as well as the results obtained by the trackers competing in the challenge. In contrast to related attempts in tracker benchmarking, the dataset is labeled per-frame by visual attributes that indicate occlusion, illumination change, motion change, size change and camera motion, offering a more systematic comparison of the trackers. Furthermore, we have designed an automated system for performing and evaluating the experiments. We present the evaluation protocol of the VOT2013 challenge and the results of a comparison of 27 trackers on the benchmark dataset. The dataset, the evaluation tools and the tracker rankings are publicly available from the challenge website (<http://votchallenge.net>).

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research Community on Data-to-Decision (D2D), University of Ljubljana, Austrian Institute of Technology, University of Birmingham, Czech Technical University in Prague, Australian National University, DSTO, Sharif University of Technology, Nile University, Consorzio CREATE, University of South Australia, Vision and Sensing, ESTeM, University of Canberra, Panasonic RandD Center, CISP, University of Malaya, Eng. Design and Math., University of West England, Izmir Institute of Technology, Zhejiang University, Institute of Automation Chinese Academy of Sciences, Shanghai Institute of Ceramics Chinese Academy of Sciences, University of Surrey, Linköping University, Robotic Vision Team, Kingston University, NII, JFLI, NII

Contributors: Kristan, M., Pflugfelder, R., Leonardis, A., Matas, J., Porikli, F., Čehovin, L., Nebehay, G., Fernandez, G., Vojtíř, T., Gatt, A., Khajenezhad, A., Salahledin, A., Soltani-Farani, A., Zarezade, A., Petrosino, A., Milton, A., Bozorgtabar, B., Li, B., Chan, C. S., Heng, C., Ward, D., Kearney, D., Monekosso, D., Karaimer, H. C., Rabiee, H. R., Zhu, J., Gao, J., Xiao, J., Zhang, J., Xing, J., Huang, K., Lebeda, K., Cao, L., Maresca, M. E., Lim, M. K., ELHelw, M., Felsberg, M., Remagnino, P., Bowden, R., Goecke, R., Stolkin, R., Lim, S. Y. Y., Maher, S., Poullot, S., Wong, S., Satoh, S., Chen, W., Hu, W., Zhang, X., Li, Y., Niu, Z.

Number of pages: 14

Pages: 98-111

Publication date: 2013

### Host publication information

Title of host publication: Proceedings - 2013 IEEE International Conference on Computer Vision Workshops, ICCVW 2013

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 6755885

ISBN (Print): 9781479930227

ASJC Scopus subject areas: Software, Computer Vision and Pattern Recognition

Keywords: Visual object tracking challenge, VOT2013

DOIs:

10.1109/ICCVW.2013.20

URLs:

<http://www.scopus.com/inward/record.url?scp=84897510119&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84897510119

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Touch gestures in communicating emotional intention via vibrotactile stimulation

Remote communication between people typically relies on audio and vision although current mobile devices are increasingly based on detecting different touch gestures such as swiping. These gestures could be adapted to interpersonal communication by using tactile technology capable of producing touch stimulation to a user's hand. It has been suggested that such mediated social touch would allow for new forms of emotional communication. The aim was to study whether vibrotactile stimulation that imitates human touch can convey intended emotions from one person to another. For this purpose, devices were used that converted touch gestures of squeeze and finger touch to vibrotactile stimulation. When one user squeezed his device or touched it with finger(s), another user felt corresponding vibrotactile stimulation on her device via four vibrating actuators. In an experiment, participant dyads comprising a sender and receiver were to communicate variations in the affective dimensions of valence and arousal using the devices. The sender's task was to create stimulation that would convey unpleasant, pleasant, relaxed, or aroused emotional intention to the receiver. Both the sender and receiver rated the stimulation using scales for valence and arousal so that the match between sender's intended emotions and receiver's interpretations could be measured. The results showed that squeeze was better at communicating unpleasant and aroused emotional intention, while finger touch was better at communicating pleasant and relaxed emotional intention. The results can be used in developing technology that enables people to communicate via touch by choosing touch gesture that matches the desired emotion.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Augmented Human Activities (AHA), Field robotics for efficient work sites (FIRE)

Contributors: Rantala, J., Salminen, K., Raisamo, R., Surakka, V.

Number of pages: 12  
Pages: 679-690  
Publication date: 2013  
Peer-reviewed: Yes

#### Publication information

Journal: International Journal of Human-Computer Studies

Volume: 71

Issue number: 6

ISSN (Print): 1071-5819

Ratings:

Scopus rating (2013): CiteScore 4.6 SJR 0.861 SNIP 2.378

Original language: English

ASJC Scopus subject areas: Human Factors and Ergonomics, Software, Education, Engineering(all), Human-Computer Interaction, Hardware and Architecture

Keywords: Affective interaction, Emotions, Haptics, Mediated social touch, Mobile devices, Tactile communication

DOIs:

10.1016/j.ijhcs.2013.02.004

URLs:

<http://www.scopus.com/inward/record.url?scp=84876589281&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84876589281

Research output: Contribution to journal > Article > Scientific > peer-review

#### Elastic image registration for guiding focal laser ablation of prostate cancer: Preliminary results

Purpose: To guide ultrasound-driven prostate photodynamic therapy using information from MRI-based treatment planning. Methods: Robust points matching (RPM) and thin plate splines (TPS) are used to solve correspondences and to map optimally positioned landmarks from MR images to transrectal ultrasound (TRUS) images. The algorithm uses a reduced number of anatomical markers that are initialized on the images. Results: Both phantom and patient data were used to evaluate precision and robustness of the method. Mean registration error ( $\pm$ standard deviation) was of 2.18.  $\pm$ . 0.25. mm and 1.55.  $\pm$ . 0.31. mm for patient prostate and urethra, respectively. Repeated tests with different markers initialization conditions showed that the quality of registration was neither influenced by the number of markers nor to the human observer. Conclusion: This method allows for satisfyingly accurate and robust non rigid registration of MRI and TRUS and provides practitioners with substantial help in mapping treatment planning from pre-operative MRI to interventional TRUS.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, Univ Paris 06, Centre National de la Recherche Scientifique (CNRS), Pierre & Marie Curie University - Paris 6, Institut de Recherche pour le Developpement (IRD), Inria, Institut National de la Sante et de la Recherche Medicale (Inserm), Univ Sorbonne, CNRS,ICM,UMR S 1127,UMR 7225,U1127, INSERM,Inria Paris Rocquencourt,Inst Cerveau & Mo, Lille University Hospital - CHRU, CHU Angers, Univ Lille Nord de France

Contributors: Makni, N., Puech, P., Colin, P., Azzouzi, A., Mordon, S., Betrouni, N.

Number of pages: 11

Pages: 213-223

Publication date: Oct 2012

Peer-reviewed: Yes

#### Publication information

Journal: Computer Methods and Programs in Biomedicine

Volume: 108

Issue number: 1

ISSN (Print): 0169-2607

Ratings:

Scopus rating (2012): CiteScore 3.1 SJR 0.489 SNIP 1.52

Original language: English

ASJC Scopus subject areas: Computer Science Applications, Software, Health Informatics

Keywords: Image-guided interventions, Magnetic resonance imaging, Non rigid registration, PDT, Prostate cancer, Transrectal ultrasound imaging

DOIs:

10.1016/j.cmpb.2012.04.001

URLs:

<http://www.scopus.com/inward/record.url?scp=84865711653&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84865711653

Research output: Contribution to journal › Article › Scientific › peer-review

### **Focused multi-task learning in a Gaussian process framework**

Multi-task learning, learning of a set of tasks together, can improve performance in the individual learning tasks. Gaussian process models have been applied to learning a set of tasks on different data sets, by constructing joint priors for functions underlying the tasks. In these previous Gaussian process models, the setting has been symmetric in the sense that all the tasks have been assumed to be equally important, whereas in settings such as transfer learning the goal is asymmetric, to enhance performance in a target task given the other tasks. We propose a focused Gaussian process model which introduces an "explaining away" model for each of the additional tasks to model their non-related variation, in order to focus the transfer to the task-of-interest. This focusing helps reduce the key problem of negative transfer, which may cause performance to even decrease if the tasks are not related closely enough. In experiments, our model improves performance compared to single-task learning, symmetric multi-task learning using hierarchical Dirichlet processes, transfer learning based on predictive structure learning, and symmetric multi-task learning with Gaussian processes.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), deCODE Genetics, Aalto University, University of Helsinki

Contributors: Leen, G., Peltonen, J., Kaski, S.

Number of pages: 26

Pages: 157-182

Publication date: Oct 2012

Peer-reviewed: Yes

### **Publication information**

Journal: Machine Learning

Volume: 89

Issue number: 1-2

ISSN (Print): 0885-6125

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Original language: English

ASJC Scopus subject areas: Artificial Intelligence, Software

Keywords: Gaussian processes, Multi-task learning, Negative transfer, Transfer learning

DOIs:

10.1007/s10994-012-5302-y

URLs:

<http://www.scopus.com/inward/record.url?scp=84865229433&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84865229433

Research output: Contribution to journal › Article › Scientific › peer-review

### **SymbolChat: A flexible picture-based communication platform for users with intellectual disabilities**

Persons with intellectual disabilities benefit from participating in the modern information society, especially the World Wide Web, social media and Internet-mediated communication services. Although several computer-based prototypes and commercial systems have been introduced for accessible in-person communication, currently few applications and services exist to support synchronous remote communication for this user group. We introduce SymbolChat, a software platform that supports the creation of multimodal communication applications utilizing picture-based instant messaging. End users and their support personnel can customize the input and output features of the application based on their individual needs and abilities. The interaction is based on touchscreen input and speech output using speech synthesis technology. The SymbolChat platform was developed together with the prospective end users and practitioners in the field of special needs care. We evaluated the prototype application in a field study with nine users with varying degrees of intellectual and other disabilities. The results clearly indicate that the participants were able to express themselves in spontaneous communication using a large-scale picture-based vocabulary (around 2000 symbols) even without prior training in the use of symbols. This finding was supported in the constructive feedback gathered from professionals working in the area. We also successfully applied methodology from other settings, such as child-computer interaction to evaluate interaction in this challenging context. Overall, the results show that social inclusion for people with intellectual disabilities can be improved with customizable communication tools. The implemented communication platform forms a solid basis for further improvements and new communication services. In addition, we found that users with motor impairments would greatly benefit from alternative input and output methods for symbol browsing and selection.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Augmented Human Activities (AHA), Laurea University of Applied Sciences  
Contributors: Keskinen, T., Heimonen, T., Turunen, M., Rajaniemi, J. P., Kauppinen, S.  
Number of pages: 13  
Pages: 374-386  
Publication date: Sep 2012  
Peer-reviewed: Yes

### Publication information

Journal: Interacting with Computers  
Volume: 24  
Issue number: 5  
ISSN (Print): 0953-5438  
Ratings:  
Scopus rating (2012): CiteScore 4.9 SJR 0.669 SNIP 1.982  
Original language: English  
ASJC Scopus subject areas: Human-Computer Interaction, Software  
Keywords: Augmentative and alternative communication, Instant messaging, Picture-based communication, User-centered design  
DOIs:  
10.1016/j.intcom.2012.06.003  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84866739334&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84866739334  
Research output: Contribution to journal › Article › Scientific › peer-review

### Barriers to task-based information access in molecular medicine

We analyze barriers to task-based information access in molecular medicine, focusing on research tasks, which provide task performance sessions of varying complexity. Molecular medicine is a relevant domain because it offers thousands of digital resources as the information environment. Data were collected through shadowing of real work tasks. Thirty work task sessions were analyzed and barriers in these identified. The barriers were classified by their character (conceptual, syntactic, and technological) and by their context of appearance (work task, system integration, or system). Also, work task sessions were grouped into three complexity classes and the frequency of barriers of varying types across task complexity levels were analyzed. Our findings indicate that although most of the barriers are on system level, there is a quantum of barriers in integration and work task contexts. These barriers might be overcome through attention to the integrated use of multiple systems at least for the most frequent uses. This can be done by means of standardization and harmonization of the data and by taking the requirements of the work tasks into account in system design and development, because information access is seldom an end itself, but rather serves to reach the goals of work tasks.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Tampere Research Center for Information and Media  
Contributors: Kumpulainen, S., Järvelin, K.  
Number of pages: 12  
Pages: 86-97  
Publication date: Jan 2012  
Peer-reviewed: Yes

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Journal: JOURNAL OF THE ASSOCIATION FOR INFORMATION SCIENCE AND TECHNOLOGY  
Volume: 63  
Issue number: 1  
ISSN (Print): 2330-1635  
Ratings:  
Scopus rating (2012): CiteScore 5.5 SJR 1.398 SNIP 2.283  
Original language: English  
ASJC Scopus subject areas: Software, Artificial Intelligence, Information Systems, Human-Computer Interaction, Computer Networks and Communications  
DOIs:  
10.1002/asi.21672

Source: Scopus  
Source ID: 83655163751  
Research output: Contribution to journal › Article › Scientific › peer-review

## **2nd international workshop on pervasive eye tracking and mobile eye-based interaction (PETMEI 2012): Proposal for a workshop (mini-track) at UbiComp 2012**

### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Augmented Human Activities (AHA), University of Cambridge, Lessius University College, Zhejiang University of Technology  
Contributors: Bulling, A., Brône, G., Cheng, S., Majaranta, P.  
Number of pages: 4  
Pages: 673-676  
Publication date: 2012

### **Host publication information**

Title of host publication: UbiComp'12 - Proceedings of the 2012 ACM Conference on Ubiquitous Computing  
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ASJC Scopus subject areas: Software  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84879468823&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84879468823  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

## **An empirical investigation of perceived reliability of open source Java programs**

Background: Open Source Software (OSS) is used by a continuously growing number of people, both end-users and developers. The quality of OSS is thus an issue of increasing interest. Specifically, OSS stakeholders need to trust OSS with respect to a number of qualities. Objective: This paper focuses on the level of trust that OSS stakeholders have in OSS reliability, one of the most important software qualities. The goal of the work reported here is to investigate to what extent the perception of reliability by users depends on objectively measurable characteristics of software. Method: We collected subjective user evaluations of the reliability of 22 Java OSS products, and then we measured their code characteristics that are generally believed to affect the quality of software. Finally, we carried out a correlational study to predict the perceived level of reliability of OSS based on the measured characteristics of the software code. Result: We obtained a set of statistically significant quantitative models, collectively called MOSSTREL, which account for the dependence of the perceived reliability of OSS on objectively observable qualities of Java code. Conclusions: The models we obtained can be used by: 1) endusers and developers that would like to reuse existing OSS products and components, to evaluate the perceived level of reliability of these OSS products that can be expected based on the characteristics of code; 2) the developers of OSS products, who can set code quality targets based on the level of perceived reliability they want to achieve.

### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Università degli Studi Dell'Insubria, Former organisation of the author  
Contributors: Lavazza, L., Morasca, S., Taibi, D., Tosi, D.  
Number of pages: 6  
Pages: 1109-1114  
Publication date: 2012

### **Host publication information**

Title of host publication: 27th Annual ACM Symposium on Applied Computing, SAC 2012  
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ASJC Scopus subject areas: Software  
Keywords: object-oriented measures, open source software, reliability model  
DOIs:  
10.1145/2245276.2231951  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84863569624&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84863569624  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **An exploratory study of eye typing fundamentals: Dwell time, text entry rate, errors, and workload**

Although eye typing (typing on an on-screen keyboard via one's eyes as they are tracked by an eye tracker) has been studied for more than three decades now, we still know relatively little about it from the users' point of view. Standard metrics such as words per minute and keystrokes per character yield information only about the effectiveness of the technology and the interaction techniques developed for eye typing. We conducted an extensive study with almost five hours of eye typing per participant and report on extended qualitative and quantitative analysis of the relationship of dwell time, text entry rate, errors made, and workload experienced by the participants. The analysis method is comprehensive and stresses the need to consider different metrics in unison. The results highlight the importance of catering for individual differences and lead to suggestions for improvements in the interface.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Augmented Human Activities (AHA)  
Contributors: Riih , K. J., Ovaska, S.  
Number of pages: 10  
Pages: 3001-3010  
Publication date: 2012

#### **Host publication information**

Title of host publication: Conference Proceedings - The 30th ACM Conference on Human Factors in Computing Systems, CHI 2012  
ISBN (Print): 9781450310154  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software  
Keywords: Adjustable dwell time, Error analysis, Extended study, Eye tracking, Eye typing, Workload  
DOIs:  
10.1145/2207676.2208711  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84862102858&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84862102858  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Briefing news reporting with mobile assignments - Perceptions, needs and challenges**

Mobile handheld devices are an increasing part of everyday fieldwork of news professionals. Mobile assignments delivered to mobile journalists' smartphones are one potential future development step. We present findings on using mobile assignments from two exploratory user studies in which smartphones were used as news reporting tools. Mobile assignments were perceived as handy for fast reporting situations and simple stories but challenging in case of more complex tasks. Structured information content of assignments, process phase based information and supporting situation and activity awareness would support the work of both editorial staff and mobile journalists. The locationing of reporters for sending location-based assignments was found acceptable for coordinating the work although some privacy concerns were expressed. The findings provide new information on using mobile assignments in work where carrying out tasks involves creativity and the tasks may be complex, not strictly limited or they may not have clear completion criteria.   2012 ACM.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Research area: User experience, Department of Software Systems, Augmented Human Activities (AHA), University of Central Lancashire  
Contributors: V t j , H., Egglestone, P.  
Number of pages: 10  
Pages: 485-494  
Publication date: 2012

#### **Host publication information**

Title of host publication: Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work CSCW'12  
Seattle, WA, USA, February 11-15, 2012  
Place of publication: New York, NY  
Publisher: ACM  
ISBN (Print): 9781450310864

#### **Publication series**

Name: ACM Conference on Computer Supported Cooperative Work

ASJC Scopus subject areas: Human-Computer Interaction, Software, Computer Networks and Communications  
Keywords: assignment, crowdsourcing, journalist, location, mobile, news, privacy., professional, smartphone, task, work  
DOIs:

10.1145/2145204.2145280

URLs:

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#### **Bibliographical note**

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Source ID: 5484

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Comparison of video-based pointing and selection techniques for hands-free text entry**

Video-based human-computer interaction has received increasing interest over the years. However, earlier research has been mainly focusing on technical characteristics of different methods rather than on user performance and experiences in using computer vision technology. This study aims to investigate performance characteristics of novice users and their subjective experiences in typing text with several video-based pointing and selection techniques. In Experiment 1, eye tracking and head tracking were applied for the task of pointing at the keys of a virtual keyboard. The results showed that gaze pointing was significantly faster but also more erroneous technique as compared with head pointing. Self-reported subjective ratings revealed that it was generally better, faster, more pleasant and efficient to type using gaze pointing than head pointing. In Experiment 2, mouth open and brows up facial gestures were utilized for confirming the selection of a given character. The results showed that text entry speed was approximately the same for both selection techniques, while mouth interaction caused significantly fewer errors than brow interaction. Subjective ratings did not reveal any significant differences between the techniques. Possibilities for design improvements are discussed.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA)

Contributors: Gizatdinova, Y., Špakov, O., Surakka, V.

Number of pages: 8

Pages: 132-139

Publication date: 2012

#### **Host publication information**

Title of host publication: Proceedings of the Working Conference on Advanced Visual Interfaces, AVI 2012

ISBN (Print): 9781450312875

ASJC Scopus subject areas: Software, Human-Computer Interaction

Keywords: computer vision, eye tracking, face detection, text entry, video-based interaction, virtual keyboard, visual gesture

DOIs:

10.1145/2254556.2254582

URLs:

<http://www.scopus.com/inward/record.url?scp=84863593939&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84863593939

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Continuous Edgewrite: Dictionary-based disambiguation instead of explicit segmentation by the user**

Edgewrite is a text entry method where the user follows the edges of a physical guiding rectangle to enter corner sequences that are interpreted as characters. The original Edgewrite character set resembles the Latin alphabet and includes explicit character segmentation by lifting the stylus (or centering the joystick, etc). We present a variant of Edgewrite that we call the continuous Edgewrite. It relies on a dictionary instead of user's character segmentation to disambiguate words. New users can use the continuous Edgewrite with the help of an interactive visualization of possible continuations while writing. In a 6-session user study we measured initial text transcription performance (increased from 1 to 5.4 wpm) and the ratio of observed explicit segmentations to optimal continuous writing (decreased from 2.5 to 1.5). These results show that it is possible to learn to use the continuous writing mode, but also that the learning takes some time.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Université de Lorraine



Contributors: Martin, B., Isokoski, P., Karmann, G., Rollinger, T.  
Number of pages: 8  
Pages: 357-364  
Publication date: 2012

#### **Host publication information**

Title of host publication: Proceedings of the Working Conference on Advanced Visual Interfaces, AVI 2012  
ISBN (Print): 9781450312875

ASJC Scopus subject areas: Software, Human-Computer Interaction

Keywords: continuous writing, dictionary, disambiguation, EdgeWrite, segmentation, text entry

DOIs:

10.1145/2254556.2254625

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<http://www.scopus.com/inward/record.url?scp=84863566610&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84863566610

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Designing and evaluating text entry methods**

Our workshop has three primary goals. The first goal is community building: we want to get text entry researchers that are active in different communities into one place. Our second goal is to promote CHI as a natural and compelling focal point for all kinds of text entry research. The third goal is to discuss some difficult issues that are hard or near impossible to handle within the traditional format of research papers.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), University of St Andrews, Georgia Institute of Technology, University of Strathclyde, Oregon Health and Science University, Montana Tech., University of Dundee, Visiting Graduate Student in Department of Urban Design and Planning, University of Washington, Seattle, USA 1.1.2012-15.6.2012 (12.9.2011 alkaen)

Contributors: Kristensson, P. O., Clawson, J., Dunlop, M., Isokoski, P., Roark, B., Vertanen, K., Waller, A., Wobbrock, J.

Number of pages: 4

Pages: 2747-2750

Publication date: 2012

#### **Host publication information**

Title of host publication: Extended Abstracts - The 30th ACM Conference on Human Factors in Computing Systems, CHI 2012

ISBN (Print): 9781450310161

ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software

Keywords: accessibility, augmentative and alternative communication, internationalization, text entry

DOIs:

10.1145/2212776.2212711

URLs:

<http://www.scopus.com/inward/record.url?scp=84862678655&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84862678655

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Enhanced gaze interaction using simple head gestures**

We propose a combination of gaze pointing and head gestures for enhanced hands-free interaction. Instead of the traditional dwell-time selection method, we experimented with five simple head gestures: nodding, turning left/right, and tilting left/right. The gestures were detected from the eye-tracking data by a range-based algorithm, which was found accurate enough in recognizing nodding and leftdirected gestures. The gaze estimation accuracy did not noticeably suffer from the quick head motions. Participants pointed to nodding as the best gesture for occasional selections tasks and rated the other gestures as promising methods for navigation (turning) and functional mode switching (tilting). In general, dwell time works well for repeated tasks such as eye typing. However, considering multimodal games or transient interactions in pervasive and mobile environments, we believe a combination of gaze and head interaction could potentially provide a natural and more accurate interaction method.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA)  
Contributors: Špakov, O., Majaranta, P.  
Number of pages: 6  
Pages: 705-710  
Publication date: 2012

#### Host publication information

Title of host publication: UbiComp'12 - Proceedings of the 2012 ACM Conference on Ubiquitous Computing  
ISBN (Print): 9781450312240  
ASJC Scopus subject areas: Software  
Keywords: Dwell time, Eye tracking, Head gestures, Selection  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84879496342&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84879496342  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### FS-PGBR: A scalable and delay sensitive cloud routing protocol

This paper proposes an improved version of a fully tributed routing protocol, that is applicable for cloud computing infrastructure. Simulation results show the protocol is ideal for discovering cloud services ... a scalable manner with minimum latency.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Wireless Communications and Positioning (WICO), Waterford Institute of Technology, Telecommunications Software and Systems Group (TSSG), University of Helsinki  
Contributors: Mineraud, J., Donnelly, W., Balasubramaniam, S., Kangasharju, J.  
Number of pages: 2  
Pages: 301-302  
Publication date: 2012

#### Host publication information

Title of host publication: Proceedings of the ACM SIGCOMM 2012 and Best Papers of the Co-located Workshops  
Volume: 42  
Edition: 4  
ISBN (Print): 9781450314190  
ASJC Scopus subject areas: Computer Networks and Communications, Software  
Keywords: Cloud computing infrastructure, Scalable route discovery  
DOIs:  
10.1145/2377677.2377741  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84894522377&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84894522377  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Inkjet-printed monopole antennas for enhanced-range WBAN and wearable biomonitoring application

In this paper, a monopole antenna backed by an inkjet-printed electromagnetic band gap ground (EBG) plane on paper substrate is proposed for wearable applications with drastically enhanced communication range. This novel design approach for WBAN and wearable biomonitoring applications alleviates the on-body antenna's performance degradation, which may cause a significant degradation of the wireless system's performance as well. The communication range improvement compared to conventional antenna is demonstrated by using a benchmarking commercial wireless temperature sensor module. In addition, the advantages and the integrability of the proposed wearable antenna topology into mobile wireless on-body health care systems is discussed in detail.

#### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, University of Tokyo  
Contributors: Kim, S., Kawahara, Y., Tentzeris, M. M.  
Number of pages: 6  
Pages: 33-38  
Publication date: 2012

### Host publication information

Title of host publication: MobileHealth'12 - Proceedings of the 2nd ACM International Workshop on Pervasive Wireless Healthcare

ISBN (Print): 9781450312929

ASJC Scopus subject areas: Software, Hardware and Architecture, Computer Networks and Communications

Keywords: electromagnetic band gap (ebg) structure, inkjet printing, personal area networks (pans), system level antenna integration, wearable antenna, wireless body area networks (wbans)

DOIs:

10.1145/2248341.2248355

URLs:

<http://www.scopus.com/inward/record.url?scp=84863544257&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84863544257

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Novel approaches to crawling important pages early

Web crawlers are essential to many Web applications, such as Web search engines, Web archives, and Web directories, which maintain Web pages in their local repositories. In this paper, we study the problem of crawl scheduling that biases crawl ordering toward important pages. We propose a set of crawling algorithms for effective and efficient crawl ordering by prioritizing important pages with the well-known PageRank as the importance metric. In order to score URLs, the proposed algorithms utilize various features, including partial link structure, inter-host links, page titles, and topic relevance. We conduct a large-scale experiment using publicly available data sets to examine the effect of each feature on crawl ordering and evaluate the performance of many algorithms. The experimental results verify the efficacy of our schemes. In particular, compared with the representative RankMass crawler, the FPR-title-host algorithm reduces computational overhead by a factor as great as three in running time while improving effectiveness by 5% in cumulative PageRank.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Korea University

Contributors: Alam, M. H., Ha, J. W., Lee, S. K.

Number of pages: 28

Pages: 707-734

Publication date: 2012

Peer-reviewed: Yes

### Publication information

Journal: Knowledge and Information Systems

Volume: 33

Issue number: 3

ISSN (Print): 0219-1377

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Scopus rating (2012): CiteScore 4.2 SJR 1.111 SNIP 2.008

Original language: English

ASJC Scopus subject areas: Software, Information Systems, Human-Computer Interaction, Hardware and Architecture, Artificial Intelligence

Keywords: Crawl ordering, Fractional PageRank, PageRank, Web crawler

DOIs:

10.1007/s10115-012-0535-4

URLs:

<http://www.scopus.com/inward/record.url?scp=84869092092&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84869092092

Research output: Contribution to journal › Article › Scientific › peer-review

### On the definition of dynamic software measures

The quantification of several software attributes (e.g., size, complexity, cohesion, coupling) is usually carried out in a static fashion, and several hundreds of measures have been defined to this end. However, static measurement may only be an approximation for the measurement of these attributes during software use. The paper proposes a theoretical framework based on Axiomatic Approaches for the definition of sensible dynamic software measures that can dynamically capture these attributes. Dynamic measures based on this framework are defined for dynamically quantifying size and coupling. In this paper, we also compare dynamic measures of size and coupling against well-known static measures by correlating them with fault-pronenesses of four case studies.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Università degli Studi Dell'Insubria, Former organisation of the author  
Contributors: Lavazza, L., Morasca, S., Taibi, D., Tosi, D.  
Number of pages: 10  
Pages: 39-48  
Publication date: 2012  
Peer-reviewed: Yes

### Publication information

Journal: International Symposium on Empirical Software Engineering and Measurement  
ISSN (Print): 1949-3770  
Original language: English  
ASJC Scopus subject areas: Computer Science Applications, Software  
Keywords: Code coverage, Dynamic coupling, Dynamic measures, Dynamic size  
DOIs:  
10.1145/2372251.2372259  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84867570388&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84867570388  
Research output: Contribution to journal › Article › Scientific › peer-review

### Parameterized scheduling for signal processing systems using topological patterns

In recent work, a graphical modeling construct called "topological patterns" has been shown to enable concise representation and direct analysis of repetitive dataflow graph sub-structures in the context of design methods and tools for digital signal processing systems [1]. In this paper, we present a formal design method for specifying topological patterns and deriving parameterized schedules from such patterns based on a novel schedule model called the scalable schedule tree. The approach represents an important class of parameterized schedule structures in a form that is intuitive for representation and efficient for code generation. We demonstrate our methods for topological pattern representation, scalable schedule tree derivation, and associated dataflow graph code generation using a case study for image processing.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing Research Community (SPRC), University of Maryland, Department of Electrical and Computer Engineering  
Contributors: Wu, S., Shen, C. C., Sane, N., Davis, K., Bhattacharyya, S. S.  
Number of pages: 4  
Pages: 1561-1564  
Publication date: 2012

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Title of host publication: 2012 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2012 - Proceedings  
Article number: 6288190  
ISBN (Print): 9781467300469  
ASJC Scopus subject areas: Software, Signal Processing, Electrical and Electronic Engineering  
Keywords: image registration, scheduling, software tools  
DOIs:  
10.1109/ICASSP.2012.6288190  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84867599709&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84867599709  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Power allocation in multi-node cooperative network in Rician fading channels

Cooperative communications have been recommended to exploit the inherent spatial diversity gains in multiuser wireless systems without the need of multiple transceivers at each node. This is achieved when wireless nodes help to each other to send multiple independent transmission paths to the destination. The advantage of cooperation can be exploited significantly by allocating the power of the system optimally. Thus, in this paper we first derive the approximate symbol error rate (SER) for multi-node cooperative networks employing decode-and-forward (DF) protocol with a maximum ratio

combining (MRC) at the receiving terminals in Rician fading channels. Using the approximated SER expression, optimal power allocation (OPA) scheme under different line-of-sight (LOS) scenarios is investigated. Numerical and simulation results are presented to illustrate the performance improvement due to OPA of the cooperative networks.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Wireless Communications and Positioning (WICO), Department of Computer Science, University of Vaasa (UVA)

Contributors: Fikadu, M. K., Elmusrati, M., Virrankoski, R.

Number of pages: 6

Pages: 496-501

Publication date: 2012

#### Host publication information

Title of host publication: 2012 IEEE 8th International Conference on Wireless and Mobile Computing, Networking and Communications, WiMob 2012

Article number: 6379119

ISBN (Print): 9781467314305

ASJC Scopus subject areas: Computer Networks and Communications, Hardware and Architecture, Software

Keywords: Cooperative, decode-and-forward, multi-node, optimal power allocation, Rician fading, SER analysis

DOIs:

10.1109/WiMOB.2012.6379119

URLs:

<http://www.scopus.com/inward/record.url?scp=84872085066&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84872085066

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### SenSprout: Inkjet-printed soil moisture and leaf wetness sensor

In this paper we show a low cost and environmentally friendly fabrication for an agricultural sensing application. An antenna, a soil moisture sensor, and a leaf wetness sensor are inkjet-printed on paper substrate. A microprocessor attached to the paper substrate is capable of detecting the capacitance change on the surface of the sensor, and report the data over the wireless communication interface. This sensing system is useful to optimize irrigation systems.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense), University of Tokyo, Georgia Institute of Technology

Contributors: Kawahara, Y., Lee, H., Tentzeris, M. M.

Number of pages: 1

Pages: 545

Publication date: 2012

#### Host publication information

Title of host publication: UbiComp'12 - Proceedings of the 2012 ACM Conference on Ubiquitous Computing

ISBN (Print): 9781450312240

ASJC Scopus subject areas: Software

Keywords: Energy harvesting, Inkjet-printing

URLs:

<http://www.scopus.com/inward/record.url?scp=84879479986&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84879479986

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### SiMPE: 7th Workshop on speech and sound in mobile and pervasive environments

The SiMPE workshop series started in 2006 [2] with the goal of enabling speech processing on mobile and embedded devices to meet the challenges of pervasive environments (such as noise) and leveraging the context they offer (such as location). SiMPE 2010 and 2011 brought together researchers from the speech and the HCI communities. Multimodality got more attention in SiMPE 2008 than it had received in the previous years. In SiMPE 2007, the focus was on developing regions. Speech User interaction in cars was a focus area in 2009. With SiMPE 2012, the 7th in the series, we hope to explore the area of speech along with sound. When using the mobile in an eyes-free manner, it is natural and convenient to hear about notifications and events. The arrival of an SMS has used a very simple sound based notification for a long time now. The technologies underlying speech processing and sound processing are quite different and these communities have been working mostly independent of each other. And yet, for multimodal interactions on the mobile, it is

perhaps natural to ask whether and how speech and sound can be mixed and used more effectively and naturally.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), IBM Research, Carnegie Mellon University, HP Laboratories, National Research Council, University of Toronto, Canada

Contributors: Nanavati, A. A., Rajput, N., Rudnicky, A. I., Turunen, M., Sandholm, T., Munteanu, C., Penn, G.

Number of pages: 3

Pages: 251-253

Publication date: 2012

#### **Host publication information**

Title of host publication: MobileHCI'12 - Companion Proceedings of the 14th International Conference on Human Computer Interaction with Mobile Devices and Services

ISBN (Print): 9781450311052

ASJC Scopus subject areas: Computer Networks and Communications, Human-Computer Interaction, Information Systems, Software

Keywords: Audio interaction, Mobile computing, Pervasive computing, Sound, Speech processing

DOIs:

10.1145/2371664.2371727

URLs:

<http://www.scopus.com/inward/record.url?scp=84867703942&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84867703942

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### **Systematic integration of flowgraph- and module-level parallelism in implementation of DSP applications on multiprocessor systems-on-chip**

Increasing use of multiprocessor system-on-chip (MPSoC) technology is an important trend in the design and implementation of signal processing systems. However, the design of efficient DSP software for MPSoC platforms involves complex inter-related steps, including data decomposition, memory management, and inter-task and inter-thread synchronization. These design steps are challenging, especially under strict constraints on performance and power consumption, and tight time to market pressures. To facilitate these steps, we have developed a new dataflow based design flow within the targeted dataflow interchange format (TDIF) design tool. Our new MPSoC-oriented design flow, called TDIF-PPG, is geared towards analysis and mapping of embedded DSP applications on MPSoCs. An important feature of TDIF-PPG is its capability to integrate graph level parallelism for DSP system flowgraphs and actor level parallelism for DSP functional modules into the application mapping processing. Here, graph level parallelism is exposed by the dataflow graph application representation in TDIF, and actor level parallelism is modeled by a novel model for multiprocessor dataflow graph implementation that we call the parallel processing group (PPG) model. We demonstrate our approach through actor and subsystem design for software defined radio.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing Research Community (SPRC), University of Maryland, Department of Electrical and Computer Engineering

Contributors: Zhou, Z., Shen, C. C., Plishker, W., Wu, H. H., Bhattacharyya, S. S.

Number of pages: 7

Pages: 402-408

Publication date: 2012

#### **Host publication information**

Title of host publication: ICSP 2012 - 2012 11th International Conference on Signal Processing, Proceedings

Volume: 1

Article number: 6491686

ISBN (Print): 9781467321945

ASJC Scopus subject areas: Software, Signal Processing, Computer Science Applications

DOIs:

10.1109/ICoSP.2012.6491686

URLs:

<http://www.scopus.com/inward/record.url?scp=84876463174&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84876463174

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Managing concern knowledge in software systems**

Knowledge representation, acquisition, and sharing in software development projects is challenging due to the involvement of different kinds of stakeholders and large heterogeneous repositories of artifacts. In this paper, we argue that the concept of a concern can be used to facilitate the management of knowledge concerning the various system artifacts. Concerns represent pieces of knowledge pertaining to various viewpoints and interests of the stakeholders. In order to represent concerns, we propose the use of a non-intrusive role-based mechanism called a fragment. Using this mechanism, tacit knowledge can be made explicit by mapping stakeholders interests to artifact repositories, concern-based queries can be addressed to the repositories, and concerns can be combined to produce new knowledge. A concern-based prototype tool environment for knowledge management has been built and used for evaluating the approach in the context of industrial case studies.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Pervasive Computing, Managing digital industrial transformation (mDIT)

Contributors: Hammouda, I., Koskimies, K., Mikkonen, T.

Number of pages: 31

Pages: 957-987

Publication date: Nov 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: INTERNATIONAL JOURNAL OF SOFTWARE ENGINEERING AND KNOWLEDGE ENGINEERING

Volume: 21

Issue number: 7

ISSN (Print): 0218-1940

Ratings:

Scopus rating (2011): CiteScore 1 SJR 0.19 SNIP 0.482

Original language: English

ASJC Scopus subject areas: Software, Artificial Intelligence, Computer Graphics and Computer-Aided Design, Computer Networks and Communications

Keywords: Knowledge management, Separation of concerns, Software development tools, Software repositories

DOIs:

10.1142/S0218194011005566

URLs:

<http://www.scopus.com/inward/record.url?scp=84856103523&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84856103523

Research output: Contribution to journal > Article > Scientific > peer-review

### **Interaction strategies for an affective conversational agent**

The development of embodied conversational agents (ECA) as companions brings several challenges for both affective and conversational dialogue. These include challenges in generating appropriate affective responses, selecting the overall shape of the dialogue, providing prompt system response times, and handling interruptions. We present an implementation of such a companion showing the development of individual modules that attempt to address these challenges. Further, to resolve resulting conflicts, we present encompassing interaction strategies that attempt to balance the competing requirements along with dialogues from our working prototype to illustrate these interaction strategies in operation. Finally, we provide the results of an evaluation of the companion using an evaluation methodology created for conversational dialogue and including analysis using appropriateness annotation.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Augmented Human Activities (AHA), School of Computing Teesside University Middlesbrough, University of Oxford, Telefonica, School of Management (JKK), School of Computing Edinburgh Napier University Edinburgh, SICS SE-164 29 Kista, ILS Institute SUNY Albany Albany

Contributors: Smith, C., Crook, N., Dobnik, S., Charlton, D., Boye, J., Pulman, S., Santos de la Camara, R., Turunen, M., Benyon, D., Bradley, J., Gambäck, B., Hansen, P., Mival, O., Webb, N., Cavazza, M.

Number of pages: 17

Pages: 395-411

Publication date: Oct 2011

Peer-reviewed: Yes

### Publication information

Journal: Presence: Teleoperators and Virtual Environments

Volume: 20

Issue number: 5

ISSN (Print): 1054-7460

Ratings:

Scopus rating (2011): CiteScore 3 SJR 0.354 SNIP 1.141

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Software, Human-Computer Interaction, Computer Vision and Pattern Recognition

DOIs:

10.1162/PRES\_a\_00063

URLs:

<http://www.scopus.com/inward/record.url?scp=84863122938&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84863122938

Research output: Contribution to journal > Article > Scientific > peer-review

### A survey on open source software trustworthiness

Trustworthiness is a crucial characteristic when it comes to evaluating any product, even more so for open source software, which is now becoming widely used. The authors conducted a survey to identify the reasons and motivations that lead software companies to adopt or reject open source software; they then ranked, according to importance, the specific trust factors used when selecting an open source software component or product. The motivations and importance ranking of factors might be useful for both developers of open source software (to make their products and components more useful for other stakeholders) and to future prospective open source software users.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Università degli Studi Dell'Insubria, Uni-versità Degli Studi dell'Insubria in Como, Università degli Studi dell'Insubria

Contributors: Del Bianco, V., Lavazza, L., Morasca, S., Taibi, D.

Number of pages: 9

Pages: 67-75

Publication date: Sep 2011

Peer-reviewed: Yes

### Publication information

Journal: IEEE Software

Volume: 28

Issue number: 5

ISSN (Print): 0740-7459

Ratings:

Scopus rating (2011): CiteScore 3.2 SJR 0.701 SNIP 2.255

Original language: English

ASJC Scopus subject areas: Software

Keywords: external software qualities, internal software qualities, open source software, pragmatic software engineering, trustworthiness

DOIs:

10.1109/MS.2011.93

Source: Scopus

Source ID: 80051758696

Research output: Contribution to journal > Article > Scientific > peer-review

### Guidelines for improving the testing process of open source software

Open Source Software (OSS) products do not usually follow traditional software engineering development paradigms. Specifically, testing activities in OSS development may be quite different from those carried out in Closed Source Software (CSS) development. As testing and verification require a good deal of resources in OSS, it is necessary to have ways to assess and improve OSS testing processes. This paper provides a set of testing guidelines and issues that OSS developers can use to decide which testing techniques make most sense for their OSS products. This paper 1) provides a checklist that helps OSS developers identify the most useful testing techniques according to the main characteristics of their products, and 2) outlines a proposal for a method that helps assess the maturity of OSS testing processes. The method is a proposal of a Maturity Model for testing processes (called OSS-TMM). To show its usefulness, the authors apply the method to seven real-life projects. Specifically, the authors apply the method to BusyBox, Apache Httpd, and Eclipse Test & Performance Tools Platform to show how the checklist supports and guides the testing process of these



OSS products.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Università degli Studi Dell'Insubria  
Contributors: Morasca, S., Taibi, D., Tosi, D.  
Number of pages: 22  
Pages: 1-22  
Publication date: Apr 2011  
Peer-reviewed: Yes

### Publication information

Journal: International Journal of Open Source Software and Processes  
Volume: 3  
Issue number: 2  
ISSN (Print): 1942-3926  
Ratings:  
Scopus rating (2011): CiteScore 0.5 SJR 0.141 SNIP 0.777  
Original language: English  
ASJC Scopus subject areas: Software  
Keywords: Open Source Software (OSS) Quality, Survey, Testing Process, Testing Quality Assessment, Trustworthiness  
DOIs:  
10.4018/jossp.2011040101  
Source: Scopus  
Source ID: 84860503937  
Research output: Contribution to journal › Article › Scientific › peer-review

### Multimodal and mobile conversational Health and Fitness Companions

Multimodal conversational spoken dialogues using physical and virtual agents provide a potential interface to motivate and support users in the domain of health and fitness. This paper describes how such multimodal conversational Companions can be implemented to support their owners in various pervasive and mobile settings. We present concrete system architectures, virtual, physical and mobile multimodal interfaces, and interaction management techniques for such Companions. In particular how knowledge representation and separation of low-level interaction modelling from high-level reasoning at the domain level makes it possible to implement distributed, but still coherent, interaction with Companions. The distribution is enabled by using a dialogue plan to communicate information from domain level planner to dialogue management and from there to a separate mobile interface. The model enables each part of the system to handle the same information from its own perspective without containing overlapping logic, and makes it possible to separate task-specific and conversational dialogue management from each other. In addition to technical descriptions, results from the first evaluations of the Companions interfaces are presented.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Augmented Human Activities (AHA), SICS, Norwegian Univ. of Sci. and Technol., Telefonica, School of Computing Teesside University Middlesbrough  
Contributors: Turunen, M., Hakulinen, J., Ståhl, O., Gambäck, B., Hansen, P., Rodríguez Gancedo, M. C., De La Cámara, R. S., Smith, C., Charlton, D., Cavazza, M.  
Number of pages: 18  
Pages: 192-209  
Publication date: Apr 2011  
Peer-reviewed: Yes

### Publication information

Journal: Computer Speech and Language  
Volume: 25  
Issue number: 2  
ISSN (Print): 0885-2308  
Ratings:  
Scopus rating (2011): CiteScore 4.2 SJR 0.586 SNIP 1.9  
Original language: English  
ASJC Scopus subject areas: Theoretical Computer Science, Software, Human-Computer Interaction  
Keywords: Cognitive modelling, Companions, Conversational spoken dialogue systems, Dialogue management, Embodied conversational agents, Mobile interfaces  
DOIs:

10.1016/j.csl.2010.04.004

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<http://www.scopus.com/inward/record.url?scp=78049527811&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 78049527811

Research output: Contribution to journal > Article > Scientific > peer-review

### **Some background on dialogue management and conversational speech for dialogue systems**

Several dialogue management (DM) architectures and conversational speech for dialogue systems are presented. Basic types of DM systems include dialogue grammars and frames, plan-based and collaborative systems, and conversational games theory. DM architectures include SmartKom, Trindi, WITAS, CONVERSE, COMIC, agent-based dialogue management, and DM and automatic speech recognition (ASR) language modeling. All data collection tasks should be tailored for the conversational scenario under consideration as each scenario can present different properties. It is shown in the multimodal dialogue system that turn taking can usually be achieved by a fusion of gesture, gaze, and intonation. Intonation within the speech signal informs the dialogue manager when new information is introduced into the current conversation. By placing established emotion detection methods within the recursive nature of conversation we can consider discourse as the exploitation of the shared set of interaction affordances.

### **General information**

Publication status: Published

MoE publication type: A2 Review article in a scientific journal

Organisations: Augmented Human Activities (AHA), University of Oxford, University of Sheffield

Contributors: Wilks, Y., Catizone, R., Worgan, S., Turunen, M.

Number of pages: 12

Pages: 128-139

Publication date: Apr 2011

Peer-reviewed: Yes

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Journal: Computer Speech and Language

Volume: 25

Issue number: 2

ISSN (Print): 0885-2308

Ratings:

Scopus rating (2011): CiteScore 4.2 SJR 0.586 SNIP 1.9

Original language: English

ASJC Scopus subject areas: Theoretical Computer Science, Software, Human-Computer Interaction

Keywords: Dialogue architectures, Dialogue management, Dialogue systems, Emotion detection, Human-computer interaction

DOIs:

10.1016/j.csl.2010.03.001

URLs:

<http://www.scopus.com/inward/record.url?scp=78049527943&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 78049527943

Research output: Contribution to journal > Review Article > Scientific > peer-review

### **A model-based schedule representation for heterogeneous mapping of dataflow graphs**

Dataflow-based application specifications are widely used in model-based design methodologies for signal processing systems. In this paper, we develop a new model called the dataflow schedule graph (DSG) for representing a broad class of dataflow graph schedules. The DSG provides a graphical representation of schedules based on dataflow semantics. In conventional approaches, applications are represented using dataflow graphs, whereas schedules for the graphs are represented using specialized notations, such as various kinds of sequences or looping constructs. In contrast, the DSG approach employs dataflow graphs for representing both application models and schedules that are derived from them. Our DSG approach provides a precise, formal framework for unambiguously representing, analyzing, manipulating, and interchanging schedules. We develop detailed formulations of the DSG representation, and present examples and experimental results that demonstrate the utility of DSGs in the context of heterogeneous signal processing system design.

### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing Research Community (SPRC), University of Maryland, Department of Electrical and Computer Engineering

Contributors: Wu, H. H., Shen, C. C., Sane, N., Plishker, W., Bhattacharyya, S. S.  
Number of pages: 12  
Pages: 70-81  
Publication date: 2011

#### Host publication information

Title of host publication: 2011 IEEE International Symposium on Parallel and Distributed Processing, Workshops and Phd Forum, IPDPSW 2011

Article number: 6008822

ISBN (Print): 9780769543857

ASJC Scopus subject areas: Computational Theory and Mathematics, Software, Theoretical Computer Science

Keywords: Dataflow graphs, Heterogeneous computing, Models of computation, Scheduling

DOIs:

10.1109/IPDPS.2011.128

URLs:

<http://www.scopus.com/inward/record.url?scp=83455253826&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 83455253826

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Bit-sliced binary normal basis multiplication

The performance of many cryptographic primitives is reliant on efficient algorithms and implementation techniques for arithmetic in binary fields. While dedicated hardware support for said arithmetic is an emerging trend, the study of software-only implementation techniques remains important for legacy or non-equipped processors. One such technique is that of software-based bit-slicing. In the context of binary fields, this is an interesting option since there is extensive previous work on bit-oriented designs for arithmetic in hardware, such designs are intuitively well suited to bit-slicing in software. In this paper we harness previous work, using it to investigate bit-sliced, software-only implementation arithmetic for binary fields, over a range of practical field sizes and using a normal basis representation. We apply our results to demonstrate significant performance improvements for a stream cipher, and over the frequently employed Ning-Yin approach to normal basis implementation in software.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Intelligent dexterity for secure networked infrastructure and applications (IDSNIA), Department of Information and Computer Science, Aalto University, University of Bristol

Contributors: Brumley, B., Page, D.

Number of pages: 8

Pages: 205-212

Publication date: 2011

#### Host publication information

Title of host publication: Proceedings - 20th IEEE Symposium on Computer Arithmetic, ARITH-20

Article number: 5992128

ISBN (Print): 9780769543185

ASJC Scopus subject areas: Theoretical Computer Science, Software, Hardware and Architecture

Keywords: Algorithm design, analysis, Computations in finite fields, Computer arithmetic, Data encryption

DOIs:

10.1109/ARITH.2011.36

URLs:

<http://www.scopus.com/inward/record.url?scp=80055027798&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80055027798

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

#### Comparison of gaze-to-objects mapping algorithms

Gaze data processing is an important and necessary step in gaze-based applications. This study focuses on the comparison of several gaze-to-object mapping algorithms using various dwell times for selection and presenting targets of several types and sizes. Seven algorithms found in literature were compared against two newly designed algorithms. The study revealed that a fractional mapping algorithm (known) has produced the highest rate of correct selections and fastest selection times, but also the highest rate of incorrect selections. The dynamic competing algorithm (designed) has shown the next best result, but also high rate of incorrect selections. A small impact on the type of target to the calculated statistics has been observed. A strictly centered gazing has helped to increase the rate of correct selections for all algorithms and types of targets. The directions for further mapping algorithms improvement and future investigation have been explained.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Augmented Human Activities (AHA)  
Contributors: Špakov, O.  
Publication date: 2011

### Host publication information

Title of host publication: Proceedings of the 1st Conference on Novel Gaze-Controlled Applications, NGCA'11  
Article number: 6  
ISBN (Print): 9781450306805  
ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software  
Keywords: Algorithm design, Eye gaze pointing and selection, Gaze controlled applications, Gaze to object mapping  
DOIs:  
10.1145/1983302.1983308  
URLs:  
<http://www.scopus.com/inward/record.url?scp=79960161638&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 79960161638  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Database-driven tool support for DisCo executable specifications

In spite of the advances in theory of formal specifications, they have not gained a wide popularity in the software development industry. This could be due to difficulties in understanding them or positioning them into the current work practices, however, we believe that one major problem is that the tool support still does not make the use of the formal specifications easy enough for the software developer. We discuss the required functionality for comprehensive tool support for executable DisCo specifications, and propose a tool architecture based on database technology, and finally, discuss our implementation of the core part of the tool set.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Research Community on Data-to-Decision (D2D), Mathematical modelling with wide societal impact (MathImpact)  
Contributors: Nummenmaa, J., Nummenmaa, T.  
Number of pages: 11  
Pages: 44-54  
Publication date: 2011

### Host publication information

Title of host publication: SPLST'11 - Proceedings 12th Symposium on Programming Languages and Software Tools  
ISBN (Print): 9789949231782  
ASJC Scopus subject areas: Computer Science Applications, Software  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84869824785&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 84869824785  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Designing tactile feedback for piezo buttons

The present aim was to study the preference of tactile feedback stimulations given by non-physical (i.e., solid) piezo-actuated buttons. Participants (n=16) ranked 16 different tactile feedback stimuli varied by 4 output delays and 4 vibration durations. The results showed that the mean ranks of the stimuli differed significantly from each other. The timing parameters of delay and duration interacted with each other, for example, so that preference of certain vibration duration fluctuated in response to different output delays. Using a very short time window (i.e., 10-453 ms) combining both delay and duration parameters of the feedback could result either in favorable or significantly less favorable subjective experience. The results suggest that a preferred perception of tactile feedback from non-physical buttons requires careful design and controlling of the timing parameters.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Augmented Human Activities (AHA), School of Management (JKK), Aito Interactive Inc

Contributors: Lylykangas, J., Surakka, V., Salminen, K., Raisamo, J., Laitinen, P., Rönning, K., Raisamo, R.  
Number of pages: 4  
Pages: 3281-3284  
Publication date: 2011

#### **Host publication information**

Title of host publication: CHI 2011 - 29th Annual CHI Conference on Human Factors in Computing Systems, Conference Proceedings and Extended Abstracts

ISBN (Print): 9781450302289

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Human-Computer Interaction, Software

Keywords: Delay, Haptics, Interaction design, Lag, Non-physical buttons, Piezo-electric, Tactile feedback

DOIs:

10.1145/1978942.1979428

URLs:

<http://www.scopus.com/inward/record.url?scp=79958177983&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79958177983

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Facial expression classification based on local spatiotemporal edge and texture descriptors**

Facial expressions are emotionally, socially and otherwise meaningful reflective signals in the face. Facial expressions play a critical role in human life, providing an important channel of nonverbal communication. Automation of the entire process of expression analysis can potentially facilitate human-computer interaction, making it to resemble mechanisms of human-human communication. In this paper, we present an ongoing research that aims at development of a novel spatiotemporal approach to expression classification in video. The novelty comes from a new facial representation that is based on local spatiotemporal feature descriptors. In particular, a combined dynamic edge and texture information is used for reliable description of both appearance and motion of the expression. Support vector machines are utilized to perform a final expression classification. The planned experiments will further systematically evaluate the performance of the developed method with several databases of complex facial expressions.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Univ of Oulu

Contributors: Gizatdinova, Y., Surakka, V., Zhao, G., Mäkinen, E., Raisamo, R.

Publication date: 2011

#### **Host publication information**

Title of host publication: Selected Papers from the Proceedings of the 7th International Conference on Methods and Techniques in Behavioral Research - Digital Edition, MB'10

Article number: 21

ISBN (Print): 9781605589268

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Action unit, Emotion, Expression classification, Facial expression, Human behaviour understanding, Local binary pattern, Local oriented edge, Spatiotemporal descriptor

DOIs:

10.1145/1931344.1931365

URLs:

<http://www.scopus.com/inward/record.url?scp=79952499491&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79952499491

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### **Framework for designing and evaluating game achievements**

This paper presents a framework for evaluating and designing game design patterns commonly called as "achievements". The results are based on empirical studies of a variety of popular achievement systems. The results, along with the framework for analyzing and designing achievements, present two definitions of game achievements. From the perspective of the achievement system, an achievement appears as a challenge consisting of a signifying element, rewards and completion logics whose fulfilment conditions are defined through events in other systems (usually games). From the perspective of a single game, an achievement appears as an optional challenge provided by a meta-game that is independent of a single game session and yields possible reward(s).

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact), Aalto University, University of Helsinki

Contributors: Hamari, J., Eranti, V.

Publication date: 2011

### Host publication information

Title of host publication: Proceedings of DiGRA 2011 Conference: Think Design Play

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Human-Computer Interaction, Software

Keywords: Game achievements, Game design, Game ontology, Game rewards, Gamification, Marketing, Motivation, Online games

URLs:

<http://www.scopus.com/inward/record.url?scp=84873368072&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84873368072

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### Generative modeling for maximizing precision and recall in information visualization

Information visualization has recently been formulated as an information retrieval problem, where the goal is to find similar data points based on the visualized nonlinear projection, and the visualization is optimized to maximize a compromise between (smoothed) precision and recall. We turn the visualization into a generative modeling task where a simple user model parameterized by the data coordinates is optimized, neighborhood relations are the observed data, and straightforward maximum likelihood estimation corresponds to Stochastic Neighbor Embedding (SNE). While SNE maximizes pure recall, adding a mixture component that "explains away" misses allows our generative model to focus on maximizing precision as well. The resulting model is a generative solution to maximizing tradeoffs between precision and recall. The model outperforms earlier models in terms of precision and recall and in external validation by unsupervised classification.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research Community on Data-to-Decision (D2D), Aalto University, University of Helsinki

Contributors: Peltonen, J., Kaski, S.

Number of pages: 9

Pages: 579-587

Publication date: 2011

Peer-reviewed: Yes

### Publication information

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Volume: 15

ISSN (Print): 1532-4435

Ratings:

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Original language: English

ASJC Scopus subject areas: Artificial Intelligence, Software, Control and Systems Engineering, Statistics and Probability

URLs:

<http://www.scopus.com/inward/record.url?scp=84862299625&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84862299625

Research output: Contribution to journal > Article > Scientific > peer-review

### Narrative friction in Alternate Reality Games: Design insights from conspiracy for good

Alternate Reality Games (ARG) tend to have story-driven game structures. Hence, it is useful to investigate how player activities interact with the often pre-scripted storyline in this genre. In this article, we report on a study of a particular ARG production, Conspiracy For Good (CFG), which was at the same time emphasising the role of strong storytelling, and active on-site participation by players. We uncover multiple levels of friction between the story content and the mode of play of live participants, but also between live and online participation. Based on the observations from the production, we present design recommendations for future productions with similar goals.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact), Nokia, Stockholm University

Contributors: Stenros, J., Holopainen, J., Waern, A., Montola, M., Ollila, E.  
Publication date: 2011

#### Host publication information

Title of host publication: Proceedings of DiGRA 2011 Conference: Think Design Play  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Human-Computer Interaction, Software  
Keywords: ARG, Design, Gameplay, Games, Larp, Narrative, Pervasive, Transmedia  
URLs:

<http://www.scopus.com/inward/record.url?scp=84873344376&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84873344376

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### Of discs, boxes and cartridges: The material life of digital games

So far the field of game studies has mostly bypassed the everyday meanings attached to the material manifestations of digital games. Based on qualitative survey data, this article examines what kind of personal and collective values are attached to the physical copies of games, including the storage medium and packaging. The results show how materiality resonates with the reliability and unambiguity of ownership. Furthermore, games as physical objects can have a key role in the project of creating a home, receiving their meaning as part of a wider technological and popular cultural meaning structure. Finally, collecting associates games with more general issues of identity, sociability and history. Through storing and organising games and having them on display, gamers position themselves as part of game culture, gather subcultural capital and ensure the possibility for nostalgia.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact)

Contributors: Toivonen, S., Sotamaa, O.

Publication date: 2011

#### Host publication information

Title of host publication: Proceedings of DiGRA 2011 Conference: Think Design Play  
ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Human-Computer Interaction, Software  
Keywords: Collecting, Digital distribution, Domestication, Game culture, Material culture, Nostalgia, Physical copies  
URLs:

<http://www.scopus.com/inward/record.url?scp=84873337886&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84873337886

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

#### On delay distribution in IEEE 802.11 wireless networks

IEEE 802.11 wireless networks have received much attention over the past number of years. Still certain aspects of behavior of wireless networks have not been studied well enough. For example, understanding MAC layer packet delay distribution remains challenging yet. However, obtaining such distribution is highly beneficial for modeling QoS provided by wireless networks. This paper proposes a way of obtaining MAC delay distribution in case of single-hop networks. The proposed way is based on theory of terminating renewal processes and delivers approximation of good precision.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Wireless Communications and Positioning (WICO), Waterford Institute of Technology, Telecommunications Software and Systems Group (TSSG)

Contributors: Ivanov, S., Botvich, D., Balasubramaniam, S.

Number of pages: 3

Pages: 254-256

Publication date: 2011

#### Host publication information

Title of host publication: 16th IEEE Symposium on Computers and Communications, ISCC'11

Article number: 5983849

ISBN (Print): 9781457706783

ASJC Scopus subject areas: Software, Signal Processing, Mathematics(all), Computer Science Applications, Computer Networks and Communications

Keywords: delay distribution, IEEE 802.11, MAC layer, modeling

DOIs:

10.1109/ISCC.2011.5983849

URLs:

<http://www.scopus.com/inward/record.url?scp=80052734083&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80052734083

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **On the costs of multiple trajectory pointing methods**

Several enhanced pointing techniques aim to reduce the Fitts' law targeting distance by providing multiple target trajectories in the hope that a shorter path is available. However, these techniques introduce a search or decision component to pointing - users must examine the alternatives available and decide upon the trajectory to use. We analyse these difficulties, present a methodology for examining them as well as other behaviour issues, and report empirical results of performance with pointer wrapping and Ninja cursors. Results show that offering multiple trajectories incurs a significant search or decision cost, and that users are therefore poor at capitalising on the theoretical benefits of reduced target distance.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), University of Canterbury, Polytech' Paris-Sud

Contributors: Quinn, P., Cockburn, A., R  ih  , K. J., Delamarche, J.

Number of pages: 4

Pages: 859-862

Publication date: 2011

#### **Host publication information**

Title of host publication: CHI 2011 - 29th Annual CHI Conference on Human Factors in Computing Systems, Conference Proceedings and Extended Abstracts

ISBN (Print): 9781450302289

ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software

Keywords: Fitts' law, Multiple trajectories, Ninja cursors, Pointing, Search/decision, Wrapping cursors

DOIs:

10.1145/1978942.1979067

URLs:

<http://www.scopus.com/inward/record.url?scp=79958170256&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79958170256

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Reducing the number of unit tests with design by contract**

Design by Contract (DbC) and unit testing (UT) are complementary approaches to improve the belief of correctness and the quality of the software. The interplay between the two techniques has been studied previously, e.g., in the use of test oracles and test automation. However, we propose that DbC should drive the UT to become more cost-effective. The paper demonstrates some means for this approach by showing how to test a mapping data structure entirely with just one unit test script.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Managing digital industrial transformation (mDIT), Department of Information Technology, Turku Centre for Computer Science, University of Turku

Contributors: Hakonen, H., Hyrynsalmi, S., J  rvi, A.

Number of pages: 6

Pages: 161-166

Publication date: 2011

#### **Host publication information**

Title of host publication: Computer Systems and Technologies - 12th International Conference, CompSysTech'11 - Proceedings

Volume: 578

ISBN (Print): 9781450309172

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: contract cohesion graph, design by contract, unit testing



DOIs:

10.1145/2023607.2023635

Source: Scopus

Source ID: 80052810613

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Scheduling of CAL actor networks based on dynamic code analysis**

CAL is a dataflow oriented language for writing high-level specifications of signal processing applications. The language has recently been standardized and selected for the new MPEG Reconfigurable Video Coding standard.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Signal Processing Research Community (SPRC), University of Oulu, Univ of Oulu, UBL

Contributors: Boutellier, J., Silven, O., Raulet, M.

Number of pages: 4

Pages: 1609-1612

Publication date: 2011

#### **Host publication information**

Title of host publication: 2011 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2011 - Proceedings

Article number: 5946805

ISBN (Print): 9781457705397

ASJC Scopus subject areas: Signal Processing, Software, Electrical and Electronic Engineering

Keywords: data flow computing, Processor scheduling, video coding

DOIs:

10.1109/ICASSP.2011.5946805

URLs:

<http://www.scopus.com/inward/record.url?scp=80051648157&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80051648157

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Silicon capillary gripper with self-alignment capability**

This paper reports a novel capillary microgripper. The microgripper is fabricated from silicon using deep reactive ion etching and is designed to be especially suitable for self-alignment. The gripper is shown to retain its self-alignment capabilities even when the head of the gripper does not match the size of the component. This mechanism is analyzed using numerical simulations and tested in pick-and-place experiments using commercial laser diode components. The advantage of the capillary microgripper has been demonstrated in picking and aligning microchips from adhesive films, which requires substantial picking force.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Integrated Technologies for Tissue Engineering Research (ITTE), Department of Automation and Systems Technology, Aalto University

Contributors: Sariola, V., Liimatainen, V., Tolonen, T., Udd, R., Zhou, Q.

Number of pages: 6

Pages: 4098-4103

Publication date: 2011

#### **Host publication information**

Title of host publication: 2011 IEEE International Conference on Robotics and Automation, ICRA 2011

Article number: 5979980

ISBN (Print): 9781612843865

ASJC Scopus subject areas: Software, Artificial Intelligence, Control and Systems Engineering, Electrical and Electronic Engineering

Keywords: Capillary gripper, Micro/nano robots, Microhandling, Self-alignment

DOIs:

10.1109/ICRA.2011.5979980

URLs:

<http://www.scopus.com/inward/record.url?scp=84871673357&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84871673357

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Social and privacy aspects of a system for collaborative public expression**

In this paper, we are concerned with how a real-world social situation shapes the interaction with a novel technology that combines collocated mobile phone and public display use for groups of people. We present a user study of a system that allows collaborative creation and sharing of comic strips on public displays in a social setting such as a pub or café. The system utilizes mobile phones and public displays for shared collaborative expression between collocated users. A user study spanning three sessions was conducted in real-world settings: one during the social event following a seminar on games research and two in a bar on a regular weekday evening. We present and discuss our findings with respect to how the larger social situation and location influenced the interaction with the system, the collaboration between participants of a team, how people moved between different roles (i.e., actor, spectator and bystander), and the privacy issues it evoked from participants.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact), Nokia

Contributors: Holopainen, J., Lucero, A., Saarenpää, H., Nummenmaa, T., Ali, A. E., Jokela, T.

Publication date: 2011

#### **Host publication information**

Title of host publication: Proceedings of the 8th International Conference on Advances in Computer Entertainment Technology, ACE 2011

Article number: 23

ISBN (Print): 9781450308274

ASJC Scopus subject areas: Human-Computer Interaction, Computer Networks and Communications, Computer Vision and Pattern Recognition, Software

Keywords: Collaborative interaction, Evaluation, Mobile phones, Public interfaces, Social context

DOIs:

10.1145/2071423.2071452

URLs:

<http://www.scopus.com/inward/record.url?scp=84855410287&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84855410287

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Squeeze vs. tilt: A comparative study using continuous tactile feedback**

This paper presents an investigation into the performance of squeezing as a manipulative interaction technique in comparison to tilting with an aim to answer two questions: is squeezing an effective input technique for mobile devices and can tactile feedback improve performance? The experiment results show that both input methods are viable but squeezing is significantly faster and more sustainable than tilting (with and without tactile feedback).

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Nokia

Contributors: Hoggan, E., Trendafilov, D., Ahmaniemi, T., Raisamo, R.

Number of pages: 6

Pages: 1309-1314

Publication date: 2011

#### **Host publication information**

Title of host publication: CHI EA 2011 - 29th Annual CHI Conference on Human Factors in Computing Systems, Conference Proceedings and Extended Abstracts

ISBN (Print): 9781450302289

ASJC Scopus subject areas: Software, Human-Computer Interaction, Computer Graphics and Computer-Aided Design

Keywords: Haptic I/O, Mobile interaction, Pressure, Squeeze

DOIs:

10.1145/1979742.1979766

URLs:

<http://www.scopus.com/inward/record.url?scp=79957943879&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79957943879

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **System level performance simulation of distributed GENESYS applications on multi-core platforms**

Modern high end mobile devices employ multi-core platforms and support diverse distributed applications due to increased computational power. A brisk performance evaluation phase is required after the application modelling to evaluate feasibility of new distributed applications on the multi-core mobile platforms. GENESYS modelling methodology which employs service-oriented and component based distributed application design has been extended for this purpose such that application level services are refined to platform-level services allowing mapping of GENESYS application architecture to workload models used in performance evaluation. This results in easy extraction of application workload models, reducing the time and effort in the performance evaluation phase needed for architectural exploration. This article presents the way brisk performance evaluation of distributed GENESYS applications is achieved by employing extended GENESYS distributed application architecture. The approach is experimented with a case study. UML2.0 MARTE profile, Papyrus UML2.0 modelling tool and SystemC were used for modelling and simulation.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: System-on-Chip for GNSS, Wireless Communications and Cyber-Physical Embedded Computing, Department of Computer Systems, Wireless Communications and Positioning (WICO), VTT Technical Research Centre of Finland

Contributors: Khan, S. A., Saastamoinen, J., Tiensyrjä, K., Nurmi, J.

Number of pages: 8

Pages: 313-320

Publication date: 2011

#### **Host publication information**

Title of host publication: Proceedings - IEEE 9th International Conference on Dependable, Autonomic and Secure Computing, DASC 2011

ISBN (Print): 9780769546124

ASJC Scopus subject areas: Computational Theory and Mathematics, Software

Keywords: ABSOLUT, GENESYS, MARTE profile, UML2.0

DOIs:

10.1109/DASC.2011.70

Source: Scopus

Source ID: 84856116007

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **The making of Nordic larp: Documenting a tradition of ephemeral co-creative play**

Research and documentation of live action role-playing games, or larps, must tackle problems of ephemerality, subjectivity, first person audience and co-creation, as well as the underlying question of what larps are. In this paper these challenges are outlined and solutions to handling them are proposed. This is done through the prism of producing a picture-heavy art book on Nordic larp. The paper also discussed the problems of writing about game cultures as an insider and makes a case for addressing normative choices in game descriptions head on.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mathematical modelling with wide societal impact (MathImpact)

Contributors: Stenros, J., Montola, M.

Publication date: 2011

#### **Host publication information**

Title of host publication: Proceedings of DiGRA 2011 Conference: Think Design Play

ASJC Scopus subject areas: Computer Graphics and Computer-Aided Design, Human-Computer Interaction, Software

Keywords: Documentation, Game culture, Games, Larp, Nordic, Play, Role-playing games

URLs:

<http://www.scopus.com/inward/record.url?scp=84873389573&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84873389573

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Conversion algorithms and implementations for koblitz curve cryptography**

In this paper, we discuss conversions between integers and  $\tau$ -adic expansions and we provide efficient algorithms and hardware architectures for these conversions. The results have significance in elliptic curve cryptography using Koblitz curves, a family of elliptic curves offering faster computation than general elliptic curves. However, in order to enable these faster computations, scalars need to be reduced and represented using a special base- $\tau$  expansion. Hence, efficient conversion algorithms and implementations are necessary. Existing conversion algorithms require several complicated operations, such as multiprecision multiplications and computations with large rationals, resulting in slow and large implementations in hardware and microcontrollers with limited instruction sets. Our algorithms are designed to utilize only simple operations, such as additions and shifts, which are easily implementable on practically all platforms. We demonstrate the practicability of the new algorithms by implementing them on Altera Stratix II FPGAs. The implementations considerably improve both computation speed and required area compared to the existing solutions.

#### **General information**

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Pervasive Computing, Aalto University  
Contributors: Brumley, B. B., Jarvinen, K. U.  
Number of pages: 12  
Pages: 81-92  
Publication date: 4 Jan 2010  
Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Transactions on Computers  
Volume: 59  
Issue number: 1  
Article number: 5255226  
ISSN (Print): 0018-9340  
Ratings:  
Scopus rating (2010): SJR 0.584 SNIP 1.868  
Original language: English  
ASJC Scopus subject areas: Software, Theoretical Computer Science, Hardware and Architecture, Computational Theory and Mathematics  
Keywords: Elliptic curve cryptography, Field-programmable gate arrays, Koblitz curves, Public-key cryptosystems  
DOIs:  
10.1109/TC.2009.132  
URLs:  
<http://www.scopus.com/inward/record.url?scp=72949120592&partnerID=8YFLogxK> (Link to publication in Scopus)  
Source: Scopus  
Source ID: 72949120592  
Research output: Contribution to journal > Article > Scientific > peer-review

### **Integrated controller for an over-constrained cable driven parallel manipulator: KNTU CDRPM**

This paper presents an approach to the control of the KNTU CDRPM using an integrated control scheme. The goal in this approach is achieving accurate trajectory tracking while assuring positive tension in the cables. By the proposed controller, the inherent nonlinear behavior of the cable and the target tracking errors are simultaneously compensated. In this paper asymptotic stability analysis of the close loop system is studied in detail. Moreover, it is shown that the integrated control strategy reduces the tracking error by 80% compared to that of a single loop controller in the considered manipulator. The closed-loop performance of the control topology is analyzed by a simulation study that is performed on the manipulator. The simulation study verifies that the proposed controller is not only promising to be implemented on the KNTU CDRPM, but also being suitable for other cable driven manipulators.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: K. N. Toosi University of Technology, Advanced Robotics and Automated Systems (ARAS)  
Contributors: Vafaei, A., Aref, M. M., Taghirad, H. D.  
Number of pages: 6  
Pages: 650-655  
Publication date: 2010

#### **Host publication information**

Title of host publication: Proceedings - IEEE International Conference on Robotics and Automation  
Article number: 5509991  
ISBN (Print): 9781424450381

ASJC Scopus subject areas: Software, Artificial Intelligence, Control and Systems Engineering, Electrical and Electronic Engineering

DOIs:

10.1109/ROBOT.2010.5509991

URLs:

<http://www.scopus.com/inward/record.url?scp=77955796077&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 77955796077

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Predicting OSS trustworthiness on the basis of elementary code assessment**

**Background.** Open Source Software (OSS) provides increasingly serious and viable alternatives to traditional closed source software. The number of OSS users is continuously growing, as is the number of potential users that are interested in evaluating the quality of OSS. The latter would greatly benefit from simple methods for evaluating the trustworthiness of OSS. **Objective.** This paper aims at finding a quantitative relationship between the perceived quality of OSS and a few simple objective measures. **Method.** the users' and developers' evaluations of trustworthiness and reliability of OSS products were collected and correlated to static code measures, called "Elementary Code Assessment" rules, which check very simple rules that well-written code should satisfy. **Results.** The result of the analysis is a set of quantitative models that link static measures of the source code to perceivable qualities of OSS. These models can be used by: 1) end-users and developers that would like to reuse existing OSS products and components, to evaluate the level of trustworthiness and reliability that can be expected based on the characteristics of code; 2) developers of OSS products, who can set code quality targets based on the level of trustworthiness and reliability they want to achieve. **Conclusions.** The perceivable quality of OSS seems to be predictable on the basis of simple static code measures. However, only a part of the many measures produced by tools appears actually correlated to the quality of software that are perceivable by users.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Università degli Studi Dell'Insubria, Università degli Studi dell'Insubria

Contributors: Lavazza, L., Morasca, S., Taibi, D., Tosi, D.

Publication date: 2010

#### **Host publication information**

Title of host publication: ESEM 2010 - Proceedings of the 2010 ACM-IEEE International Symposium on Empirical Software Engineering and Measurement

Article number: 1852834

ISBN (Print): 9781450300391

ASJC Scopus subject areas: Software

Keywords: elementary code assessment (ECA) rules, source code analysis, static analysis, trustworthiness of open-source software

DOIs:

10.1145/1852786.1852834

Source: Scopus

Source ID: 78149231335

Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **The QualiSPo approach to OSS product quality evaluation**

The quality of Open Source Software (OSS) is generally much debated. Some state that it is generally higher than closed-source counterparts, while others are more skeptical. In the QualiSPo project the authors addressed the problem of evaluating OSS products in a manner that is both as complete as possible and objective. To this end, a toolset and an evaluation framework are needed. The paper describes such toolset and framework, and accounts for the first evaluations that are being obtained.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University College Dublin, Ireland, Christina Thorpe, Università degli Studi Dell'Insubria, Università degli Studi dell'Insubria

Contributors: Del Bianco, V., Lavazza, L., Morasca, S., Taibi, D., Tosi, D.

Number of pages: 6

Pages: 23-28

Publication date: 2010

#### **Host publication information**

Title of host publication: 3rd Int. Workshop on Emerging Trends in Free/Libre/Open Source Software Research and Development, FLOSS-3, in Conj. with the 32nd ACM/IEEE International Conference on Software Engineering, ICSE 2010  
ISBN (Print): 9781605589787

ASJC Scopus subject areas: Software

Keywords: open source software, software quality evaluation, software trustworthiness

DOIs:

10.1145/1833272.1833277

Source: Scopus

Source ID: 77955875392

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Mobile Journalist Toolkit: A field study on producing news articles with a mobile device**

Today's handheld mobile devices with advanced multimedia capabilities and wireless broadband connectivity have emerged as potential new tools for journalists to produce news articles. It is envisioned that they could enable faster, more authentic, and more efficient news production, and many large news producing organizations, including Reuters and BBC, have recently been experimenting with them. In this paper, we present a field study on using mobile devices to produce news articles. During the study, a group of 19 M.A.-level journalism students used the Mobile Journalist Toolkit, a lightweight set of tools for mobile journalist work built around the Nokia N82 camera phone, to produce an online news blog. Our results indicate that while the mobile device cannot completely replace the traditional tools, for some types of journalist tasks they provide major benefits over the traditional tools, and are thus a useful addition to the journalist's toolbox.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Software Systems, Nokia

Contributors: Jokela, T., Väättäjä, H., Koponen, T.

Number of pages: 8

Pages: 45-52

Publication date: 2009

#### **Host publication information**

Title of host publication: MindTrek 2009 - 13th International Academic MindTrek Conference: Everyday Life in the Ubiquitous Era

ISBN (Print): 9781605586335

ASJC Scopus subject areas: Computer Science Applications, Human-Computer Interaction, Software

Keywords: Camera phones, Field study, Journalism, Mobile devices, Multimedia publishing

DOIs:

10.1145/1621841.1621851

Source: Scopus

Source ID: 76749139559

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Pure e-learning course in information security**

We describe key elements and contents of an e-learning course on practical information security that deals with awareness and skills required in daily life. We have had good results in reaching the learning goals and in low resource consuming nature from a teacher's point of view. From a student's point of view the course has been laborious but very instructive and meaningful. We outline also the opportunities of using such a course to contribute to work for information security awareness and usability studies.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Communications Engineering

Contributors: Koskinen, J. A., Kelo, T. O.

Number of pages: 6

Pages: 8-13

Publication date: 2009

#### **Host publication information**

Title of host publication: Proceedings of SIN'09, Second International Conference on Security of Information and Networks, Famagusta, North Cyprus, October 6-10, 2009

Editor: Elci, A.

Article number: 1626200

ASJC Scopus subject areas: Artificial Intelligence, Computational Theory and Mathematics, Computer Networks and Communications, Software

Keywords: Design, Documentation, Economics, Experimentation, Human factors, K.3.2 [Computer and information science education]: Information systems education, Legal aspects, Measurement, Performance, Reliability, Security  
DOIs:

10.1145/1626195.1626200

URLs:

<http://www.scopus.com/inward/record.url?scp=70350635766&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 70350635766

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Towards certifying the testing process of open-source software: New challenges or old methodologies?**

To improve both the quality and the trustworthiness perception of Open Source Software (OSS) products, we introduce the new idea of certifying the testing process of an OSS system. While the global certification of an OSS product is an emerging research field, the idea of certifying only its testing process has never been studied, conversely to the case of Closed Source Software (CSS) products. The certification of the testing process has a twofold goal: simplify the process of testing OSS products by guiding developers in identifying the proper testing strategies and the limitations of their existing testing plans; simplify the selection of equivalent OSS and CSS products by evaluating the certificates released by the companies. Specifically, in this paper we discuss 1) a set of issues, inherent to OSS, that must be taken into account when testing the OSS product; 2) a preliminary methodology that suggests how to certificate the testing process of OSS products; 3) the BusyBox case study that shows how our idea can be applied to real-life OSS.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Università degli Studi Dell'Insubria, Former organisation of the author

Contributors: Morasca, S., Taibi, D., Tosi, D.

Number of pages: 6

Pages: 25-30

Publication date: 2009

#### **Host publication information**

Title of host publication: Proceedings of the 2009 ICSE Workshop on Emerging Trends in Free/Libre/Open Source Software Research and Development, FLOSS 2009

Article number: 5071356

ISBN (Print): 9781424437207

ASJC Scopus subject areas: Computer Science Applications, Information Systems, Software

DOIs:

10.1109/FLOSS.2009.5071356

URLs:

<http://www.scopus.com/inward/record.url?scp=70349739151&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 70349739151

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **Wrench feasible workspace analysis of cable-driven parallel manipulators using LMI approach**

Workspace analysis is one of the most important issues in robotic manipulator design. This paper introduces a systematic method of analysis the wrench feasible workspace for general redundant cable-driven parallel manipulators. In this method, wrench feasible workspace is formulated in term of linear matrix inequalities and projective method is used for solving them. This method is one of the most efficient interiorpoint methods with a polynomial-time complexity. Moreover, the notion of dexterous workspace is defined, which can be determined for redundant cable driven manipulators exerting a worst case external wrench at the end effector. A detailed case study of the wrench feasible workspace and dexterous workspace determination are included for a six DOF, eight actuated cable-driven redundant parallel manipulator.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: K. N. Toosi University of Technology

Contributors: Loloeei, A. Z., Mohammadi Aref, M., Taghirad, H. D.

Number of pages: 6

Pages: 1034-1039

Publication date: 2009

### Host publication information

Title of host publication: IEEE/ASME International Conference on Advanced Intelligent Mechatronics, AIM

Article number: 5229723

ISBN (Print): 9781424428533

ASJC Scopus subject areas: Electrical and Electronic Engineering, Control and Systems Engineering, Computer Science Applications, Software

DOIs:

10.1109/AIM.2009.5229723

URLs:

<http://www.scopus.com/inward/record.url?scp=70350447954&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 70350447954

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Classification of large graphs by a local tree decomposition

We present a binary graph classifier (BGC) which allows to classify large, unweighted, undirected graphs. This classifier is based on a local decomposition of the graph for each node in generalized trees. The obtained trees, forming the tree set of the graph, are then pairwise compared by a generalized tree-similarity-algorithm (GTSA) and the resulting similarity scores determine a characteristic similarity distribution of the graph. Classification in this context is defined as mutual consistency for all pure and mixed tree sets and their resulting similarity distributions in a graph class. We demonstrate the application of this method to an artificially generated data set and for data from microarray experiments of cervical cancer.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Stowers Institute for Medical Research, Technical University Darmstadt

Contributors: Emmert-Streib, F., Dehmert, M., Kilian, J.

Number of pages: 8

Pages: 200-207

Publication date: 2005

### Host publication information

Title of host publication: Proceedings of the 2005 International Conference on Data Mining, DMIN'05

ISBN (Print): 9781932415797

ASJC Scopus subject areas: Computer Science Applications, Software

URLs:

<http://www.scopus.com/inward/record.url?scp=49749142261&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 49749142261

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### HCI and homecare: Connecting families and clinicians

The proposed workshop aims to form a community of individuals interested in using computing technology to promote healthcare and support wellness in the context of homecare. We strive to connect and engage researchers from several distinct fields of scientific inquiry and practice: people with clinical experience, developers of enabling technologies and HCI researchers interested in home healthcare and issues such as aging in place. The focus of this one-day workshop is on establishing common ground in vocabulary, research methods and research framework; understanding the shared needs of people with health challenges, their families and clinicians, and developing a joint framework for future research.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Visiting Graduate Student in Department of Urban Design and Planning, University of Washington, Seattle, USA 1.1.2012-15.6.2012 (12.9.2011 alkaen), VTT Technical Research Centre of Finland, Coherent, Inc., Aarhus Univ, Aarhus University, MINDLab, VTT Information Technology, Siemens Corporate Research, Center for Pervasive Healthcare, GVU Center, Georgia Institute of Technology, Information School and Biomedical and Health Informatics, University of Washington Seattle

Contributors: Mamykina, L., Bardram, J. E., Korhonen, I., Mynatt, E., Pratt, W.

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Pages: 1715-1716

Publication date: 2004

### Host publication information

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ASJC Scopus subject areas: Human-Computer Interaction, Computer Graphics and Computer-Aided Design, Software  
Keywords: Aging, Health care, Home, Medicine, Pervasive computing

DOIs:

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URLs:

<http://www.scopus.com/inward/record.url?scp=84876764103&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84876764103

Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### **A simulation case study of production planning and control in printed wiring board manufacturing**

Production planning and control in printed wiring board (PWB) manufacturing is becoming more difficult as PWB's technology is developing and the production routings become more complex. Simultaneously, the strategic importance of delivery accuracy, short delivery times, and production flexibility is increasing with the highly fluctuating demand and short product life cycles of end products. New principles, that minimize throughput time while guaranteeing excellent customer service and adequate capacity utilization, are needed for production planning and control. Simulation is needed in order to develop the new principles and test their superiority. This paper presents an ongoing simulation product that aims at developing the production planning and control of a PWB manufacturer. In the project, a discrete event simulation model is built of a pilot case factory. The model is used for comparing the effect of scheduling, queuing rules, buffer policies, and lot sizes on customer service and cost efficiency.

### **General information**

Publication status: Published

MoE publication type: Not Eligible

Organisations: Industrial Engineering and Management, Aalto University, TAI Research Centre

Contributors: Korhonen, H. M. E., Heikkilä, J., Törnwall, J. M.

Number of pages: 4

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Publication date: 1 Dec 2001

Peer-reviewed: Yes

### **Publication information**

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Scopus rating (2001): SJR 0.377

Original language: English

ASJC Scopus subject areas: Chemical Health and Safety, Software, Safety, Risk, Reliability and Quality, Applied Mathematics, Modelling and Simulation

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Source: Scopus

Source ID: 0035708229

Research output: Contribution to journal › Conference article › Scientific › peer-review