

### Introduction to the Special Section on Sound Scene and Event Analysis

The papers in this special section are devoted to the growing field of acoustic scene classification and acoustic event recognition. Machine listening systems still have difficulties to reach the ability of human listeners in the analysis of realistic acoustic scenes. If sustained research efforts have been made for decades in speech recognition, speaker identification and to a lesser extent in music information retrieval, the analysis of other types of sounds, such as environmental sounds, is the subject of growing interest from the community and is targeting an ever increasing set of audio categories. This problem appears to be particularly challenging due to the large variety of potential sound sources in the scene, which may in addition have highly different acoustic characteristics, especially in bioacoustics. Furthermore, in realistic environments, multiple sources are often present simultaneously, and in reverberant conditions.

#### General information

Publication status: Published

MoE publication type: B1 Article in a scientific magazine

Organisations: Signal Processing, University Paris-Saclay, New York University, National Institute of Informatics, University of Toulon

Contributors: Richard, G., Virtanen, T., Bello, J. P., Ono, N., Glotin, H.

Number of pages: 3

Pages: 1169-1171

Publication date: 1 Jun 2017

Peer-reviewed: No

#### Publication information

Journal: IEEE/ACM Transactions on Audio Speech and Language Processing

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Issue number: 6

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Ratings:

Scopus rating (2017): CiteScore 4.9 SJR 0.841 SNIP 2.152

Original language: English

ASJC Scopus subject areas: Signal Processing, Media Technology, Instrumentation, Acoustics and Ultrasonics, Linguistics and Language, Speech and Hearing, Electrical and Electronic Engineering

DOIs:

10.1109/TASLP.2017.2699334

Source: Scopus

Source ID: 85028340233

Research output: Contribution to journal > Article > Scientific

### Acquiring respiration rate from photoplethysmographic signal by recursive bayesian tracking of intrinsic modes in time-frequency spectra

Respiration rate (RR) provides useful information for assessing the status of a patient. We propose RR estimation based on photoplethysmography (PPG) because the blood perfusion dynamics are known to carry information on breathing, as respiration-induced modulations in the PPG signal. We studied the use of amplitude variability of transmittance mode finger PPG signal in RR estimation by comparing four time-frequency (TF) representation methods of the signal cascaded with a particle filter. The TF methods compared were short-time Fourier transform (STFT) and three types of synchrosqueezing methods. The public VORTAL database was used in this study. The results indicate that the advanced frequency reallocation methods based on synchrosqueezing approach may present improvement over linear methods, such as STFT. The best results were achieved using wavelet synchrosqueezing transform, having a mean absolute error and median error of 2.33 and 1.15 breaths per minute, respectively. Synchrosqueezing methods were generally more accurate than STFT on most of the subjects when particle filtering was applied. While TF analysis combined with particle filtering is a promising alternative for real-time estimation of RR, artefacts and non-respiration-related frequency components remain problematic and impose requirements for further studies in the areas of signal processing algorithms an PPG instrumentation.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Sensor Technology and Biomeasurements (STB)

Contributors: Pirhonen, M., Peltokangas, M., Vehkaoja, A.

Publication date: 1 Jun 2018

Peer-reviewed: Yes

#### Publication information

Journal: Sensors

Volume: 18

Issue number: 6  
Article number: 1693  
ISSN (Print): 1424-8220  
Ratings:

Scopus rating (2018): CiteScore 4.3 SJR 0.592 SNIP 1.642

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Particle filters, Photoplethysmography, Respiration, Synchrosqueezing, Time-frequency analysis

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### Bibliographical note

int=TUT-BMT,"Pirhonen, Mikko"

Source: Scopus

Source ID: 85047608517

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

### Adaptive and nonlinear control of discharge pressure for variable displacement axial piston pumps

This paper proposes, for the first time without using any linearization or order reduction, an adaptive and model-based discharge pressure control design for the variable displacement axial piston pumps (VDAPPs), whose dynamical behaviors are highly nonlinear and can be described by a fourth-order differential equation. The rigorous stability proof, with an asymptotic convergence, is given for the entire system. In the proposed novel controller design method, the specifically designed stabilizing terms constitute an essential core to cancel out all the stability-preventing terms. The experimental results reveal that rapid parameter adaptation significantly improves the feedback signal tracking precision compared to a known-parameter controller design. In the comparative experiments, the adaptive controller design demonstrates the state-of-the-art discharge pressure control performance, enabling a possibility for energy consumption reductions in hydraulic systems driven with VDAPP.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation and Hydraulic Engineering, Research group: Mobile manipulation

Contributors: Koivumäki, J., Mattila, J.

Publication date: 1 Oct 2017

Peer-reviewed: Yes

### Publication information

Journal: Journal of Dynamic Systems, Measurement and Control: Transactions of the ASME

Volume: 139

Issue number: 10

Article number: 101008

ISSN (Print): 0022-0434

Ratings:

Scopus rating (2017): CiteScore 3 SJR 0.618 SNIP 1.024

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Information Systems, Instrumentation, Mechanical Engineering, Computer Science Applications

DOIs:

10.1115/1.4036537

Source: Scopus

Source ID: 85021623538

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

### Adaptive multiresolution method for MAP reconstruction in electron tomography

3D image reconstruction with electron tomography holds problems due to the severely limited range of projection angles and low signal to noise ratio of the acquired projection images. The maximum a posteriori (MAP) reconstruction methods have been successful in compensating for the missing information and suppressing noise with their intrinsic regularization techniques. There are two major problems in MAP reconstruction methods: (1) selection of the regularization parameter that controls the balance between the data fidelity and the prior information, and (2) long computation time. One aim of this

study is to provide an adaptive solution to the regularization parameter selection problem without having additional knowledge about the imaging environment and the sample. The other aim is to realize the reconstruction using sequences of resolution levels to shorten the computation time. The reconstructions were analyzed in terms of accuracy and computational efficiency using a simulated biological phantom and publically available experimental datasets of electron tomography. The numerical and visual evaluations of the experiments show that the adaptive multiresolution method can provide more accurate results than the weighted back projection (WBP), simultaneous iterative reconstruction technique (SIRT), and sequential MAP expectation maximization (sMAPEM) method. The method is superior to sMAPEM also in terms of computation time and usability since it can reconstruct 3D images significantly faster without requiring any parameter to be set by the user.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Signal Processing, BioMediTech  
Contributors: Acar, E., Peltonen, S., Ruotsalainen, U.  
Number of pages: 11  
Pages: 24-34  
Publication date: 1 Nov 2016  
Peer-reviewed: Yes

#### Publication information

Journal: Ultramicroscopy  
Volume: 170  
ISSN (Print): 0304-3991  
Ratings:  
Scopus rating (2016): CiteScore 5.5 SJR 1.896 SNIP 1.184  
Original language: English  
ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Atomic and Molecular Physics, and Optics, Instrumentation  
Keywords: Adaptive reconstruction, Electron tomography (ET), Maximum a posteriori (MAP) reconstruction, Missing wedge, Multiresolution reconstruction, Regularization parameter  
DOIs:  
10.1016/j.ultramic.2016.08.002  
Source: Scopus  
Source ID: 84981309739  
Research output: [Contribution to journal](#) › [Article](#) › [Scientific](#) › [peer-review](#)

#### Alpha radiation-induced luminescence by am-241 in aqueous nitric acid solution

When exposed to air, alpha particles cause the production of light by exciting the molecules surrounding them. This light, the radioluminescence, is indicative of the presence of alpha radiation, thus allowing for the optical sensing of alpha radiation from distances larger than the few centimeters an alpha particle can travel in air. While the mechanics of radioluminescence in air and other gas compositions is relatively well understood, the same cannot be said about the radioluminescence properties of liquids. Better understanding of the radioluminescence properties of liquids is essential to design methods for the detection of radioactively contaminated liquids by optical means. In this article, we provide radioluminescence images of Am-241 dissolved in aqueous nitric acid ( $\text{HNO}_3$ ) solution and present the recorded radioluminescence spectrum with a maximum between and, and a steep decrease at the short wavelength side of the maximum. The shape of the spectrum resembles a luminescence process rather than Cerenkov light, bremsstrahlung, or other mechanisms with broadband emission. We show that the amount of light produced is about 150 times smaller compared to that of the same amount of Am-241 in air. The light production in the liquid is evenly distributed throughout the sample volume with a slight increase on the surface of the liquid. The radioluminescence intensity is shown to scale linearly with the Am-241 concentration and not be affected by the  $\text{HNO}_3$  concentration.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Physics, University of Helsinki, European Commission Joint Research Centre  
Contributors: Kerst, T., Malmbeck, R., Ial Banik, N. L., Toivonen, J.  
Publication date: 1 Apr 2019  
Peer-reviewed: Yes

#### Publication information

Journal: Sensors (Switzerland)  
Volume: 19  
Issue number: 7  
Article number: 1602

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Alpha radiation, Americium, Liquid phase luminescence, Radioluminescence

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10.3390/s19071602

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Source: Scopus

Source ID: 85064822061

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

### **Ambient rf energy harvesting sensor device with capacitor-leakage-aware duty cycle control**

In this paper, we present a software control method that maximizes the sensing rate of wireless sensor networks (WSNs) that are solely powered by ambient RF power. Unlike all other energy harvesting WSN systems, RF-powered systems present new challenges for energy management. A WSN node repeatedly charges and discharges at short intervals, depending on the energy intake. Typically in energy harvesting systems, a capacitor is used for energy storage because of its efficient charge and discharge performance and infinite recharge cycles. When the charging time is too short, a node is more likely to experience an energy shortage. On the contrary, if it is too long, more energy is lost because of leakage in the capacitor. In this paper, we introduce an adaptive duty cycle control scheme optimized for RF energy harvesting. This method maximizes the sensing rate by taking into account the leakage problem, a factor that has never been previously studied in this context. Our control scheme improves the efficiency by aggregate evaluation of operation reliability and leakage reduction.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), University of Tokyo, Graduate School of Information Science and Technology, Georgia Institute of Technology, School of Electrical and Computer Engineering

Contributors: Shigeta, R., Sasaki, T., Quan, D. M., Kawahara, Y., Vyas, R. J., Tentzeris, M. M., Asami, T.

Number of pages: 11

Pages: 2973-2983

Publication date: 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Sensors Journal

Volume: 13

Issue number: 8

Article number: 6521342

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2013): CiteScore 3.5 SJR 0.663 SNIP 1.767

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: Ambient RF energy harvesting, capacitor, digital TV, duty cycle control, wireless sensor networks

DOIs:

10.1109/JSEN.2013.2264931

URLs:

<http://www.scopus.com/inward/record.url?scp=84880683308&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84880683308

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

### **Amplifier similariton laser with extra-broad bandwidth output pulse**

We propose an advanced scheme of amplifier similariton laser providing an output pulse spectrum much wider than the gain bandwidth. The upgrade is an additional dispersive element introduced into the cavity to locally increase the peak pulse power. The proposed scheme demonstrates a drastic increase in the output pulse spectrum width, reduction of the pulse duration, and an increase in the output peak pulse power after compression.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Optoelectronics Research Centre, Research group: Ultrafast and intense lasers, Ulyanovsk State University

Contributors: Korobko, D. A., Okhotnikov, O. G., Zolotovskii, I. O.

Publication date: 1 Mar 2016

Peer-reviewed: Yes

### Publication information

Journal: Laser Physics Letters

Volume: 13

Issue number: 3

Article number: 035106

ISSN (Print): 1612-2011

Ratings:

Scopus rating (2016): CiteScore 5 SJR 0.942 SNIP 1.098

Original language: English

ASJC Scopus subject areas: Physics and Astronomy (miscellaneous), Instrumentation

Keywords: amplifier similariton laser, gain bandwidth, parabolic pulses

DOIs:

10.1088/1612-2011/13/3/035106

Source: Scopus

Source ID: 84974823891

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

### An activity recognition framework deploying the random forest classifier and a single optical heart rate monitoring and triaxial accelerometer wrist-band

Wrist-worn sensors have better compliance for activity monitoring compared to hip, waist, ankle or chest positions. However, wrist-worn activity monitoring is challenging due to the wide degree of freedom for the hand movements, as well as similarity of hand movements in different activities such as varying intensities of cycling. To strengthen the ability of wrist-worn sensors in detecting human activities more accurately, motion signals can be complemented by physiological signals such as optical heart rate (HR) based on photoplethysmography. In this paper, an activity monitoring framework using an optical HR sensor and a triaxial wrist-worn accelerometer is presented. We investigated a range of daily life activities including sitting, standing, household activities and stationary cycling with two intensities. A random forest (RF) classifier was exploited to detect these activities based on the wrist motions and optical HR. The highest overall accuracy of  $89.6 \pm 3.9\%$  was achieved with a forest of a size of 64 trees and 13-s signal segments with 90% overlap. Removing the HR-derived features decreased the classification accuracy of high-intensity cycling by almost 7%, but did not affect the classification accuracies of other activities. A feature reduction utilizing the feature importance scores of RF was also carried out and resulted in a shrunken feature set of only 21 features. The overall accuracy of the classification utilizing the shrunken feature set was  $89.4 \pm 4.2\%$ , which is almost equivalent to the above-mentioned peak overall accuracy.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Personal Health Informatics-PHI, Department of Future Technologies

Contributors: Mehrang, S., Pietilä, J., Korhonen, I.

Publication date: 22 Feb 2018

Peer-reviewed: Yes

### Publication information

Journal: Sensors

Volume: 18

Issue number: 2

Article number: 613

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2018): CiteScore 4.3 SJR 0.592 SNIP 1.642

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Accelerometer, Activity recognition, Context awareness, Machine learning, Photoplethysmography, Random forest, Wrist-worn sensors

Electronic versions:

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<http://urn.fi/URN:NBN:fi:tty-201803141373>

Source: Scopus

Source ID: 85042489750

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

### Binary Non-Negative Matrix Deconvolution for Audio Dictionary Learning

In this study, we propose an unsupervised method for dictionary learning in audio signals. The new method, called binary nonnegative matrix deconvolution (BNMD), is developed and used to discover patterns from magnitude-scale spectrograms. The BNMD models an audio spectrogram as a sum of delayed patterns having binary gains (activations). Only small subsets of patterns can be active for a given spectrogram excerpt. The proposed method was applied to speaker identification and separation tasks. The experimental results show that dictionaries obtained by the BNMD bring much higher speaker identification accuracies averaged over a range of SNRs from -6 dB to 9 dB (91.3%) than the NMD-based dictionaries (37.8-75.4%). The BNMD also gives a benefit over dictionaries obtained using vector quantization (87.8%). For bigger dictionaries the difference between the BNMD and the vector quantization (VQ) is getting smaller. For the speech separation task the BNMD dictionary gave a slight improvement over the VQ.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Audio research group - ARG, Poznan University of Technology, University of Oldenburg, Yousician Ltd.

Contributors: Drgas, S., Virtanen, T., Lücke, J., Hurmalainen, A.

Number of pages: 13

Pages: 1644-1656

Publication date: 1 Aug 2017

Peer-reviewed: Yes

### Publication information

Journal: IEEE/ACM Transactions on Audio Speech and Language Processing

Volume: 25

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ISSN (Print): 2329-9290

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Original language: English

ASJC Scopus subject areas: Signal Processing, Media Technology, Instrumentation, Acoustics and Ultrasonics, Linguistics and Language, Speech and Hearing, Electrical and Electronic Engineering

Keywords: Sparse coding, speaker recognition, speech separation

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DOIs:

10.1109/TASLP.2017.2709909

URLs:

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### Bibliographical note

EXT="Hurmalainen, Antti"

Source: Scopus

Source ID: 85028409183

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

### Bioimpedance Sensor Array for Long-Term Monitoring of Wound Healing from Beneath the Primary Dressings and Controlled Formation of H<sub>2</sub>O<sub>2</sub> Using Low-Intensity Direct Current

Chronic wounds impose a significant financial burden for the healthcare system. Currently, assessment and monitoring of hard-to-heal wounds are often based on visual means and measuring the size of the wound. The primary wound dressings must be removed before assessment can be done. We have developed a quasi-monopolar bioimpedance-measurement-based method and a measurement system to determine the status of wound healing. The objective of this study was to demonstrate that with an appropriate setup, long-term monitoring of wound healing from beneath the primary dressings is feasible. The developed multielectrode sensor array was applied on the wound area and left under the primary dressings for 142 h. The impedance of the wounds and the surrounding intact skin area was measured regularly during the study at

150 Hz, 300 Hz, 1 kHz, and 5 kHz frequencies. At the end of the follow-up period, the wound impedance had reached the impedance of the intact skin at the higher frequencies and increased significantly at the lowest frequencies. The measurement frequency affected the measurement sensitivity in wound monitoring. The skin impedance remained stable over the measurement period. The sensor array also enabled the administration of periodical low-intensity direct current (LIDC) stimulation in order to create an antimicrobial environment across the wound area via the controlled formation of hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>).

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Turku University Hospital, Kaarinantie 700, Åbo Akademi University

Contributors: Kekonen, A., Bergelin, M., Johansson, M., Kumar Joon, N., Bobacka, J., Viik, J.

Publication date: 31 May 2019

Peer-reviewed: Yes

#### Publication information

Journal: Sensors

Volume: 19

Issue number: 11

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: beneath the dressings, bioimpedance, hydrogen peroxide, long-term monitoring, low-intensity direct current, multielectrode, quasi-monopolar, sensor array, wound dressing, wound monitoring, wound stimulation

Electronic versions:

sensors-19-02505-v2

DOIs:

10.3390/s19112505

URLs:

<http://urn.fi/URN:NBN:fi:ty-201906241904>

Source: Scopus

Source ID: 85067176313

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

#### Blind Separation of Audio Mixtures Through Nonnegative Tensor Factorization of Modulation Spectrograms

This paper presents an algorithm for unsupervised single-channel source separation of audio mixtures. The approach specifically addresses the challenging case of separation where no training data are available. By representing mixtures in the modulation spectrogram (MS) domain, we exploit underlying similarities in patterns present across frequency. A three-dimensional tensor factorization is able to take advantage of these redundant patterns, and is used to separate a mixture into an approximated sum of components by minimizing a divergence cost. Furthermore, we show that the basic tensor factorization can be extended with convolution in time being used to improve separation results and provide update rules to learn components in such a manner. Following factorization, sources are reconstructed in the audio domain from estimated components using a novel approach based on reconstruction masks that are learned using MS activations, and then applied to a mixture spectrogram. We demonstrate that the proposed method produces superior separation performance to a spectrally based nonnegative matrix factorization approach, in terms of source-to-distortion ratio. We also compare separation with the perceptually motivated interference-related perceptual score metric and identify cases with higher performance.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Audio research group

Contributors: Barker, T., Virtanen, T.

Number of pages: 13

Pages: 2377-2389

Publication date: 1 Dec 2016

Peer-reviewed: Yes

#### Publication information

Journal: IEEE-Acm transactions on audio speech and language processing

Volume: 24

Issue number: 12

ISSN (Print): 2329-9290

Ratings:

Scopus rating (2016): CiteScore 2.7 SJR 0.711 SNIP 3.007

Original language: English

ASJC Scopus subject areas: Signal Processing, Media Technology, Instrumentation, Acoustics and Ultrasonics, Linguistics and Language, Speech and Hearing, Electrical and Electronic Engineering

Keywords: Factorization, nonnegative matrix factorization (NMF), source separation, speech enhancement

DOIs:

10.1109/TASLP.2016.2602546

Source: Scopus

Source ID: 84991442139

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

### **ClothFace: A Batteryless RFID-Based Textile Platform for Handwriting Recognition**

This paper introduces a prototype of ClothFace technology, a battery-free textile-based handwriting recognition platform that includes an e-textile antenna and a  $10 \times 10$  array of radio frequency identification (RFID) integrated circuits (ICs), each with a unique ID. Touching the textile platform surface creates an electrical connection from specific ICs to the antenna, which enables the connected ICs to be read with an external UHF (ultra-high frequency) RFID reader. In this paper, the platform is demonstrated to recognize handwritten numbers 0-9. The raw data collected by the platform are a sequence of IDs from the touched ICs. The system converts the data into bitmaps and their details are increased by interpolating between neighboring samples using the sequential information of IDs. These images of digits written on the platform can be classified, with enough accuracy for practical use, by deep learning. The recognition system was trained and tested with samples from six volunteers using the platform. The real-time number recognition ability of the ClothFace technology is demonstrated to work successfully with a very low error rate. The overall recognition accuracy of the platform is 94.6% and the accuracy for each digit is between 91.1% and 98.3%. As the solution is fully passive and gets all the needed energy from the external RFID reader, it enables a maintenance-free and cost-effective user interface that can be integrated into clothing and into textiles around us.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group, Computing Sciences, Research group: Machine Learning Group MLG, Research group: Vision, Research group: Inverse Problems

Contributors: He, H., Chen, X., Mehmood, A., Raivio, L., Huttunen, H., Raunonen, P., Virkki, J.

Number of pages: 12

Publication date: 28 Aug 2020

Peer-reviewed: Yes

### **Publication information**

Journal: Sensors (Basel, Switzerland)

Volume: 20

Issue number: 17

Article number: 4878

ISSN (Print): 1424-8220

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: deep learning, human-machine interaction, passive UHF RFID, textile electronics, user interface, wearables

Electronic versions:

ClothFace A Batteryless RFID-Based 2020

DOIs:

10.3390/s20174878

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009167026>

Source: Scopus

Source ID: 85090182156

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

### **Coupled dictionaries for exemplar-based speech enhancement and automatic speech recognition**

Exemplar-based speech enhancement systems work by decomposing the noisy speech as a weighted sum of speech and noise exemplars stored in a dictionary and use the resulting speech and noise estimates to obtain a time-varying filter in the full-resolution frequency domain to enhance the noisy speech. To obtain the decomposition, exemplars sampled in lower dimensional spaces are preferred over the full-resolution frequency domain for their reduced computational complexity and the ability to better generalize to unseen cases. But the resulting filter may be sub-optimal as the mapping of the obtained speech and noise estimates to the full-resolution frequency domain yields a low-rank approximation. This



paper proposes an efficient way to directly compute the full-resolution frequency estimates of speech and noise using coupled dictionaries: an input dictionary containing atoms from the desired exemplar space to obtain the decomposition and a coupled output dictionary containing exemplars from the full-resolution frequency domain. We also introduce modulation spectrogram features for the exemplar-based tasks using this approach. The proposed system was evaluated for various choices of input exemplars and yielded improved speech enhancement performances on the AURORA-2 and AURORA-4 databases. We further show that the proposed approach also results in improved word error rates (WERs) for the speech recognition tasks using HMM-GMM and deep-neural network (DNN) based systems.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: Audio research group, Research Community on Data-to-Decision (D2D), Signal Processing Research Community (SPRC), Speech Processing Research Group, Electrical Engineering Department (ESAT), KU Leuven

Contributors: Baby, D., Virtanen, T., Gemmeke, J. F., Van hamme, H.

Number of pages: 12

Pages: 1788-1799

Publication date: 1 Nov 2015

Peer-reviewed: Yes

### Publication information

Journal: *Ieee-Acm transactions on audio speech and language processing*

Volume: 23

Issue number: 11

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Ratings:

Scopus rating (2015): CiteScore 1.6 SJR 1.13 SNIP 1.475

Original language: English

ASJC Scopus subject areas: Signal Processing, Electrical and Electronic Engineering, Media Technology, Acoustics and Ultrasonics, Instrumentation, Linguistics and Language, Speech and Hearing

Keywords: Exemplar-based, Modulation envelope, Noise robust automatic speech recognition, Non-negative sparse coding

DOIs:

10.1109/TASLP.2015.2450491

Source: Scopus

Source ID: 84942609488

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

### Cysteine-tagged chimeric avidin forms high binding capacity layers directly on gold

Cysteine-tagged, genetically engineered avidin named ChiAvd-Cys and wild-type avidin form monolayers or bilayer structures when immobilised directly on gold. Non-specific binding can be reduced by a post-treatment of the avidin layers with a N-[tris(hydroxymethyl)methyl]-acrylamide (pTHMMAA) polymer. ChiAvd-Cys showed excellent activity when immobilised on gold. About 70% of the ChiAvd-Cys molecules were able to bind two biotinylated green fluorescent proteins (per avidin tetramer). Amino-biotinylated antibody F(ab')<sub>2</sub> fragments could be bound to every 4th and 8th ChiAvd-Cys and wild-type avidin molecule, respectively, whereas on average one thiol-biotinylated antibody Fab'-fragment was bound to every ChiAvd-Cys. Antigen binding to the thiol-biotinylated Fab'-fragment bound to the ChiAvd-Cys/pTHMMAA layer was almost twice compared to that of the amino-biotinylated F(ab')<sub>2</sub>-fragments. The high antigen binding was due to a site-directed orientation of the thiol-biotinylated fragments. The ChiAvd-Cys/pTHMMAA layers offer high capacity that may be used to couple biotinylated compounds on biosensor surfaces.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), VTT Technical Research Centre of Finland, School of Management (JKK), Adult Stem Cells, Tampere University Hospital

Contributors: Vikholm-Lundin, I., Auer, S., Paakkunainen, M., Määttä, J. A. E., Munter, T., Leppiniemi, J., Hytönen, V. P., Tappura, K.

Number of pages: 9

Pages: 440-448

Publication date: Aug 2012

Peer-reviewed: Yes

### Publication information

Journal: *Sensors and Actuators B: Chemical*

Volume: 171-172

ISSN (Print): 0925-4005

Ratings:

Scopus rating (2012): CiteScore 6.1 SJR 1.412 SNIP 1.653

Original language: English

ASJC Scopus subject areas: Instrumentation, Materials Chemistry, Surfaces, Coatings and Films, Metals and Alloys, Electronic, Optical and Magnetic Materials, Condensed Matter Physics, Electrical and Electronic Engineering

Keywords: Avidin, Biotin, Cysteine tagged, Non-specific binding, Self-assembled monolayer

DOIs:

10.1016/j.snb.2012.05.008

URLs:

<http://www.scopus.com/inward/record.url?scp=84864284365&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84864284365

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

### **Design and development of a novel passive wireless ultrasensitive RF temperature transducer for remote sensing**

A wireless, passive, and ultrasensitive temperature transducer is presented in this paper. The transducer consists of split ring resonators loaded with micro-bimorph cantilevers, which can potentially operate up to millimeter-wave frequencies (above 30 GHz). As the temperature changes, the bimorph cantilevers deflect and result in a shift of the resonant frequency of the split rings. A design is proposed, that has a maximum sensitivity of 2.62 GHz/ $\mu\text{m}$ , in terms of frequency shift per deflection unit, corresponding to a sensitivity of 498 MHz/ $^{\circ}\text{C}$  for an operating frequency around 30 GHz, i.e., a frequency shift of 1.6% per  $^{\circ}\text{C}$ . Theoretically, it's about two orders of magnitude higher than the existing sensors observed in the same class. This sensor design also offers a high Q factor and is ultra-compact, enabling easy fabrication and integration in micro-electromechanical systems technology. Depending on the choice of materials, the proposed designs can also be utilized in harsh environments. As a proof of concept, a prototype is implemented around 4.7 GHz which exhibits a frequency shift of 0.05%/ $^{\circ}\text{C}$ , i.e., 17 times more sensitive than the existing sensors.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Microsoft Research, LAAS-CNRS, University of Toulouse, INP, LAAS-CNRS, Georgia Institute of Technology

Contributors: Thai, T. T., Mehdi, J. M., Chebila, F., Aubert, H., Pons, P., Dejean, G. R., Tentzeris, M. M., Plana, R.

Number of pages: 11

Pages: 2756-2766

Publication date: 2012

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Sensors Journal

Volume: 12

Issue number: 9

Article number: 6208808

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2012): CiteScore 2.8 SJR 0.663 SNIP 1.602

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Instrumentation

Keywords: Micro-electromechanical systems (MEMS) cantilevers, passive remote sensing, radar cross section (RCS), radio frequency transducer, split ring resonators (SRRs), temperature sensor, wireless sensor

DOIs:

10.1109/JSEN.2012.2201463

URLs:

<http://www.scopus.com/inward/record.url?scp=84864561259&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84864561259

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

### **Designing, Manufacturing and Testing of a Piezoelectric Polymer Film In-Sole Sensor for Plantar Pressure Distribution Measurements**

We have designed, manufactured, and tested a prototype of an in-sole plantar pressure sensor. The sensor is made of a piezoelectric polymer film (polyvinylidene fluoride, PVDF) with evaporated copper electrodes. The size and the location of measuring sites are carefully considered to produce a light-weighted, practical, and inexpensive matrix sensor for measurement of plantar pressure distribution. The sensor consists of eight measurement locations: hallux, first metatarsal

head (under both sesamoid bones), metatarsal heads 2-5 and heel. The developed in-sole sensor was evaluated through piezoelectric sensitivity measurements and test measurements with subjects (used as a platform sensor). Average peak-to-peak pressures from 58 to 486 kPa were obtained in plantar pressure measurements. The in-sole sensor can be used to prevent pressure ulcers. Also other application areas for the sensor are available, e.g., rehabilitation and sports. The developed sensor enables unobtrusive and long-term plantar pressure measurements. In future, an option for manufacturing the PVDF in-soles may be printing of desired electrode pattern on PVDF material, that would allow fast production, and if needed, the production of even individual in-soles.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Automation and Hydraulic Engineering, Faculty of Biomedical Sciences and Engineering, Research group: Sensor Technology and Biomeasurements (STB), Tampere University Hospital

Contributors: Rajala, S., Mattila, R., Kaartinen, I., Lekkala, J.

Number of pages: 8

Pages: 6798-6805

Publication date: 15 Oct 2017

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Sensors Journal

Volume: 17

Issue number: 20

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2017): CiteScore 4.9 SJR 0.619 SNIP 1.588

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: diabetes, in-sole sensor, piezoelectric polymer PVDF, Plantar pressure

DOIs:

10.1109/JSEN.2017.2750241

#### Bibliographical note

INT=aut,"Mattila, Raisa"

Source: Scopus

Source ID: 85031124350

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

#### Detection and Classification of Acoustic Scenes and Events: Outcome of the DCASE 2016 Challenge

Public evaluation campaigns and datasets promote active development in target research areas, allowing direct comparison of algorithms. The second edition of the challenge on Detection and Classification of Acoustic Scenes and Events (DCASE 2016) has offered such an opportunity for development of state-of-the-art methods, and succeeded in drawing together a large number of participants from academic and industrial backgrounds. In this paper, we report on the tasks and outcomes of the DCASE 2016 challenge. The challenge comprised four tasks: acoustic scene classification, sound event detection in synthetic audio, sound event detection in real-life audio, and domestic audio tagging. We present in detail each task and analyse the submitted systems in terms of design and performance. We observe the emergence of deep learning as the most popular classification method, replacing the traditional approaches based on Gaussian mixture models and support vector machines. By contrast, feature representations have not changed substantially throughout the years, as mel frequency-based representations predominate in all tasks. The datasets created for and used in DCASE 2016 are publicly available and are a valuable resource for further research.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Research group: Audio research group - ARG, School of Mathematical Sciences, Ecole Centrale de Nantes, IRCCyN UMR CNRS 6597 1, University of Surrey

Contributors: Mesaros, A., Heittola, T., Benetos, E., Foster, P., Lagrange, M., Virtanen, T., Plumbley, M. D.

Pages: 379-393

Publication date: Feb 2018

Peer-reviewed: Yes

Early online date: 28 Nov 2017

#### Publication information

Journal: IEEE/ACM Transactions on Audio Speech and Language Processing

Volume: 26

Issue number: 2  
ISSN (Print): 2329-9290  
Ratings:

Scopus rating (2018): CiteScore 6.9 SJR 1.045 SNIP 2.428

Original language: English

ASJC Scopus subject areas: Signal Processing, Media Technology, Instrumentation, Acoustics and Ultrasonics, Linguistics and Language, Electrical and Electronic Engineering, Speech and Hearing

Keywords: Acoustic scene classification, Acoustics, audio datasets, Event detection, Hidden Markov models, pattern recognition, sound event detection, Speech, Speech processing, Tagging

Electronic versions:

dcase2016\_taslp

DOIs:

10.1109/TASLP.2017.2778423

URLs:

<http://urn.fi/URN:NBN:fi:ty-201802081200>

Source: Scopus

Source ID: 85037645922

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

### Detection of 3,4-methylenedioxyamphetamine (MDMA, ecstasy) by displacement of antibodies

A molecular layer with low non-specific binding enabling determination of low concentrations of 3,4-methylenedioxyamphetamine (MDMA) by the displacement of antibodies has been developed. Antibody Fab'-fragments at various concentrations have been site-directly immobilised on gold and intercalated with a hydrophilic non-ionic polymer that reduces non-specific binding. Bovine serum albumin conjugated with MDMA and various concentrations of anti-MDMA antibodies were bound to the layer. The amount of conjugates and antibodies bound was dependent on the amount of Fab'-fragments in the layer. Antibodies were also bound to the conjugates physisorbed directly onto the gold surface and in mixtures with the polymer or with a lipoamide. A high displacement of antibodies was observed by surface plasmon resonance (SPR) on interaction of MDMA with the different layers in buffer solution. No displacement could, however, be observed in saliva with the pure conjugate layer because of a high non-specific binding of proteins. When the conjugates were coupled to the surface through the antibody Fab-fragment/polymer layer, MDMA concentrations as low as  $0.02 \text{ ng mL}^{-1}$  ( $0.14 \text{ nM}$ ) could easily be detected in buffer. In diluted saliva the lowest limit of detection was  $0.4 \text{ ng mL}^{-1}$  enabling determination of drugs from saliva with a cut-off concentration of  $2 \text{ ng mL}^{-1}$ . The molecular layer of antibody Fab'-fragments and polymer thus shows great potential for binding conjugates and antibodies that can be displaced on the interaction with very low concentrations of small-sized molecules. A low non-specific binding is guaranteed by the presence of the hydrophilic polymer.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), VTT Technical Research Centre of Finland, Biosensors Applications AB

Contributors: Vikholm-Lundin, I., Auer, S., Hellgren, A. C.

Number of pages: 7

Pages: 28-34

Publication date: 10 Aug 2011

Peer-reviewed: Yes

### Publication information

Journal: Sensors and Actuators B: Chemical

Volume: 156

Issue number: 1

ISSN (Print): 0925-4005

Ratings:

Scopus rating (2011): CiteScore 6 SJR 1.485 SNIP 1.752

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Instrumentation, Condensed Matter Physics, Surfaces, Coatings and Films, Metals and Alloys, Materials Chemistry, Electrical and Electronic Engineering

Keywords: Antibody displacement, Drugs of abuse, Ecstasy, Immobilisation, MDMA, Surface plasmon resonance

DOIs:

10.1016/j.snb.2011.03.069

URLs:

<http://www.scopus.com/inward/record.url?scp=79957806721&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79957806721

### **Development of a constant dilution sampling system for particulate and gaseous pollutant measurements**

This paper presents a new concept of a partial flow sampling system (PFSS), involving a two-stage diluter which operates on the principle of underpressure, while exhaust is sampled through a capillary. Due to the low flowrate through the capillary, the diluter may be sampling from a freely exhausting tailpipe and is not prone to pressure variations in the exhaust line. In addition, the PFSS operates at constant pressure conditions even upstream of diesel particle filters that increase the backpressure in the tailpipe. As a result, the PFSS offers a constant dilution ratio (DR) over any engine or vehicle operation condition. This study presents the diluter concept and a straightforward model developed to calculate the DR, depending on the dilution air flowrate and the diluter underpressure. The model is validated using CO<sub>2</sub> as a trace gas, and very good agreement is demonstrated between the calculated and the measured DR values. Following validation, the PFSS is combined with aerosol measurement instruments to measure the exhaust particle concentration of a diesel engine operating at different steady-state modes. For demonstrating the stability of the DR and applicability of the PFSS, measurements are conducted with both heavy duty and light duty diesel exhaust gases. Future applications of this device include gas and particle exhaust measurements both in laboratory environments and on-board vehicles.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Urban circular bioeconomy (UrCirBio), Aristotle University of Thessaloniki, Laboratory of Applied Thermodynamics, Dekati Ltd

Contributors: Tzamkiozis, T., Ntziachristos, L., Amanatidis, S., Niemelä, V., Ukkonen, A., Samaras, Z.

Publication date: Aug 2013

Peer-reviewed: Yes

#### **Publication information**

Journal: Measurement Science and Technology

Volume: 24

Issue number: 8

Article number: 085801

ISSN (Print): 0957-0233

Ratings:

Scopus rating (2013): CiteScore 3.1 SJR 0.639 SNIP 1.417

Original language: English

ASJC Scopus subject areas: Applied Mathematics, Instrumentation

DOIs:

10.1088/0957-0233/24/8/085801

URLs:

<http://www.scopus.com/inward/record.url?scp=84880789628&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84880789628

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

### **Development of Low Cost, Wireless, Inkjet Printed Microfluidic RF Systems and Devices for Sensing or Tunable Electronics**

In this paper, a review of recent improvements on inkjet-printed microfluidic-based tunable/sensing RF systems is reported. The devices, such as Radio Frequency Identification (RFID) passive wireless tags, coplanar patch antennas, bandstop filters, and loop antennas, are all fabricated by combining the inkjet printing technology on photographic paper for metallization and bonding layers, and laser etching for cavities and channels manufacturing. A novelty is also introduced for the loop antennas where the photographic paper is replaced with a polymer based substrate [i.e., (Poly(methyl-methacrylate))], to reduce the substrate losses for the RF part and solve the issue of paper hydrophilia. Along this paper an evolution toward higher working frequencies and higher detecting performance is shown, demonstrating a sensitivity up to 0.5%/εr with at most 6 μL of liquid in the channel.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), University of Perugia, Georgia Institute of Technology

Contributors: Mariotti, C., Su, W., Cook, B. S., Roselli, L., Tentzeris, M. M.

Number of pages: 8

Pages: 3156-3163

Publication date: 1 Jun 2015

Peer-reviewed: Yes

### Publication information

Journal: IEEE Sensors Journal

Volume: 15

Issue number: 6

Article number: 6966729

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2015): CiteScore 4.2 SJR 0.655 SNIP 1.821

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: Inkjet Printing, Microfluidics, RFID, Sensors, Tag, Tunable Electronics

DOIs:

10.1109/JSEN.2014.2374874

URLs:

<http://www.scopus.com/inward/record.url?scp=84928485604&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84928485604

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

### Environmental monitoring with distributed mesh networks: An overview and practical implementation perspective for urban scenario

Almost inevitable climate change and increasing pollution levels around the world are the most significant drivers for the environmental monitoring evolution. Recent activities in the field of wireless sensor networks have made tremendous progress concerning conventional centralized sensor networks known for decades. However, most systems developed today still face challenges while estimating the trade-off between their flexibility and security. In this work, we provide an overview of the environmental monitoring strategies and applications. We conclude that wireless sensor networks of tomorrow would mostly have a distributed nature. Furthermore, we present the results of the developed secure distributed monitoring framework from both hardware and software perspectives. The developed mechanisms provide an ability for sensors to communicate in both infrastructure and mesh modes. The system allows each sensor node to act as a relay, which increases the system failure resistance and improves the scalability. Moreover, we employ an authentication mechanism to ensure the transparent migration of the nodes between different network segments while maintaining a high level of system security. Finally, we report on the real-life deployment results.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, St. Petersburg State University of Aerospace Instrumentation, ITMO University, Brno University of Technology, National Research University Higher School of Economics

Contributors: Ometov, A., Bezzateev, S., Voloshina, N., Masek, P., Komarov, M.

Number of pages: 19

Publication date: 2 Dec 2019

Peer-reviewed: Yes

### Publication information

Journal: Sensors (Switzerland)

Volume: 19

Issue number: 24

Article number: 5548

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: Authentication mechanism, Distributed systems, Environmental monitoring, Security, Wireless sensor network

Electronic versions:

sensors-19-05548-v3

DOIs:

10.3390/s19245548

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001171367>

### Bibliographical note

EXT="Komarov, Mikhail"

Source: Scopus

Source ID: 85076920114

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

### Evaluation of dry electrodes in canine heart rate monitoring

The functionality of three dry electrocardiogram electrode constructions was evaluated by measuring canine heart rate during four different behaviors: Standing, sitting, lying and walking. The testing was repeated ( $n = 9$ ) in each of the 36 scenarios with three dogs. Two of the electrodes were constructed with spring-loaded test pins while the third electrode was a molded polymer electrode with Ag/AgCl coating. During the measurement, a specifically designed harness was used to attach the electrodes to the dogs. The performance of the electrodes was evaluated and compared in terms of heartbeat detection coverage. The effect on the respective heart rate coverage was studied by computing the heart rate coverage from the measured electrocardiogram signal using a pattern-matching algorithm to extract the R-peaks and further the beat-to-beat heart rate. The results show that the overall coverage ratios regarding the electrodes varied between 45-95% in four different activity modes. The lowest coverage was for lying and walking and the highest was for standing and sitting.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Pervasive Computing, Research group: Sensor Technology and Biomeasurements (STB), University of Helsinki, Institute of Biomedical Engineering and Informatics, University of Tampere (UTA), Research Group for Emotions

Contributors: Virtanen, J., Somppi, S., Törnqvist, H., Jeyhani, V., Fiedler, P., Gizatdinova, Y., Majaranta, P., Väätäjä, H., Cardó, A. V., Lekkala, J., Tuukkanen, S., Surakka, V., Vainio, O., Vehkaoja, A.

Publication date: 1 Jun 2018

Peer-reviewed: Yes

### Publication information

Journal: Sensors

Volume: 18

Issue number: 6

Article number: 1757

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2018): CiteScore 4.3 SJR 0.592 SNIP 1.642

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Dry electrode, Heart rate canine

Electronic versions:

sensors-18-01757-v2

DOIs:

10.3390/s18061757

URLs:

<http://urn.fi/URN:NBN:fi:tty-201806212014>

Source: Scopus

Source ID: 85047961818

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

### Fluid Transmission Line Modeling Using a Variational Method

A variational method is used to derive numerical models for transient flow simulation in fluid transmission lines. These are generalizations of models derived using the more traditional modal method. Three different transient compressible laminar pipe flow models are considered (inviscid, one-dimensional linear viscous, and two-dimensional dissipative viscous flow), and a model for transient turbulent pipe flow is given. The (model) equations in the laminar case are given in the form of a set of constant coefficient ordinary differential equations, and for the turbulent case (model) in the form of a set of nonlinear ordinary differential equations. Explicit equations are given for various end conditions. Attenuation factors, similar to the window functions used in spectral analysis, are used to attenuate Gibbs phenomenon oscillations.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Civil Engineering, Research group: Structural Mechanics, Tampere University of Technology, Department of Mathematics, Institute of Hydraulics and Automation, Research group: Positioning

Contributors: Mäkinen, J., Piché, R., Ellman, A.  
Number of pages: 10  
Pages: 153-162  
Publication date: Mar 2000  
Peer-reviewed: Yes

#### Publication information

Journal: Journal of Dynamic Systems, Measurement and Control: Transactions of the ASME  
Volume: 122  
Issue number: 1  
ISSN (Print): 0022-0434  
Ratings:

Scopus rating (2000): SJR 0.648 SNIP 1.412

Original language: English

ASJC Scopus subject areas: Control and Systems Engineering, Instrumentation

URLs:

[http://ojs.aip.org/journal\\_cgi/dbt?KEY=JDSMAA](http://ojs.aip.org/journal_cgi/dbt?KEY=JDSMAA)

URLs:

<http://www.scopus.com/inward/record.url?scp=4244134506&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

Contribution: organisation=mat,FACT1=1

Source: researchoutputwizard

Source ID: 26963

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

#### Fluorimetric oxygen sensor with an efficient optical read-out for in vitro cell models

This paper presents a phase fluorimetric sensor for the monitoring of the oxygen concentration in in vitro cell models. The sensing surface of the sensor consists of oxygen sensitive fluorescent dyes (platinum(II) octaethylporphyrinketone) embedded in a thin polystyrene film. In order to optimize the optical read-out scheme of the sensor, we carried out electromagnetic simulations of a fluorescently doped polystyrene film deposited on a glass-water interface. The simulation results showed highly anisotropic angular emission distribution with the maximum irradiance being at super critical angles, which attracts tailored optical designs to maximize the fluorescence collection efficiency. For this purpose, we applied an efficient optical read-out scheme based on an in-contact parabolic lens. The use of parabolic lens also facilitates confocal total internal reflection excitation from the substrate side. This makes the excitation effective and insensitive to biofouling or other optical changes in the sensing surface and, more importantly, greatly reduces the amount of excitation power radiated into the cell culture chamber. Experimental results show that when applied together with phase fluorimetric lifetime sensing, this optical scheme allows one to use thin films (

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research group: Micro and Nanosystems Research Group, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB), VTT Technical Research Centre of Finland, BioMediTech Institute and Faculty of Biomedical Sciences and Engineering

Contributors: Välimäki, H., Verho, J., Kreutzer, J., Kattiparambil Rajan, D., Rynnänen, T., Pekkanen-Mattila, M., Ahola, A., Tappura, K., Kallio, P., Lekkala, J.

Number of pages: 9

Pages: 738-746

Publication date: 1 Oct 2017

Peer-reviewed: Yes

#### Publication information

Journal: Sensors and Actuators B: Chemical

Volume: 249

ISSN (Print): 0925-4005

Ratings:

Scopus rating (2017): CiteScore 9.3 SJR 1.406 SNIP 1.453

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Instrumentation, Condensed Matter Physics, Surfaces, Coatings and Films, Metals and Alloys, Materials Chemistry, Electrical and Electronic Engineering

Keywords: Cardiac cells, Enhanced optical read-out, Fluorimetric oxygen sensor, in vitro cell models, PtOEPK, Thin film fluorescence

DOIs:

10.1016/j.snb.2017.04.182



Source: Scopus

Source ID: 85019164799

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

### **Fusionsense: Emotion classification using feature fusion of multimodal data and deep learning in a brain-inspired spiking neural network**

Using multimodal signals to solve the problem of emotion recognition is one of the emerging trends in affective computing. Several studies have utilized state of the art deep learning methods and combined physiological signals, such as the electrocardiogram (EEG), electroencephalogram (ECG), skin temperature, along with facial expressions, voice, posture to name a few, in order to classify emotions. Spiking neural networks (SNNs) represent the third generation of neural networks and employ biologically plausible models of neurons. SNNs have been shown to handle Spatio-temporal data, which is essentially the nature of the data encountered in emotion recognition problem, in an efficient manner. In this work, for the first time, we propose the application of SNNs in order to solve the emotion recognition problem with the multimodal dataset. Specifically, we use the NeuCube framework, which employs an evolving SNN architecture to classify emotional valence and evaluate the performance of our approach on the MAHNOB-HCI dataset. The multimodal data used in our work consists of facial expressions along with physiological signals such as ECG, skin temperature, skin conductance, respiration signal, mouth length, and pupil size. We perform classification under the Leave-One-Subject-Out (LOSO) cross-validation mode. Our results show that the proposed approach achieves an accuracy of 73.15% for classifying binary valence when applying feature-level fusion, which is comparable to other deep learning methods. We achieve this accuracy even without using EEG, which other deep learning methods have relied on to achieve this level of accuracy. In conclusion, we have demonstrated that the SNN can be successfully used for solving the emotion recognition problem with multimodal data and also provide directions for future research utilizing SNN for Affective computing. In addition to the good accuracy, the SNN recognition system is requires incrementally trainable on new data in an adaptive way. It only one pass training, which makes it suitable for practical and on-line applications. These features are not manifested in other methods for this problem.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Auckland University of Technology, University of Los Andes, Aalto University

Contributors: Tan, C., Ceballos, G., Kasabov, N., Subramaniam, N. P.

Number of pages: 27

Publication date: 17 Sep 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: Sensors (Switzerland)

Volume: 20

Issue number: 18

Article number: 5328

ISSN (Print): 1424-8220

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: Evolving Spiking Neural Networks (eSNNs), Facial emotion recognition, Multimodal data, NeuCube, Spatio-temporal data

Electronic versions:

FusionSense Emotion Classification 2020

DOIs:

10.3390/s20185328

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202009297163>

Source: Scopus

Source ID: 85091041249

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

### **Gas-phase endstation of electron, ion and coincidence spectroscopies for diluted samples at the FinEstBeAMS beamline of the MAX IV 1.5 GeV storage ring**

Since spring 2019 an experimental setup consisting of an electron spectrometer and an ion time-of-flight mass spectrometer for diluted samples has been available for users at the FinEstBeAMS beamline of the MAX IV Laboratory in Lund, Sweden. The setup enables users to study the interaction of atoms, molecules, (molecular) microclusters and nanoparticles with short-wavelength (vacuum ultraviolet and X-ray) synchrotron radiation and to follow the electron and nuclear dynamics induced by this interaction. Test measurements of N<sub>2</sub> and thiophene (C<sub>4</sub>H<sub>4</sub>S) molecules have demonstrated that the setup can be used for many-particle coincidence spectroscopy. The measurements of the Ar 3p photoelectron spectra by linear horizontal and vertical polarization show that angle-resolved experiments can also be

performed. The possibility to compare the electron spectroscopic results of diluted samples with solid targets in the case of Co<sub>2</sub>O<sub>3</sub> and Fe<sub>2</sub>O<sub>3</sub> at the Co and Fe L 2,3-absorption edges in the same experimental session is also demonstrated. Because the photon energy range of the FinEstBeAMS beamline extends from 4.4 eV up to 1000 eV, electron, ion and coincidence spectroscopy studies can be executed in a very broad photon energy range.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Research group: Surface Science, Turun Yliopisto/Turun Biomateriaalikeskus, University of Tartu, University of Oulu, Lunds Universitet / Lunds Tekniska Högskola

Contributors: Kooser, K., Kivimäki, A., Turunen, P., Pärna, R., Reisberg, L., Kirm, M., Valden, M., Huttula, M., Kukk, E.

Number of pages: 12

Pages: 1080-1091

Publication date: 1 Jul 2020

Peer-reviewed: Yes

#### Publication information

Journal: JOURNAL OF SYNCHROTRON RADIATION

Volume: 27

ISSN (Print): 0909-0495

Original language: English

ASJC Scopus subject areas: Radiation, Nuclear and High Energy Physics, Instrumentation

Keywords: electron and nuclear dynamics, gas-phase endstation, MAX IV, multi-particle coincidence spectroscopy, VUV and soft X-ray spectroscopy

Electronic versions:

Gas-phase endstation of electron 2020

DOIs:

10.1107/S1600577520007146

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008316783>

Source: Scopus

Source ID: 85089516941

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

#### Highly directive radiation and negative refraction using photonic crystals

In this article, we present an experimental and numerical study of certain optical properties of two-dimensional dielectric photonic crystals (PCs). By modifying the band structure of a two-dimensional photonic crystal through its crystal parameters, we show how it is possible to confine the angular distribution of radiation from an embedded omnidirectional source. We then demonstrate that the anomalous band dispersions of PCs give rise to completely novel optical phenomena, in particular, the negative refraction of electromagnetic waves at the interface of a PC. We investigate the spectral negative refraction, which utilizes a transverse magnetic (TM)-polarized upper band of a PC, in detail and show that a high degree of isotropy can be achieved for the corresponding effective index of refraction. The presence of nearly a isotropic negative refractive index leads to focusing of omnidirectional sources by a PC slab lens, which can surpass certain limitations of conventional (positive refractive) lenses. These examples indicate the potential of PCs for photonics applications utilizing the band structure.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Bilkent University

Contributors: Ozbay, E., Bulu, I., Aydin, K., Caglayan, H., Alici, K. B., Guven, K.

Number of pages: 8

Pages: 217-224

Publication date: Feb 2005

Peer-reviewed: Yes

#### Publication information

Journal: Laser Physics

Volume: 15

Issue number: 2

ISSN (Print): 1054-660X

Ratings:

Scopus rating (2005): SJR 0.343 SNIP 0.32

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Instrumentation, Condensed Matter Physics, Industrial and Manufacturing Engineering

URLs:

<http://pleiades.online/cgi-perl/search.pl?type=abstract&name=lasphys&number=2&year=5&page=217>

URLs:

<http://www.scopus.com/inward/record.url?scp=16244395788&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, H."

Source: Scopus

Source ID: 16244395788

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

#### **High performance corrosion resistant coatings by novel coaxial cold- and hot-wire laser cladding methods**

In the last few years, coaxial laser heads have been developed with centric wire feeding equipment, which enables the laser processing of complex-shaped objects in various applications. These newly developed laser heads are being used particularly in laser brazing experiments in the automotive industry. This study presents experimental results of using a coaxial laser head for cold- and hot-wire cladding application. The coaxial wire cladding method has significant improvements compared with the off-axis wire cladding method such as independence of the travel direction, alignment of the wire to the laser beam, and a reduced number of controlling parameters. These features are important to achieve high quality coatings. Cladding tests were conducted on mild steel with a coaxial laser wire welding head using Ni-based Inconel 625 and Thermanit 2509 super duplex stainless steel solid wires in order to determine the properties of the cladding process and the coatings deposited. The corrosion resistance of the obtained coatings was examined by long-term acetic acid salt spray (AASS) and electrochemical critical pitting temperature tests. The test results showed that by using the coaxial wire cladding method, defect-free high quality and corrosion resistant Inconel 625 and super duplex stainless steel coatings with low dilution were achieved. The average pitting temperature for Thermanit 2509 duplex coating was 75 °C in 1M NaCl solution, which was comparable to wrought 2507 duplex stainless steel. Low diluted Inconel 625 coating survived the AASS test for 2000 h without signs of corrosion.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Materials Science, Research group: Surface Engineering, Tampere University of Technology, Technology Centre Ketek Ltd.

Contributors: Pajukoski, H., Näkki, J., Thieme, S., Tuominen, J., Nowotny, S., Vuoristo, P.

Publication date: 2016

Peer-reviewed: Yes

Early online date: 8 Dec 2015

#### **Publication information**

Journal: Journal of Laser Applications

Volume: 28

Issue number: 1

Article number: 012011

ISSN (Print): 1042-346X

Ratings:

Scopus rating (2016): CiteScore 2 SJR 0.673 SNIP 1.233

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Electronic, Optical and Magnetic Materials, Biomedical Engineering, Instrumentation

Keywords: coaxial wire feed, hot-wire laser cladding, Inconel 625, super duplex stainless steel

DOIs:

10.2351/1.4936988

#### **Bibliographical note**

AUX=mol,"Pajukoski, H."

Source: Scopus

Source ID: 84950156186

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

#### **Improving reliability for classification of metallic objects using a WTMD portal**

In this paper, a walk-through metal detection (WTMD) portal is used for classification of metallic objects. The classification is based on the inversion of the magnetic polarisability tensor (tensor) of the object. The nature of bias and noise components in the tensor are examined by using real walk-through data, and consequently, a novel classifier is introduced. Furthermore, a novel method for detecting poorly inverted tensors is presented, enabling self-diagnostics for the WTMD portal. Based on the results, the novel methods increase the accuracy of metal object classification and have the potential to improve the reliability of a WTMD system.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Signal Processing, Research group: MMDM, Signal Processing Research Community (SPRC), School of Electrical and Electronic Engineering, University of Manchester, Rapiscan Systems Oy

Contributors: Makkonen, J., Marsh, L. A., Vihonen, J., Järvi, A., Armitage, D. W., Visa, A., Peyton, A. J.

Publication date: 26 Aug 2015

Peer-reviewed: Yes

### Publication information

Journal: Measurement Science and Technology

Volume: 26

Issue number: 10

Article number: 105103

ISSN (Print): 0957-0233

Ratings:

Scopus rating (2015): CiteScore 3.2 SJR 0.704 SNIP 1.396

Original language: English

ASJC Scopus subject areas: Applied Mathematics, Instrumentation

Keywords: bias, classification, eigenvalues, electromagnetic polarisability, noise, tensor, WTMD

DOIs:

10.1088/0957-0233/26/10/105103

Source: Scopus

Source ID: 84941975778

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

### In-flight wind field identification and prediction of parafoil systems

The wind field is an essential factor that affects accurate homing and flare landing of parafoil systems. In order to obtain the ambient wind field during the descent of a parafoil system, a combination method of in-flight wind field identification and prediction is proposed. First, a wind identification method only using global position system information is derived based on the flight dynamics of parafoil systems. Then a wind field prediction model is constructed using the atmospheric dynamics, and the low-altitude wind field is predicted based on the identified wind field of high-altitude. Finally, simulations of wind field identification and prediction are conducted. The results demonstrate that the proposed method can identify the wind fields precisely and also predict the wind fields reasonably. This method can potentially be applied in practical parafoil systems to provide wind field information for homing tasks.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research group: Predictive Society and Data Analytics (PSDA), Research group: Computational Medicine and Statistical Learning Laboratory (CMSL), Anhui Science and Technology University, Aalto University, Peking University, University of Applied Sciences Upper Austria, School of Management, Nankai University

Contributors: Gao, H., Tao, J., Dehmer, M., Emmert-Streib, F., Sun, Q., Chen, Z., Xie, G., Zhou, Q.

Number of pages: 15

Publication date: 2020

Peer-reviewed: Yes

### Publication information

Journal: Applied Sciences (Switzerland)

Volume: 10

Issue number: 6

Article number: 1958

ISSN (Print): 2076-3417

Original language: English

ASJC Scopus subject areas: Materials Science(all), Instrumentation, Engineering(all), Process Chemistry and Technology, Computer Science Applications, Fluid Flow and Transfer Processes

Keywords: Autonomous homing, Identification, Parafoil system, Prediction, Wind field

Electronic versions:

In-flight wind field identification 2020

DOIs:

10.3390/app10061958

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008266688>

Source: Scopus

Source ID: 85082646563

### **Inkjet printed, self powered, wireless sensors for environmental, gas, and authentication-based sensing**

In this paper, inkjet-printed flexible sensors fabricated on paper substrates are introduced as a system-level solution for ultra-low-cost mass production of UHF Radio Frequency Identification (RFID) Tags and wireless sensor nodes in a green approach that could be easily extended to other microwave and wireless applications. The authors briefly touch up the state-of-the-art area of fully integrated wireless sensor modules on paper and show several active and power scavenging platforms to power on wireless sensors that could potentially set the foundation for the truly convergent wireless sensor ad hoc networks of the future. Plus, the authors address the integration of carbon-nanotubes on paper substrates for the realization of ultra sensitive (parts per billion) gas sensors and present benchmarking results for various scavenging approaches involving solar and charge transfer-based mechanisms. Various challenges of packaging, passives, antennas, sensors and power sources integration are investigated in terms of ruggedness, reliability and flexibility performance for space, automotive, "smart-skin" and wearable applications.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, University of Waterloo, Texas Instruments, University of Perugia

Contributors: Vyas, R., Lakafosis, V., Lee, H., Shaker, G., Yang, L., Orecchini, G., Traille, A., Tentzeris, M. M., Roselli, L.

Number of pages: 14

Pages: 3139-3152

Publication date: 2011

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Sensors Journal

Volume: 11

Issue number: 12

Article number: 6008617

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2011): CiteScore 2.8 SJR 0.693 SNIP 1.648

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: Antennas, battery-less, carbon nanotube, green electronics, inkjet-printed electronics, low-power, passives, radio frequency (RF), radio frequency identification (RFID), sensor, solar, system-on-paper, system-onpackage (SOP), wireless

DOIs:

10.1109/JSEN.2011.2166996

URLs:

<http://www.scopus.com/inward/record.url?scp=80155122728&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 80155122728

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

### **Joint-Space Kinematic Model for Gravity-Referenced Joint Angle Estimation of Heavy-Duty Manipulators**

A gravity-referenced joint angle estimation, which acts in joint space, is proposed for multiple-degree-of-freedom hydraulic manipulators. As a novelty, the estimation pairs up inertial units across a section of an open kinematic chain. In this way, the three-axis linear accelerometers and the three-axis rate gyros provide a drift-free solution for observing the motion state of a rotary joint connecting two links without relying on the full forward kinematics. For a low-noise, low-delay estimate, the linear accelerations acting on the paired inertial units are modeled and robustly combined with the principles of complementary and Kalman filtering. In pick-and-place experiments with a serial-link manipulator on a multiton, off-road forestry vehicle, joint angle sensing error of less than  $1 \times 10^{-3}$  rad was achieved in spite of the dynamic interaction between the vehicle base and the terrain. Furthermore, the kinematic modeling's ability to compensate for the nonplanar, coupled 3-D linkage motion is studied for one- and two-axis rate measurements along with Cartesian path tracking. This gives new insights from the typical planar kinematic models and heavy-duty control viewpoints.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, Automation and Hydraulic Engineering, Research group: Mobile manipulation, Research group: MMDM

Contributors: Vihonen, J., Mattila, J., Visa, A.

Pages: 3280-3288  
Publication date: 2017  
Peer-reviewed: Yes

#### Publication information

Journal: IEEE Transactions on Instrumentation and Measurement  
Volume: 66  
Issue number: 12  
ISSN (Print): 0018-9456  
Ratings:

Scopus rating (2017): CiteScore 5.7 SJR 0.938 SNIP 1.917

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: Acceleration, Accelerometers, Couplings, Estimation, gyroscopes, Kinematics, kinematics, Manipulators, manipulators, microelectromechanical devices., Robot sensing systems

DOIs:

10.1109/TIM.2017.2749918

Source: Scopus

Source ID: 85030782867

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

#### Low-cost inkjet-printed fully passive RFID tags for calibration-free capacitive/haptic sensor applications

A fully passive, compact, and low-cost capacitive wireless radio frequency identification (RFID)-enabled sensing system for capacitive sensing and other Internet of Things applications is proposed. This calibration-free sensor utilizes a dual-tag topology, which consists of two closely spaced RFID tags with dipole antennas and printed capacitive sensor component connected to one of the tags. A series LC resonator is used to both reduce the antenna size and improve the isolation between the two antennas and the design/optimization steps are discussed in detail. All components except for the RFID chips are inkjet printed on an off-the-shelf photopaper using a silver nanoparticle ink. The complete sensor dimension is 84mm × 95mm and the sensor is compatible with EPC Class 1 Gen 2 (UHF) standard reader technology at 915 MHz.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, University of Tokyo , Centre Tecnologic de Telecomunicacions de Catalunya

Contributors: Kim, S., Kawahara, Y., Georgiadis, A., Collado, A., Tentzeris, M. M.

Number of pages: 11

Pages: 3135-3145

Publication date: 1 Jun 2015

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Sensors Journal

Volume: 15

Issue number: 6

Article number: 6945328

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2015): CiteScore 4.2 SJR 0.655 SNIP 1.821

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Instrumentation

Keywords: Capacitive sensing, cross-talk suppression, differential sensing, haptic sensors, inkjet-printing technology, Internet of Things (IoT), remote sensing, RFID, RFID-enabled sensor, wireless sensors

DOIs:

10.1109/JSEN.2014.2366915

URLs:

<http://www.scopus.com/inward/record.url?scp=84928112627&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84928112627

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

#### M2M Communication Assessment in Energy-Harvesting and Wake-Up Radio Assisted Scenarios Using Practical Components

Techniques for wireless energy harvesting (WEH) are emerging as a fascinating set of solutions to extend the lifetime of energy-constrained wireless networks, and are commonly regarded as a key functional technique for almost perpetual

communications. For example, with WEH technology, wireless devices are able to harvest energy from different light sources or Radio Frequency (RF) signals broadcast by ambient or dedicated wireless transmitters to support their operation and communications capabilities. WEH technology will have increasingly wider range of use in upcoming applications such as wireless sensor networks, Machine-to-Machine (M2M) communications, and the Internet of Things. In this paper, the usability and fundamental limits of joint RF and solar cell or photovoltaic harvesting based M2M communication systems are studied and presented. The derived theoretical bounds are in essence based on the Shannon capacity theorem, combined with selected propagation loss models, assumed additional link nonidealities, diversity processing, as well as the given energy harvesting and storage capabilities. Fundamental performance limits and available capacity of the communicating link are derived and analyzed, together with extensive numerical results evaluated in different practical scenarios, including realistic implementation losses and state-of-the-art printed supercapacitor performance figures with voltage doubler-based voltage regulator. In particular, low power sensor type communication applications using passive and semi-passive wake-up radio (WuR) are addressed in the study. The presented analysis principles and results establish clear feasibility regions and performance bounds for wireless energy harvesting based low rate M2M communications in the future IoT networks.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electronics and Communications Engineering, Nano Communication Centre, Department of Electrical and Computer Engineering, Ohio State University

Contributors: Rinne, J., Keskinen, J., Berger, P. R., Lupo, D., Valkama, M.

Publication date: 16 Nov 2018

Peer-reviewed: Yes

#### Publication information

Journal: Sensors (Basel, Switzerland)

Volume: 18

Issue number: 11

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2018): CiteScore 4.3 SJR 0.592 SNIP 1.642

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: diversity system, M2M communications, perpetual communications, propagation loss, Shannon limit, supercapacitor, wake-up radio, wireless energy harvesting

Electronic versions:

sensors-18-03992-v2

DOIs:

10.3390/s18113992

URLs:

<http://urn.fi/URN:NBN:fi:ty-201901071020>

Source: Scopus

Source ID: 85056711381

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

#### Measurement of sensitivity distribution map of a ferroelectret polymer film

ElectroMechanical Film (EMFi) is an electroactive ferroelectret polymer film with a special cellular structure. Sensitivity distribution maps of EMFi sensors were measured in this study. Seven EMFi sensors with evaporated gold electrodes, size 55 mm x 55 mm, were measured with a measurement grid spacing of 5 mm. The sensitivity is defined here as the charge generated by the EMFi sensor divided by the force applied to excite the sensor, and this is closely related to piezoelectric  $d_{33}$  coefficient. The sensitivity of EMFi was found to vary in different places of the sensors and between the measured sensors. This is presumably due to the relatively large gas voids and local corona breakdowns. The maximum and minimum sensitivities were found to vary around 30 % from the measured average sensitivity value. Thermally stimulated current (TSC) analysis confirmed the results obtained in the sensitivity distribution map measurements.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Automation Science and Engineering, Research area: Microsystems, Research area: Measurement Technology and Process Control, VTT Technical Research Centre of Finland

Contributors: Rajala, S., Paajanen, M., Lekkala, J.

Pages: 8517-8522

Publication date: 27 Sep 2016

Peer-reviewed: Yes

### Publication information

Journal: IEEE Sensors Journal

Volume: 16

Issue number: 23

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2016): CiteScore 4.4 SJR 0.654 SNIP 1.697

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: Electromechanical sensors, measurement, polymer films

DOIs:

10.1109/JSEN.2016.2613876

Source: Scopus

Source ID: 85027524810

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

### Measurement of the refractive index dispersion of $\text{As}_2\text{Se}_3$ bulk glass and thin films prior to and after laser irradiation and annealing using prism coupling in the near- and mid-infrared spectral range

The prism coupling technique has been utilized to measure the refractive index in the near- and mid-IR spectral region of chalcogenide glasses in bulk and thin film form. A commercial system (Metricon model 2010) has been modified with additional laser sources, detectors, and a new GaP prism to allow the measurement of refractive index dispersion over the 1.5-10.6 $\mu\text{m}$  range. The instrumental error was found to be 0.001 refractive index units across the entire wavelength region examined. Measurements on thermally evaporated AMTIR2 thin films confirmed that (i) the film deposition process provides thin films with reduced index compared to that of the bulk glass used as a target, (ii) annealing of the films increases the refractive index of the film to the level of the bulk glass used as a target to create it, and (iii) it is possible to locally increase the refractive index of the chalcogenide glass using laser exposure at 632.8 nm.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Frontier Photonics, School of Materials Science and Engineering COMSET, Pacific Northwest National Laboratory

Contributors: Carlie, N., Anheier, N. C., Qiao, H. A., Bernacki, B., Phillips, M. C., Petit, L., Musgraves, J. D., Richardson, K.

Publication date: May 2011

Peer-reviewed: Yes

### Publication information

Journal: Review of Scientific Instruments

Volume: 82

Issue number: 5

Article number: 053103

ISSN (Print): 0034-6748

Ratings:

Scopus rating (2011): CiteScore 2.6 SJR 0.868 SNIP 1.118

Original language: English

ASJC Scopus subject areas: Instrumentation

DOIs:

10.1063/1.3587616

URLs:

<http://www.scopus.com/inward/record.url?scp=79958074043&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 79958074043

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

### Methods for simultaneous robot-world-hand-eye calibration: A comparative study

In this paper, we propose two novel methods for robot-world-hand-eye calibration and provide a comparative analysis against six state-of-the-art methods. We examine the calibration problem from two alternative geometrical interpretations, called 'hand-eye' and 'robot-world-hand-eye', respectively. The study analyses the effects of specifying the objective function as pose error or reprojection error minimization problem. We provide three real and three simulated datasets with rendered images as part of the study. In addition, we propose a robotic arm error modeling approach to be used along with the simulated datasets for generating a realistic response. The tests on simulated data are performed in both ideal cases and with pseudo-realistic robotic arm pose and visual noise. Our methods show significant improvement and robustness on many metrics in various scenarios compared to state-of-the-art methods.



### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Computing Sciences, Remote Handling Project Team  
Contributors: Ali, I., Suominen, O., Gotchev, A., Morales, E. R.  
Publication date: 2 Jun 2019  
Peer-reviewed: Yes

### Publication information

Journal: Sensors (Switzerland)  
Volume: 19  
Issue number: 12  
Article number: 2837  
ISSN (Print): 1424-8220  
Ratings:  
Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586  
Original language: English  
ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering  
Keywords: Hand-eye calibration, Optimization, Robot-world-hand-eye calibration  
Electronic versions:  
sensors-19-02837-v2  
DOIs:  
10.3390/s19122837  
URLs:  
<http://urn.fi/URN:NBN:fi:tty-201909032055>  
Source: Scopus  
Source ID: 85068904338  
Research output: Contribution to journal > Article > Scientific > peer-review

### Metrics for polyphonic sound event detection

This paper presents and discusses various metrics proposed for evaluation of polyphonic sound event detection systems used in realistic situations where there are typically multiple sound sources active simultaneously. The system output in this case contains overlapping events, marked as multiple sounds detected as being active at the same time. The polyphonic system output requires a suitable procedure for evaluation against a reference. Metrics from neighboring fields such as speech recognition and speaker diarization can be used, but they need to be partially redefined to deal with the overlapping events. We present a review of the most common metrics in the field and the way they are adapted and interpreted in the polyphonic case. We discuss segment-based and event-based definitions of each metric and explain the consequences of instance-based and class-based averaging using a case study. In parallel, we provide a toolbox containing implementations of presented metrics.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Signal Processing, Research group: Audio research group  
Contributors: Mesaros, A., Heittola, T., Virtanen, T.  
Publication date: 2016  
Peer-reviewed: Yes

### Publication information

Journal: Applied Sciences  
Volume: 6  
Issue number: 6  
Article number: 162  
ISSN (Print): 2076-3417  
Ratings:  
Scopus rating (2016): SJR 0.315 SNIP 0.791  
Original language: English  
ASJC Scopus subject areas: Fluid Flow and Transfer Processes, Process Chemistry and Technology, Computer Science Applications, Engineering(all), Materials Science(all), Instrumentation  
Keywords: Audio content analysis, Audio signal processing, Computational auditory scene analysis, Evaluation of sound event detection, Everyday sounds, Pattern recognition, Polyphonic sound event detection, Sound events  
Electronic versions:  
Metrics for Polyphonic Sound Event Detection

DOIs:

10.3390/app6060162

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201607294341>

Source: Scopus

Source ID: 84973574836

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

### **Microwave assisted laser-induced breakdown spectroscopy at ambient conditions**

Signal enhancements in laser-induced breakdown spectroscopy (LIBS) using external microwave power are demonstrated in ambient air. Pulsed microwave at 2.45 GHz and of 1 millisecond duration was delivered via a simple near field applicator (NFA), with which an external electric field is generated and coupled into laser induced plasma. The external microwave power can significantly increase the signal lifetime from a few microseconds to hundreds of microseconds, resulting in a great enhancement on LIBS signals with the use of a long integration time. The dependence of signal enhancement on laser energy and microwave power is experimentally assessed. With the assistance of microwave source, a significant enhancement of ~ 100 was achieved at relatively low laser energy that is only slightly above the ablation threshold. A limit of detection (LOD) of 8.1 ppm was estimated for copper detection in Cu/Al<sub>2</sub>O<sub>3</sub> solid samples. This LOD corresponds to a 93-fold improvement compared with conventional single-pulse LIBS. Additionally, in the microwave assisted LIBS, the self-reversal effect was greatly reduced, which is beneficial in measuring elements of high concentration. Temporal measurements have been performed and the results revealed the evolution of the emission process in microwave-enhanced LIBS. The optimal position of the NFA related to the ablation point has also been investigated.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Applied Optics, Optics Laboratory, Department of Physics, Tampere University of Technology, University of Adelaide

Contributors: Viljanen, J., Sun, Z., Alwahabi, Z. T.

Number of pages: 8

Pages: 29-36

Publication date: 1 Apr 2016

Peer-reviewed: Yes

### **Publication information**

Journal: Spectrochimica Acta Part B: Atomic Spectroscopy

Volume: 118

ISSN (Print): 0584-8547

Ratings:

Scopus rating (2016): CiteScore 5.3 SJR 1.095 SNIP 1.351

Original language: English

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics, Analytical Chemistry, Spectroscopy

Keywords: Copper Detection, Laser-induced breakdown spectroscopy, Microwave signal enhancement

DOIs:

10.1016/j.sab.2016.02.002

Source: Scopus

Source ID: 84962861465

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

### **Molecular dynamics simulation of the damage production in Al (110) surface with slow argon ions**

We have developed a molecular dynamics simulation program to gain more insight into the sputtering process, especially the damage produced by it. We have studied the sputtering of aluminium (110) surface with argon ions. The Morse pair potential was used for Al-Al interaction, the Lennard-Jones potential for Ar-Ar interaction and both the Molière potential and the universal potential of Ziegler et al. for Ar-Al interaction. An electronic friction term proportional to the particle velocities was also used. The studied incident argon ion energies and angles were 200 and 400 eV and 0° (normal), 25°, 45° and 75°, respectively. The calculated sputtering yield and the overall shape and the mean depth of the vacancy profiles agree with the experimental results. The obtained profiles contain a narrow peak within the topmost atomic layers, followed by a weak tail deeper in the material. The interstitial and argon ion distributions are much more spread out at larger depths. The total number of vacancies per incident Ar<sup>+</sup> ion varies from 0 to 7, increasing as function of Ar<sup>+</sup> ion energy.

### **General information**

Publication status: Published

MoE publication type: Not Eligible  
Organisations: Jyväskylän yliopisto  
Contributors: Valkealahti, S., Nieminen, R. M.  
Number of pages: 5  
Pages: 365-369  
Publication date: 1 Jan 1986  
Peer-reviewed: Yes

#### Publication information

Journal: Nuclear Inst. and Methods in Physics Research, B  
Volume: 18  
Issue number: 1-6  
ISSN (Print): 0168-583X  
Original language: English  
ASJC Scopus subject areas: Nuclear and High Energy Physics, Instrumentation  
DOIs:  
10.1016/S0168-583X(86)80060-X  
Source: Scopus  
Source ID: 0022664315  
Research output: Contribution to journal › Article › Scientific › peer-review

#### New Evidence for the Mechanism of Action of a Type-2 Diabetes Drug Using a Magnetic Bead-Based Automated Biosensing Platform

The mechanism of action (MOA) of the first line type-2 diabetes drug metformin remains unclear despite its widespread usage. However, recent evidence suggests that the mitochondrial copper (Cu)-binding action of metformin may contribute toward the drug's MOA. Here, we present a novel biosensing platform for investigating the MOA of metformin using a magnetic microbead-based agglutination assay which has allowed us to demonstrate for the first time the interaction between Cu and metformin at clinically relevant low micromolar concentrations of the drug, thus suggesting a potential pathway of metformin's blood-glucose lowering action. In this assay, cysteine-functionalized magnetic beads were agglutinated in the presence of Cu due to cysteine's Cu-chelation property. Addition of clinically relevant doses of metformin resulted in disaggregation of Cu-bridged bead-clusters, whereas the effect of adding a closely related but blood-glucose neutral drug propanediimidamide (PDI) showed completely different responses to the clusters. The entire assay was integrated in an automated microfluidics platform with an advanced optical imaging unit by which we investigated these aggregation-disaggregation phenomena in a reliable, automated, and user-friendly fashion with total assay time of 17 min requiring a sample (metformin/PDI) volume of 30  $\mu$ L. The marked difference of Cu-binding action between the blood-glucose lowering drug metformin and its inactive analogue PDI thus suggests that metformin's distinctive Cu-binding properties may be required for its effect on glucose homeostasis. The novel automated platform demonstrating this novel investigation thus holds the potential to be utilized for investigating significant and sensitive molecular interactions via magnetic bead-based agglutination assay.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Chemistry and Bioengineering, Danmarks Tekniske Universitet, DTU Informatik, University of Dundee, Academia Sinica Taiwan  
Contributors: Uddin, R., Nur-E-Habiba, N., Rena, G., Hwu, E. T., Boisen, A.  
Number of pages: 8  
Pages: 1329-1336  
Publication date: 22 Sep 2017  
Peer-reviewed: Yes

#### Publication information

Journal: ACS Sensors  
Volume: 2  
Issue number: 9  
ISSN (Print): 1424-8220  
Ratings:  
Scopus rating (2017): CiteScore 4.3 SJR 0.584 SNIP 1.593  
Original language: English  
ASJC Scopus subject areas: Bioengineering, Fluid Flow and Transfer Processes, Process Chemistry and Technology, Instrumentation  
Keywords: agglutination assay, biosensor, magnetic beads, metformin, molecular interactions, optical imaging, type-2 diabetes  
DOIs:  
10.1021/acssensors.7b00384

### Bibliographical note

INT=keb,"Nur-E-Habiba, N."

Source: Scopus

Source ID: 85029817525

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

### Noncontact Respiration Monitoring during Sleep with Microwave Doppler Radar

This paper demonstrates the measurement of respiration waveform during sleep with a noncontact radar sensor. Instead of measuring only the respiration rate, the methods that allow monitoring the absolute respiration displacement were studied. Absolute respiration displacement can in theory be measured with a quadrature microwave Doppler radar sensor and using the nonlinear demodulation as the channel combining method. However, in this paper, relative respiration displacement measures were used as a reference. This is the first time that longer data sets have been analyzed successfully with the nonlinear demodulation method. This paper consists of whole-night recordings of three patients in an uncontrolled environment. The reference respiration data were obtained from a full polysomnography recorded simultaneously. The feasibility of the nonlinear demodulation in a real-life setting has been unclear. However, this paper shows that it is successful most of the time. The coverage of successfully demodulated radar data was ~ 58 %-78%. The use of the nonlinear demodulation is not possible in the following cases: 1) if the chest wall displacement is too small compared with the wavelength of the radar; 2) if the radar data do not form an arc-like shape in the IQ\$-plot; or 3) if there are large movement artifacts present in the data. Both in academic literature and in commercial radar devices, the data are processed based on the presumption that it forms either an arc or a line in the IQ-plot. Our measurements show that the presumption is not always valid.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Electronics and Communications Engineering, Research group: Personal Electronics Group, Department of Automation Science and Engineering, Research area: Microsystems, Research area: Measurement Technology and Process Control, Augmented Human Activities (AHA), Integrated Technologies for Tissue Engineering Research (ITTE)

Contributors: Zakrzewski, M., Vehkaoja, A., Joutsen, A. S., Palovuori, K. T., Vanhala, J. J.

Number of pages: 11

Pages: 5683-5693

Publication date: 1 Oct 2015

Peer-reviewed: Yes

### Publication information

Journal: IEEE Sensors Journal

Volume: 15

Issue number: 10

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2015): CiteScore 4.2 SJR 0.655 SNIP 1.821

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Instrumentation

Keywords: breathing patterns, Doppler radar, non-contact respiration measurement, radar measurements

Electronic versions:

Noncontact Respiration Monitoring During Sleep With Microwave Doppler Radar

DOIs:

10.1109/JSEN.2015.2446616

URLs:

<http://urn.fi/URN:NBN:fi:ty-201901111055>

URLs:

<http://www.scopus.com/inward/record.url?scp=84939488373&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

ORG=elt,0.75

ORG=ase,0.25

Source: Scopus

Source ID: 84939488373

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

### Non-destructive and wireless monitoring of biodegradable polymers

A method for monitoring changes in biodegradable polymers during hydrolysis is proposed. This wireless and non-destructive method is based on inductively coupled passive resonance sensors embedded in the polymer shell. In this study, we prepared specimens using two poly(lactide-co-glycolide) copolymers possessing different degradation profiles.

The copolymer embedded sensors were immersed in buffer solution and their resonance features were compared with periodically performed conventional polymer characterization methods. A clear difference was noticed in the wirelessly measured signals between the two tested copolymer materials. Also the reference methods showed clear differences between the degradation profiles of the copolymers. The wirelessly measured signals are likely to correlate to the structural changes in the materials during the hydrolysis. In the future, this technique could be used in the laboratory to provide easy-to-access in situ information about the polymers. Even the state of biodegradable polymer implants could be wirelessly monitored.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB), Research group: Biomaterials and Tissue Engineering Group, BioMediTech

Contributors: Salpavaara, T., Hänninen, A., Antniemi, A., Lekkala, J., Kellomäki, M.

Pages: 1018-1025

Publication date: 2017

Peer-reviewed: Yes

### Publication information

Journal: Sensors and Actuators B: Chemical

Volume: 251

ISSN (Print): 0925-4005

Ratings:

Scopus rating (2017): CiteScore 9.3 SJR 1.406 SNIP 1.453

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Instrumentation, Condensed Matter Physics, Surfaces, Coatings and Films, Metals and Alloys, Materials Chemistry, Electrical and Electronic Engineering

Keywords: Biodegradable polymers, Passive resonance sensor, Poly(lactide-co-glycolide), Telemetry, Wireless monitoring

Electronic versions:

non\_destructive\_and\_wireless\_2018. Embargo ended: 25/07/19

DOIs:

10.1016/j.snb.2017.05.116

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910234047>

Source: Scopus

Source ID: 85020132649

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

### Optimal emission enhancement in orthogonal double-pulse laser-induced breakdown spectroscopy

Abstract Orthogonal double-pulse (DP) laser-induced breakdown spectroscopy (LIBS) was performed using reheating and pre-ablative configurations. The ablation pulse power density was varied by two orders of magnitude and the DP experiments were carried out for a wide range of interpulse delays. For both DP-LIBS schemes, the signal enhancement was evaluated with respect to the corresponding single-pulse (SP) LIBS as a function of the interpulse delay. The reheating scheme shows a sharp maximum signal enhancement of up to 200-fold for low ablative power densities ( $0.4 \text{ GW cm}^{-2}$ ); however, for power densities larger than  $10 \text{ GW cm}^{-2}$  this configuration did not improve the SP outcome. On the other hand, a more uniform signal enhancement of about 4-6 was obtained for the pre-ablative scheme nearly independently of the used ablative power density. In terms of the signal-to-noise ratio (SNR) the pre-ablative scheme shows a monotonic increment with the ablative power density. Whereas the reheating configuration reaches a maximum at  $2.2 \text{ GW cm}^{-2}$ , its enhancement effect collapses markedly for fluencies above  $10 \text{ GW cm}^{-2}$ .

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Physics, Research area: Optics, Research group: Applied Optics, Centro de Ciencias Aplicadas y Desarrollo Tecnológico, Universidad Nacional Autónoma de México (CCADET-UNAM), Cátedra CONACyT, Centro de Nanociencias y Nanotecnología, Universidad Nacional Autónoma de México, Universidad Autónoma Metropolitana-Unidad Azcapotzalco

Contributors: Sanginés, R., Contreras, V., Sobral, H., Robledo-Martinez, A.

Number of pages: 7

Pages: 139-145

Publication date: 6 Jul 2015

Peer-reviewed: Yes

### Publication information

Journal: Spectrochimica Acta Part B: Atomic Spectroscopy  
Volume: 110  
Article number: 4935  
ISSN (Print): 0584-8547  
Ratings:

Scopus rating (2015): CiteScore 4.9 SJR 0.999 SNIP 1.414

Original language: English

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics, Analytical Chemistry, Spectroscopy

Keywords: Double-pulse, Emission enhancement, LIBS

DOIs:

10.1016/j.sab.2015.06.012

URLs:

<http://www.scopus.com/inward/record.url?scp=84934759672&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84934759672

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

### **Passive Moisture Sensor Based on Conductive and Water-Soluble Yarns**

In this paper, we establish a new type of passive ultra-high-frequency (UHF) radio frequency identification (RFID) technology-based moisture sensor. The sensor system consists of a sensor tag and a reference tag to indicate exposure to moisture. The sensor tag is fabricated on a cotton substrate from conductive silver yarn and water-soluble polyvinyl alcohol (PVA) yarn. When the sensor is exposed to water, the PVA yarn will melt, which causes a permanent change to the tag antenna body and to the wireless performance of the sensor tag. By measuring the backscattered power strength difference,  $\Delta P$ , the presence of moisture can be detected and recorded. When  $\Delta P$  is below 0, the sensor system shows that it has been in a highly moist condition. Our PVA-based moisture-sensing system can provide cost-effective and maintenance-free monitoring of moisture exposure for versatile application fields.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group, City University of Hong Kong

Contributors: Chen, X., He, H., Gou, M., Yang, Y., Sydänheimo, L., Ukkonen, L., Virkki, J.

Number of pages: 7

Pages: 10989-10995

Publication date: 15 Sep 2020

Peer-reviewed: Yes

#### **Publication information**

Journal: IEEE Sensors Journal

Volume: 20

Issue number: 18

ISSN (Print): 1530-437X

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: Embroidery, moisture sensor, passive UHF RFID technology, polyvinyl alcohol, wireless sensor, zero-energy sensor

DOIs:

10.1109/JSEN.2020.2994449

Source: Scopus

Source ID: 85090216624

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

### **Passive resonance sensor based method for monitoring particle suspensions**

Control of particle suspensions is needed in several modern industrial processes. A reason for the difficulty in this task has been the lack of a fast and reliable measurement. In this study, we tested the measurement of particle suspension by using a method based on a passive resonance sensor. The relative amounts of dispersing agent and aluminium oxide in the suspension were varied. The studied method yielded signals which depended on the complex permittivity of the suspension. The results indicated that we were able to measure information that can be used as feedback for the suspension preparation process. In addition, the tested instrumentation was simple and robust and thus this method may allow online measurements directly from the industrial processes.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Department of Automation Science and Engineering, Research area: Microsystems, Research area: Measurement Technology and Process Control, Department of Materials Science, Research group: Ceramic materials, Engineering materials science and solutions (EMASS), Integrated Technologies for Tissue Engineering Research (ITTE), Smart Energy Systems (SES)

Contributors: Salpavaara, T., Järveläinen, M., Seppälä, S., Yli-Hallila, T., Verho, J., Vilkkö, M., Lekkala, J., Levänen, E.

Number of pages: 7

Pages: 324-330

Publication date: 8 Jun 2015

Peer-reviewed: Yes

### Publication information

Journal: Sensors and Actuators B: Chemical

Volume: 219

ISSN (Print): 0925-4005

Ratings:

Scopus rating (2015): CiteScore 7.4 SJR 1.225 SNIP 1.486

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Condensed Matter Physics, Electronic, Optical and Magnetic Materials, Metals and Alloys, Surfaces, Coatings and Films, Materials Chemistry, Instrumentation

Keywords: Complex permittivity, Inductive coupling, Passive resonance sensor, Slurry, Suspension

DOIs:

10.1016/j.snb.2015.04.121

URLs:

<http://www.scopus.com/inward/record.url?scp=84930646590&partnerID=8YFLogxK> (Link to publication in Scopus)

### Bibliographical note

ORG=ase,0.5

ORG=mol,0.5

Source: Scopus

Source ID: 84930646590

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

### Piezoresistive natural rubber-multiwall carbon nanotube nanocomposite for sensor applications

We explore, both experimentally and theoretically, the possibility to use a composite of natural rubber (NR) and multiwall carbon nanotubes (MWCNT) as a piezoresistive tensile sensor. As an essentially new feature relative to the previous work, we have performed a systematic study of the mechanism of the piezoresistance at large deformations in a wide range of MWCNT concentrations and crosslinking degrees of the host rubber material. In qualitative agreement with the previous work, the conductivity of the unstrained NR/MWCNT nanocomposite is shown to be adequately described by the percolation theory with the critical exponent evaluated to  $\sim 2.31$ . Varying tensile stress-induced strains in the composite has been shown to result in a non-linear electrical response that cannot be described by simple modifications of the percolation theory. In order to explain the observed non-linear dependence of the resistance  $R$  of the composite on the strain  $\epsilon$ , we have developed a scaling theory that relates this resistance to the structural changes in the conducting MWCNT network caused by deforming the host NR. Based on the obtained results, we discuss the ways of using the highly stretchable conductive elastomer composites as an efficient piezoresistive tensile sensor.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science, Rubber Technology Centre, Indian Institute of Technology Kharagpur, Vodafone Department of Mobile Communications Systems, University of Münster, Leibniz-Institut für Polymerforschung Dresden E.V.

Contributors: Selvan, N. T., Eshwaran, S. B., Das, A., Stöckelhuber, K. W., Wießner, S., Pötschke, P., Nando, G. B., Chervanyov, A. I., Heinrich, G.

Number of pages: 12

Pages: 102-113

Publication date: 1 Mar 2016

Peer-reviewed: Yes

### Publication information

Journal: Sensors and Actuators, A: Physical

Volume: 239

ISSN (Print): 0924-4247

Ratings:

Scopus rating (2016): CiteScore 4.8 SJR 0.787 SNIP 1.619

Original language: English

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Instrumentation, Condensed Matter Physics, Surfaces, Coatings and Films, Metals and Alloys, Electrical and Electronic Engineering

Keywords: Sensor rubber filler strain nano-composite conductivity

DOIs:

10.1016/j.sna.2016.01.004

Source: Scopus

Source ID: 84955467512

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

### **Polarization control of the bound state of a vector soliton**

This article demonstrates that the number of pulses in a group of vector bound solitons can be accurately adjusted by polarization control. We could achieve states with up to seven pulses trapped in a group with equally firm pulse separation. The stable relative phase between pulses within the group is manifested as an interference pattern in the soliton spectrum. © 2013 Astro Ltd.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Research group: Ultrafast and intense lasers, Optoelectronics Research Centre, Frontier Photonics

Contributors: Gumenyuk, R., Okhotnikov, O. G.

Number of pages: 3

Pages: 1-3

Publication date: May 2013

Peer-reviewed: Yes

### **Publication information**

Journal: Laser Physics Letters

Volume: 10

Issue number: 5

Article number: 055111

ISSN (Print): 1612-2011

Ratings:

Scopus rating (2013): CiteScore 7.8 SJR 1.418 SNIP 1.667

Original language: English

ASJC Scopus subject areas: Physics and Astronomy (miscellaneous), Instrumentation

DOIs:

10.1088/1612-2011/10/5/055111

URLs:

<http://www.scopus.com/inward/record.url?scp=84879033640&partnerID=8YFLogxK> (Link to publication in Scopus)

### **Bibliographical note**

Contribution: organisation=orc,FACT1=1<br/>Portfolio EDEND: 2013-07-29<br/>Publisher name: Institute of Physics Publishing

Source: researchoutputwizard

Source ID: 2201

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

### **Positioning information privacy in intelligent transportation systems: An overview and future perspective**

Today, the Intelligent Transportation Systems (ITS) are already in deep integration phase all over the world. One of the most significant enablers for ITS are vehicle positioning and tracking techniques. Worldwide integration of ITS employing Dedicated Short Range Communications (DSRC) and European standard for vehicular communication, known as ETSI ITS-G5, brings a variety of options to improve the positioning in areas where GPS connectivity is lacking precision. Utilization of the ready infrastructure, next-generation cellular 5G networks, and surrounding electronic devices together with conventional positioning techniques could become the solution to improve the overall ITS operation in vehicle-to-everything (V2X) communication scenario. Nonetheless, effective and secure communication protocols between the vehicle and roadside units should be both analyzed and improved in terms of potential attacks on the transmitted positioning-related data. In particular, said information might be misused or stolen at the infrastructure side conventionally assumed to be trusted. In this paper, we first survey different methods of vehicle positioning, which is followed by an overview of potential attacks on ITS systems. Next, we propose potential improvements allowing mutual authentication between the vehicle and infrastructure aiming at improving positioning data privacy. Finally, we propose a vision on the development and standardization aspects of such systems.



### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electrical Engineering, St. Petersburg State University of Aerospace Instrumentation, ITMO University, Brno University of Technology

Contributors: Ometov, A., Bezzateev, S., Davydov, V., Shchesniak, A., Masek, P., Lohan, E. S., Koucheryavy, Y.

Publication date: 1 Apr 2019

Peer-reviewed: Yes

### Publication information

Journal: Sensors

Volume: 19

Issue number: 7

Article number: 1603

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Atomic and Molecular Physics, and Optics, Biochemistry, Instrumentation, Electrical and Electronic Engineering

Keywords: Authentication, Data privacy, GDPR, Intelligent transportation systems, Positioning

Electronic versions:

sensors-19-01603

DOIs:

10.3390/s19071603

URLs:

<http://urn.fi/URN:NBN:fi:ty-201906111889>

Source: Scopus

Source ID: 85064829981

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

### Ranges and stopping power of KeV electrons in the solid hydrogens

1-3 keV electron ranges and stopping power in the solid hydrogens have been investigated by the Monte Carlo simulation method on the basis of experimental thin film measurements. In the simulation, elastic scattering cross sections are calculated exactly using the single-atom crystalline potentials. Inelastic processes for gold are treated by modifying Gryziński's semiempirical expression for each core and valence electron excitation. For H<sub>2</sub> the ionization cross section from Green and Sawada is applied together with the gas phase stopping power from Parkš et al. Simulations of electron penetration in a layer of solid hydrogen on a gold substrate with normal incidence and reflection from bulk hydrogen with different angles of incidence are fitted to experimental measurements by adjusting the stopping power of electrons in solid hydrogen. It is found to be 0.75 times the stopping power for the gas phase. The mean path length and mean penetration depth of electrons in solid hydrogen are determined from the simulations with this modified stopping power. Also the full penetration depth distributions are presented as well as their Gaussian parametrizations. The previously determined measured projected range is almost equal to the calculated mean path length.

### General information

Publication status: Published

MoE publication type: Not Eligible

Organisations: Association EURATOM - Risø National Laboratory, Risø Campus, Aalto University

Contributors: Valkealahti, S., Schou, J., Sørensen, H., Nieminen, R. M.

Number of pages: 11

Pages: 321-331

Publication date: 1 Jan 1988

Peer-reviewed: Yes

### Publication information

Journal: Nuclear Inst. and Methods in Physics Research, B

Volume: 34

Issue number: 3

ISSN (Print): 0168-583X

Original language: English

ASJC Scopus subject areas: Nuclear and High Energy Physics, Instrumentation

DOIs:

10.1016/0168-583X(88)90052-3

Source: Scopus

Source ID: 0024082640

### **Rapid and sensitive detection of norovirus antibodies in human serum with a biolayer interferometry biosensor**

Here, we describe the use of a biolayer interferometry biosensor for the fast and sensitive detection of virus-specific antibodies from human serum samples. Norovirus-like particles and norovirus P-particles were used to functionalise the biosensor tip. The detection of antibodies directly from serum samples was challenging, but the addition of a metal chelator (DAB) combined with an anti-human horseradish peroxidase-tagged antibody enabled enhanced detection of virus-specific antibodies in serum dilutions up to 1:100,000. Biolayer interferometry provides results faster than an ELISA, with results in as little as 10-20 min when using pre-functionalised sensors. Therefore, biolayer interferometry combined with DAB enhancement offers an attractive method for quick and sensitive quantification of biomolecules from complicated sample matrices.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Multi-scaled biodata analysis and modelling (MultiBAM), Fimlab Laboratories Ltd

Contributors: Auer, S., Koho, T., Uusi-Kerttula, H., Vesikari, T., Blazevic, V., Hytönen, V. P.

Number of pages: 8

Pages: 507-514

Publication date: 31 Dec 2015

Peer-reviewed: Yes

#### **Publication information**

Journal: Sensors and Actuators B: Chemical

Volume: 221

ISSN (Print): 0925-4005

Ratings:

Scopus rating (2015): CiteScore 7.4 SJR 1.225 SNIP 1.486

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Condensed Matter Physics, Electronic, Optical and Magnetic Materials, Metals and Alloys, Surfaces, Coatings and Films, Materials Chemistry, Instrumentation

Keywords: Biolayer interferometry, Fast diagnostics, Non-labelled detection, Norovirus, P-particles, Virus-like particles (VLPs)

DOIs:

10.1016/j.snb.2015.06.088

URLs:

<http://www.scopus.com/inward/record.url?scp=84956972181&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84956972181

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

### **Restoration of low-dose digital breast tomosynthesis**

In breast cancer screening, the radiation dose must be kept to the minimum necessary to achieve the desired diagnostic objective, thus minimizing risks associated with cancer induction. However, decreasing the radiation dose also degrades the image quality. In this work we restore digital breast tomosynthesis (DBT) projections acquired at low radiation doses with the goal of achieving a quality comparable to that obtained from current standard full-dose imaging protocols. A multiframe denoising algorithm was applied to low-dose projections, which are filtered jointly. Furthermore, a weighted average was used to inject a varying portion of the noisy signal back into the denoised one, in order to attain a signal-to-noise ratio comparable to that of standard full-dose projections. The entire restoration framework leverages a signal-dependent noise model with quantum gain which varies both upon the projection angle and on the pixel position. A clinical DBT system and a 3D anthropomorphic breast phantom were used to validate the proposed method, both on DBT projections and slices from the 3D reconstructed volume. The framework is shown to attain the standard full-dose image quality from data acquired at 50% lower radiation dose, whereas progressive loss of relevant details compromises the image quality if the dosage is further decreased.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Signal Processing, University of São Paulo, Noiseless Imaging Ltd, University of Pennsylvania

Contributors: Borges, L. R., Azzari, L., Bakic, P. R., Maidment, A. D., Vieira, M. A., Foi, A.

Publication date: 19 Apr 2018

Peer-reviewed: Yes

#### **Publication information**

Journal: Measurement Science and Technology

Volume: 29

Issue number: 6

Article number: 064003

ISSN (Print): 0957-0233

Ratings:

Scopus rating (2018): CiteScore 3.3 SJR 0.57 SNIP 1.268

Original language: English

ASJC Scopus subject areas: Instrumentation, Engineering (miscellaneous), Applied Mathematics

Keywords: denoising, digital breast tomosynthesis, dose reduction, variance stabilization

Electronic versions:

Borges-DBT\_Restoration-IOPMST2018. Embargo ended: 19/04/19

DOIs:

10.1088/1361-6501/aab2f6

URLs:

<http://urn.fi/URN:NBN:fi:ty:201807252021>. Embargo ended: 19/04/19

Source: Scopus

Source ID: 85047322570

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

### RFID-based sensors for zero-power autonomous wireless sensor networks

Radio frequency identification (RFID) technology has enabled a new class of low cost, wireless zero-power sensors, which open up applications in highly pervasive and distributed RFID-enabled sensing, which were previously not feasible with wired or battery powered wireless sensor nodes. This paper provides a review of RFID sensing techniques utilizing chip-based and chipless RFID principles, and presents a variety of implementations of RFID-based sensors, which can be used to detect strain, temperature, water quality, touch, and gas.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Georgia Institute of Technology, School of Electrical and Computer Engineering, LAAS-CNRS

Contributors: Cook, B. S., Vyas, R., Kim, S., Thai, T., Le, T., Traile, A., Aubert, H., Tentzeris, M. M.

Number of pages: 13

Pages: 2419-2431

Publication date: 2014

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Sensors Journal

Volume: 14

Issue number: 8

Article number: 6701187

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2014): CiteScore 4.2 SJR 0.775 SNIP 1.875

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: inkjet printing, mmwave, RFID, Wireless sensors

DOIs:

10.1109/JSEN.2013.2297436

URLs:

<http://www.scopus.com/inward/record.url?scp=84903626370&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84903626370

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

### RFID-Based Wireless Passive Sensors Utilizing Cork Materials

This paper presents the design of low-cost, conformal UHF antennas and RFID tags on two types of cork substrates: 1) natural cork and 2) agglomerate cork. Such RFID tags find an application in wine bottle and barrel identification, and in addition, they are suitable for numerous antenna-based sensing applications. This paper includes the high-frequency characterization of the selected cork substrates considering the anisotropic behavior of such materials. In addition, the variation of their permittivity values as a function of the humidity is also verified. As a proof-of-concept demonstration, three conformal RFID tags have been implemented on cork, and their performance has been evaluated using both a

commercial Alien ALR8800 reader and an in-house measurement setup. The reading of all tags has been checked, and a satisfactory performance has been verified, with reading ranges spanning from 0.3 to 6 m. In addition, this paper discusses how inkjet printing can be applied to cork surfaces, and an RFID tag printed on cork is used as a humidity sensor. Its performance is tested under different humidity conditions, and a good range in excess of 3 m has been achieved, allied to a good sensitivity obtained with a shift of >5 dB in threshold power of the tag for different humid conditions.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), Universidade de Aveiro, Centre Tecnologic de Telecomunicacions de Catalunya, Instituto Superior de Engenharia de Lisboa, Georgia Institute of Technology

Contributors: Gonçalves, R., Rima, S., Magueta, R., Pinho, P., Collado, A., Georgiadis, A., Hester, J., Carvalho, N. B., Tentzeris, M. M.

Number of pages: 10

Pages: 7242-7251

Publication date: 1 Dec 2015

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Sensors Journal

Volume: 15

Issue number: 12

Article number: 7222363

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2015): CiteScore 4.2 SJR 0.655 SNIP 1.821

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: cork characterization, humidity sensor, inkjet printing, passive sensor, UHF RFID, wireless sensor

DOIs:

10.1109/JSEN.2015.2472980

URLs:

<http://www.scopus.com/inward/record.url?scp=84960192714&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84960192714

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

#### Round Robin computer simulation of ejection probability in sputtering

We have studied the ejection of a copper atom through a planar copper surface as a function of recoil velocity and depth of origin. Results were obtained from six molecular dynamics codes, four binary collision lattice simulation codes, and eight Monte Carlo codes. Most results were found with a Born-Mayer interaction potential between the atoms with Gibson 2 parameters and a planar surface barrier, but variations on this standard were allowed for, as well as differences in the adopted cutoff radius for the interaction potential, electronic stopping, and target temperature. Large differences were found between the predictions of the various codes, but the cause of these differences could be determined in most cases. A fairly clear picture emerges from all three types of codes for the depth range and the angular range for ejection at energies relevant to sputter ejection, although a quantitative discussion would have to include an analysis of replacement collision events which has been left out here.

#### General information

Publication status: Published

MoE publication type: Not Eligible

Organisations: University of Southern Denmark, Oak Ridge National Laboratory, Sandia National Laboratories, California, Yliopisto-lehti: Helsingin yliopiston tiedelehti, Tsinghua University, Max-Planck-Institut für Plasmaphysik, Okayama University of Science, Hitachi Ltd., Moscow State University, Naval Postgraduate School, Institute of Electronics Bulgarian Academy of Sciences, Osaka University, Jyväskylän yliopisto, TU Vienna, California State University, Fullerton, Technische Universität Braunschweig

Contributors: Sigmund, P., Robinson, M. T., Baskes, M. I., Hautala, M., Cui, F. Z., Eckstein, W., Yamamura, Y., Hosaka, S., Ishitani, T., Shulga, V. I., Harrison, D. E., Chakarov, I. R., Karpuzo, D. S., Kawatoh, E., Shimizu, R., Valkealahti, S., Nieminen, R. M., Betz, G., Husinsky, W., Shapiro, M. H., Vicanek, M., Urbassek, H. M.

Number of pages: 14

Pages: 110-123

Publication date: 1 Feb 1989

Peer-reviewed: Yes

### Publication information

Journal: Nuclear Inst. and Methods in Physics Research, B  
Volume: 36  
Issue number: 2  
ISSN (Print): 0168-583X  
Original language: English  
ASJC Scopus subject areas: Nuclear and High Energy Physics, Instrumentation  
DOIs:  
10.1016/0168-583X(89)90573-9  
Source: Scopus  
Source ID: 0008335191  
Research output: Contribution to journal › Article › Scientific › peer-review

### Screen-printed curvature sensors for soft robots

Castable elastomers have been used to fabricate soft robotic devices and it has been shown that the technique scales well from prototyping to mass manufacturing. However, similarly scalable techniques for integrating strain or curvature sensors into such devices are still lacking. In this paper, we show that screenprinted silver conductors serve well as curvature sensors for soft robotic devices. The sensors are produced onto elastomer substrates in a single printing step and integrated into soft pneumatic actuators. We characterized the resistance-curvature relationship of the sensors, which allows the curvature of the actuators to be estimated from the sensor measurements. Hysteresis was observed, which does limit the absolute accuracy of the sensors. However, temperature characterizations showed that the sensor measurements are not significantly affected by temperature fluctuations during normal operation. Dynamic experiments showed that the bandwidth of the sensors is larger than the bandwidth of the actuators. We experimentally validated that these sensors can be used to detect whether the motion of an actuator has been blocked, clearing the way towards simple-to-fabricate soft robots that react to their surroundings. Finally, we demonstrate a three-fingered soft robotic gripper with integrated sensors. We conclude that screen-printing is a promising way to integrate curvature sensors into soft robots.

### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Faculty of Biomedical Sciences and Engineering, Electronics and Communications Engineering, Research group: Wireless Communications and Positioning, Research group: Micro and Nanosystems Research Group, Research group: Bioinspired Materials and Robotics (BMR)  
Contributors: Koivikko, A., Raei, E. S., Mosallaei, M., Mäntysalo, M., Sariola, V.  
Pages: 223-230  
Publication date: 2018  
Peer-reviewed: Yes

### Publication information

Journal: IEEE Sensors Journal  
Volume: 18  
Issue number: 1  
ISSN (Print): 1530-437X  
Ratings:  
Scopus rating (2018): CiteScore 5.8 SJR 0.726 SNIP 1.753  
Original language: English  
ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering  
Keywords: Actuators, Electrical resistance measurement, Flexible printed circuit, Mechanical Sensors, Sensor phenomena and characterization, Silver, Soft robotics, Strain measurement, Temperature measurement  
Electronic versions:  
08080224  
DOIs:  
10.1109/JSEN.2017.2765745  
URLs:  
<http://urn.fi/URN:NBN:fi:ty-201711202174>  
Source: Scopus  
Source ID: 85032437182  
Research output: Contribution to journal › Article › Scientific › peer-review

### Secure and connected wearable intelligence for content delivery at a mass event: A case study

Presently, smart and connected wearable systems, such as on-body sensors and head-mounted displays, as well as other small form factor but powerful personal computers are rapidly pervading all areas of our life. Motivated by the opportunities that next-generation wearable intelligence is expected to provide, the goal of this work is to build a comprehensive understanding around some of the user-centric security and trust aspects of the emerging wearable and close-to-body

wireless systems operating in mass events and under heterogeneous conditions. The paper thus intends to bring the attention of the research community to this emerging paradigm and discuss the pressing security and connectivity challenges within a popular consumer context. Our selected target scenario is that of a sports match, where wearable-equipped users may receive their preferred data over various radio access protocols. We also propose an authentication framework that allows for delivery of the desired content securely within the considered ecosystem.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Electronics and Communications Engineering, Pervasive Computing, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, Research area: Information security, Research group: Wireless Communications and Positioning, ITMO University

Contributors: Ometov, A., Solomitckii, D., Olsson, T., Bezzateev, S., Shchesniak, A., Andreev, S., Harju, J., Koucheryavy, Y.

Publication date: 1 Jun 2017

Peer-reviewed: Yes

#### Publication information

Journal: Journal of Sensor and Actuator Networks

Volume: 6

Issue number: 2

Article number: 5

ISSN (Print): 2224-2708

Ratings:

Scopus rating (2017): CiteScore 2.4 SNIP 0.887

Original language: English

ASJC Scopus subject areas: Computer Networks and Communications, Control and Optimization, Instrumentation

Keywords: Authentication, Challenges, Mass event, Security, Wearables, WiGig, Wireless

Electronic versions:

jsan-06-00005

DOIs:

10.3390/jsan6020005

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201710091990>

Source: Scopus

Source ID: 85029506641

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

#### Sensitivity modeling of an RFID-based strain-sensing antenna with dielectric constant change

An radiofrequency identification (RFID)-based folded patch antenna has been developed as a novel passive wireless sensor to measure surface strain and crack, for the structural health monitoring of metallic structures. Up to 2.5 m of read range is achieved by a proof-of-concept prototype patch antenna sensor with a strain sensitivity around  $-760 \text{ Hz}/\mu \epsilon$ , which is equivalent to a normalized strain sensitivity of  $-0.74 \text{ ppm}/\mu \epsilon$ . In this paper, we propose to consider the change of the substrate dielectric constant due to strain when modeling the antenna sensor. An enhanced strain sensitivity model is introduced for more accurately estimating the strain sensing performance of the hereby introduced smart skin antenna sensor. Laboratory experiments are carried out to quantify the dielectric constant change under strain. The measurement results are incorporated into a mechanics-electromagnetics coupled simulation model. Accuracy of the multi-physics coupled simulation is improved by integrating dielectric constant change in the model.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Sensing Systems for Wireless Medicine (MediSense), ExxonMobil Upstream Research Company, DirecTV, Georgia Institute of Technology, Georgia Institute of Technology, School of Electrical and Computer Engineering

Contributors: Yi, X., Wu, T., Wang, Y., Tentzeris, M. M.

Number of pages: 9

Pages: 6147-6155

Publication date: 1 Nov 2015

Peer-reviewed: Yes

#### Publication information

Journal: IEEE Sensors Journal

Volume: 15

Issue number: 11

Article number: 7152827

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2015): CiteScore 4.2 SJR 0.655 SNIP 1.821

Original language: English

ASJC Scopus subject areas: Electrical and Electronic Engineering, Instrumentation

Keywords: antenna sensor, dielectric constant change, Folded patch antenna, RFID sensor, smart skin, strain sensing, structural health monitoring, wireless sensor

DOIs:

10.1109/JSEN.2015.2453947

URLs:

<http://www.scopus.com/inward/record.url?scp=84941557336&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84941557336

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

### **Sensor Fusion for Unobtrusive Respiratory Rate Estimation in Dogs**

Respiration is vital to land-dwelling mammals; besides, salient information is encoded in the respiratory rate. Objective assessment of the respiratory rate is difficult in dogs; in particular, if the unobtrusive measurement is desired. The goal of this work was to develop and evaluate a method for unobtrusive sensing of respiratory rate in dogs. For this, the 'FlexPock' multisensor system, originally developed for unobtrusive estimation of heart rate and respiratory rate in humans via magnetic impedance; accelerometry; and optical measurements, was used to assess canine respiratory rate. In a proof-of-concept study with 10 healthy dogs of different breeds and sizes, a total of 240 minutes of data was recorded in the phases standing, sitting, lying down, and walking. An algorithm was developed that estimates the respiratory rate by fusing the information from multiple sensors for increased accuracy and robustness. To discard unusable data, a simple yet effective signal quality metric was introduced. Impedance pneumography recorded using adhesive electrodes was used as a reference. Analysis of the raw FlexPock data revealed that the magnetic impedance and accelerometry were the best individual sensing modalities and fusion of these data further increased the accuracy. Using leave-one-dog-out cross-validation, the average estimation error was 9.5% at a coverage of 50.1%. However, strong variation between dogs and phases was observed. During the walking phase, neither reference nor unobtrusive sensor reported usable results, while the sitting phase exhibited the best performance. In conclusion, the fusion of magnetic impedance and accelerometry can be used for unobtrusive respiratory rate estimation in stationary dogs.

### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Computing Sciences, Research area: User experience, BioMediTech, RWTH Aachen University, Tampere University, University of Helsinki, Massachusetts Institute of Technology

Contributors: Antink, C. H., Pirhonen, M., Väättäjä, H., Somppi, S., Tornqvist, H., Cardo, A., Teichmann, D., Vainio, O., Surakka, V., Vehkaoja, A.

Number of pages: 10

Pages: 7072-7081

Publication date: 15 Aug 2019

Peer-reviewed: Yes

### **Publication information**

Journal: IEEE Sensors Journal

Volume: 19

Issue number: 16

ISSN (Print): 1530-437X

Ratings:

Scopus rating (2019): CiteScore 6.2 SJR 0.749 SNIP 1.659

Original language: English

ASJC Scopus subject areas: Instrumentation, Electrical and Electronic Engineering

Keywords: animal health management, dogs, monitoring, respiratory rate, Sensor fusion, unobtrusive sensing

Electronic versions:

Sensor Fusion for Unobtrusive Respiratory Rate Estimation in Dogs - post-print

DOIs:

10.1109/JSEN.2019.2912002

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201912237110>

### **Bibliographical note**

dupl=49134380

Source: Scopus

Source ID: 85069512410

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

### Separation of Moving Sound Sources Using Multichannel NMF and Acoustic Tracking

In this paper we propose a method for separation of moving sound sources. The method is based on first tracking the sources and then estimation of source spectrograms using multichannel non-negative matrix factorization (NMF) and extracting the sources from the mixture by single-channel Wiener filtering. We propose a novel multichannel NMF model with time-varying mixing of the sources denoted by spatial covariance matrices (SCM) and provide update equations for optimizing model parameters minimizing squared Frobenius norm. The SCMs of the model are obtained based on estimated directions of arrival of tracked sources at each time frame. The evaluation is based on established objective separation criteria and using real recordings of two and three simultaneous moving sound sources. The compared methods include conventional beamforming and ideal ratio mask separation. The proposed method is shown to exceed the separation quality of other evaluated blind approaches according to all measured quantities. Additionally, we evaluate the method's susceptibility towards tracking errors by comparing the separation quality achieved using annotated ground truth source trajectories.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

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

Contributors: Nikunen, J., Diment, A., Virtanen, T.

Pages: 281-295

Publication date: 2018

Peer-reviewed: Yes

Early online date: 16 Nov 2017

#### Publication information

Journal: IEEE/ACM Transactions on Audio Speech and Language Processing

Volume: 26

Issue number: 2

ISSN (Print): 2329-9290

Ratings:

Scopus rating (2018): CiteScore 6.9 SJR 1.045 SNIP 2.428

Original language: English

ASJC Scopus subject areas: Signal Processing, Media Technology, Instrumentation, Acoustics and Ultrasonics, Linguistics and Language, Electrical and Electronic Engineering, Speech and Hearing

Keywords: acoustic source tracking, Acoustics, Array signal processing, Direction-of-arrival estimation, Estimation, Mathematical model, microphone arrays, Microphones, moving sound sources, Sound source separation, Spectrogram, time-varying mixing model

DOIs:

10.1109/TASLP.2017.2774925

Source: Scopus

Source ID: 85035748523

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

### Sequential Collinear Photofragmentation and Atomic Absorption Spectroscopy for Online Laser Monitoring of Triatomic Metal Species

Industrial chemical processes are struggling with adverse effects, such as corrosion and deposition, caused by gaseous alkali and heavy metal species. Mitigation of these problems requires novel monitoring concepts that provide information on gas-phase chemistry. However, selective optical online monitoring of the most problematic diatomic and triatomic species is challenging due to overlapping spectral features. In this work, a selective, all-optical, in situ gas-phase monitoring technique for triatomic molecules containing metallic atoms was developed and demonstrated with detection of PbCl<sub>2</sub>. Sequential collinear photofragmentation and atomic absorption spectroscopy (CPFAAS) enables determination of the triatomic PbCl<sub>2</sub> concentration through detection of released Pb atoms after two consecutive photofragmentation processes. Absorption cross-sections of PbCl<sub>2</sub>, PbCl, and Pb were determined experimentally in a laboratory-scale reactor to enable calibration-free quantitative determination of the precursor molecule concentration in an arbitrary environment. Limit of detection for PbCl<sub>2</sub> in the laboratory reactor was determined to be 0.25 ppm. Furthermore, the method was introduced for in situ monitoring of PbCl<sub>2</sub> concentration in a 120 MWth power plant using demolition wood as its main fuel. In addition to industrial applications, the method can provide information on chemical reaction kinetics of the intermediate species that can be utilized in reaction simulations.

#### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed



Organisations: Physics, Research group: Applied Optics, Tampere University, University Central Hospital Kuopio, Valmet Automation Oy, Universidad Nacional Autónoma de México  
Contributors: Viljanen, J., Kalmankoski, K., Contreras, V., Sarin, J. K., Sorvajärvi, T., Kinnunen, H., Enestam, S., Toivonen, J.  
Number of pages: 14  
Publication date: 18 Jan 2020  
Peer-reviewed: Yes

#### Publication information

Journal: Sensors (Basel, Switzerland)  
Volume: 20  
Issue number: 2  
Article number: 533  
ISSN (Print): 1424-8220  
Original language: English  
ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering  
Keywords: absorption, combustion, kinetics, lead, photofragmentation  
Electronic versions:  
Sequential Collinear Photofragmentation 2020  
DOIs:  
10.3390/s20020533  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202003252864>

#### Bibliographical note

INT=phys,"Kalmankoski, Kim"  
INT=phys,"Sarin, Jaakko K."  
Source: Scopus  
Source ID: 85078213348  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Spectral object recognition in hyperspectral holography with complex-domain denoising

In this paper, we have applied a recently developed complex-domain hyperspectral denoiser for the object recognition task, which is performed by the correlation analysis of investigated objects' spectra with the fingerprint spectra from the same object. Extensive experiments carried out on noisy data from digital hyperspectral holography demonstrate a significant enhancement of the recognition accuracy of signals masked by noise, when the advanced noise suppression is applied.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Computing Sciences, Research group: Computational Imaging-CI, ITMO University, University of Ulm Medical Center, University of Stuttgart  
Contributors: Shevkunov, I., Katkovnik, V., Claus, D., Pedrini, G., Petrov, N. V., Egiazarian, K.  
Number of pages: 10  
Publication date: 26 Nov 2019  
Peer-reviewed: Yes

#### Publication information

Journal: Sensors (Switzerland)  
Volume: 19  
Issue number: 23  
Article number: 5188  
ISSN (Print): 1424-8220  
Ratings:  
Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586  
Original language: English  
ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering  
Keywords: Hyperspectral imaging, Noise filtering, Noise in imaging systems, Singular value decomposition, Sparse representation  
Electronic versions:  
sensors-19-05188-v2

DOIs:

10.3390/s19235188

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201912166905>

Source: Scopus

Source ID: 85075511855

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

### Statistical evaluation of barkhausen noise testing (BNT) for ground samples

Barkhausen noise testing (BNT) is a nondestructive method for investigating many properties of ferromagnetic materials. The most common application is the monitoring of grinding burns caused by introducing locally high temperatures while grinding. Other features, such as microstructure, residual stress changes, hardening depth, and so forth, can be monitored as well. Nevertheless, because BNT is a method based on a complex magnetoelectric phenomenon, it is not yet standardized. Therefore, there is a need to study the traceability and stability of the measurement method. This study aimed to carry out a statistical analysis of ferromagnetic samples after grinding processes by the use of BNT. The first part of the experiment was to grind samples in different facilities (Sweden and Finland) with similar grinding parameters, different grinding wheels, and different hardness values. The second part was to evaluate measured BNT parameters to determine significant factors affecting BNT signal value. The measurement data from the samples were divided into two different batches according to where they were manufactured. Both grinding batches contained measurement data from three different participants. The main feature for calculation was the root-mean-square (RMS) value. The first processing step was to normalize the RMS values for all the measurements. A standard analysis of variance (ANOVA) was applied for the normalized dataset. The ANOVA showed that the grinding parameters had a significant impact on the BNT signal value, while the other investigated factors (e.g., participant) were negligible. The reasons for this are discussed at the end of the paper.

### General information

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Materials Science and Environmental Engineering, Univ of Oulu, Schlumpf Scandinavia AB, Kungliga Tekniska Högskolan KTH

Contributors: Tomkowski, R., Sorsa, A., Santa-Aho, S., Lundin, P., Vippola, M.

Publication date: 1 Nov 2019

Peer-reviewed: Yes

### Publication information

Journal: Sensors (Switzerland)

Volume: 19

Issue number: 21

Article number: 4716

ISSN (Print): 1424-8220

Ratings:

Scopus rating (2019): CiteScore 5 SJR 0.653 SNIP 1.586

Original language: English

ASJC Scopus subject areas: Analytical Chemistry, Biochemistry, Atomic and Molecular Physics, and Optics, Instrumentation, Electrical and Electronic Engineering

Keywords: ANOVA, Barkhausen noise testing (BNT), Proficiency test, Uncertainty

Electronic versions:

sensors-19-04716-v2

DOIs:

10.3390/s19214716

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201911135926>

Source: Scopus

Source ID: 85074321480

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

### Structural characterization, spectroscopic, thermal, AC conductivity and dielectric properties and antimicrobial studies of $(C_8H_{12}N)_2[SnCl_6]$

A new inorganic-organic hybrid material produced from 2,6-dimethylanilinium cations and tin halide  $(SnCl_6)^{2-}$  has been synthesized and structurally determined by X-ray diffraction method. The title compound crystallizes in the monoclinic system, space group C2/m with  $a = 19.8772(4)$ ,  $b = 6.9879(1)$ ,  $c = 8.3001(2)$  Å,  $\beta = 98.487(2)^\circ$  and  $V = 1140.26(4)$  Å<sup>3</sup>. The crystal structure is built up of sheets of  $(SnCl_6)^{2-}$  octahedral anions and 2,6-xylidinium cations. The optical band gap was calculated and found to be 4.11 eV. At high temperature this compound exhibits a structural phase transition at 338 K. This has been characterized by differential scanning calorimetric and dielectric studies. Measurements of AC conductivity

as a function of frequency at different temperatures indicated the hopping conduction mechanism. The bioassay results showed that the structure exhibits significant antibacterial activity.

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Department of Chemistry and Bioengineering, Carthage University  
Contributors: Mathlouthi, M., Valkonen, A., Rzaigui, M., Smirani, W.  
Number of pages: 16  
Pages: 399-414  
Publication date: 2017  
Peer-reviewed: Yes  
Early online date: 1 Jul 2016

#### Publication information

Journal: PHASE TRANSITIONS  
Volume: 90  
Issue number: 4  
ISSN (Print): 0141-1594  
Ratings:  
Scopus rating (2017): CiteScore 1.6 SJR 0.233 SNIP 0.61  
Original language: English  
ASJC Scopus subject areas: Instrumentation, Materials Science(all)  
Keywords: antibacterial activity, Crystal structure, fluorescent properties, phase transition, spectroscopies  
DOIs:  
10.1080/01411594.2016.1212194  
Source: Scopus  
Source ID: 84979648011  
Research output: Contribution to journal > Article > Scientific > peer-review

#### Third order nonlinear optical response of TTF-based molecular corners

Comparative study of the nonlinear optical response of pyrrolo- tetrathiafulvalene polygons has been carried out. These materials are of great importance for photonics, because they can be used as building blocks for more complicated molecular systems like rotaxanes, catenanes which are promising candidates for opto-electronic applications like optical computing, optical switching etc. During this work the third order nonlinear susceptibility ( $\chi^{(3)}$ ) has been determined by the Degenerate Four Wave Mixing experiment, while the imaginary part of the  $\chi^{(3)}$ , which is related with the nonlinear absorption was determined by "open-aperture" Z-scan measurements. Moreover measurements have been carried out in order to provide information about the optical limiting efficiency of the materials. High  $\chi^{(3)}$  has been found reaching  $2.30 \times 10^{-21} \text{ m}^2/\text{V}^2$ , corresponding to second order hyperpolarizability  $\gamma$  values of about  $6.5 \times 10^{-45} \text{ m}^5/\text{V}^2$ .

#### General information

Publication status: Published  
MoE publication type: A1 Journal article-refereed  
Organisations: Frontier Photonics, CNRS, Centre National de la Recherche Scientifique (CNRS), Universite de Bordeaux - PRES, Lab Bordelais Rech Informat, PICTURA Res Grp, UMR 5800, Univ Angers, Centre National de la Recherche Scientifique (CNRS), University of Nantes Angers Le Mans, University of Angers, CNRS UMR 6200, Inst Sci & Technol Mol Angers, LUNAM Université, Laboratoire MOLTECH-Anjou  
Contributors: Iliopoulos, K., Czaplicki, R., Ouazzani, H. E., Balandier, J., Chas, M., Goeb, S., Sallé, M., Gindre, D., Sahraoui, B.  
Number of pages: 8  
Pages: 205-212  
Publication date: 2012  
Peer-reviewed: Yes

#### Publication information

Journal: Nonlinear Optics, Quantum Optics  
Volume: 43  
Issue number: 1-4  
ISSN (Print): 1543-0537  
Ratings:  
Scopus rating (2012): CiteScore 0.7 SJR 0.211 SNIP 0.272  
Original language: English  
ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Statistical and Nonlinear Physics, Instrumentation , Computer Science(all), Electronic, Optical and Magnetic Materials  
Keywords: Degenerate four wave mixing (DFWM), Nonlinear optical response, TTF derivatives, Z-scan

URLs:

<http://www.scopus.com/inward/record.url?scp=84862149419&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84862149419

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

### **Tuning plasmon induced reflectance with hybrid metasurfaces**

Electrically tunable metasurfaces with graphene offer design flexibility to efficiently manipulate and control light. These metasurfaces can be used to generate plasmon-induced reflectance (PIR), which can be tuned by electrostatic doping of the graphene layer. We numerically investigated two designs for tunable PIR devices using the finite difference time-domain (FDTD) method. The first design is based on two rectangular antennas of the same size and a disk; in the second design, two parallel rectangular antennas with different dimensions are used. The PIR-effect was achieved by weak hybridization of two bright modes in both devices and tuned by changing the Fermi level of graphene. A total shift of 362 nm was observed in the design with the modulation depth of 53% and a spectral contrast ratio of 76%. These tunable PIR devices can be used for tunable enhanced biosensing and switchable systems.

#### **General information**

Publication status: Published

MoE publication type: A1 Journal article-refereed

Organisations: Physics, Photonics Laboratory, Balochistan University of Information Technology, Bilkent University

Contributors: Habib, M., Ozbay, E., Caglayan, H.

Publication date: 2019

Peer-reviewed: Yes

#### **Publication information**

Journal: Photonics

Volume: 6

Issue number: 1

Article number: 29

ISSN (Print): 2304-6732

Ratings:

Scopus rating (2019): CiteScore 2.9 SJR 0.646 SNIP 1.182

Original language: English

ASJC Scopus subject areas: Atomic and Molecular Physics, and Optics, Instrumentation, Radiology Nuclear Medicine and imaging

Keywords: Plasmonics, Surface plasmon, Tunable metasurfaces

Electronic versions:

photonics-06-00029-v2

DOIs:

10.3390/photonics6010029

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202004083140>

Source: Scopus

Source ID: 85063129342

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

### **160W single-frequency laser based on active tapered double-clad fiber amplifier**

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Tampere University of Technology, Frontier Photonics, A. M. Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow State University, Tampere University of Technology, Institute of Radio Engineering and Electronics of the Russian Academy of Sciences

Contributors: Trikshev, A. I., Kurkov, A. S., Tsvetkov, V. B., Filatova, S. A., Kertulla, J., Filippov, V., Chamorovskiy, Y. K., Okhotnikov, O. G.

Publication date: 2013

#### **Host publication information**

Title of host publication: Optics InfoBase Conference Papers

ISBN (Print): 9781479905942

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84898722786&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84898722786

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

### **5G new radio evolution towards sub-THz communications**

In this paper, the potential of extending 5G New Radio physical layer solutions to support communications in sub-THz frequencies is studied. More specifically, we introduce the status of third generation partnership project studies related to operation on frequencies beyond 52.6 GHz and note also the recent proposal on spectrum horizons provided by federal communications commission (FCC) related to experimental licenses on 95 GHz-3 THz frequency band. Then, we review the power amplifier (PA) efficiency and output power challenge together with the increased phase noise (PN) distortion effect in terms of the supported waveforms. As a practical example on the waveform and numerology design from the perspective of the PN robustness, link performance results using 90 GHz carrier frequency are provided. The numerical results demonstrate that new, higher subcarrier spacings are required to support high throughput, which requires larger changes in the physical layer design. It is also observed that new phase-tracking reference signal designs are required to make the system robust against PN. The results illustrate that single-carrier frequency division multiple access is significantly more robust against PN and can provide clearly larger PA output power than cyclic-prefix orthogonal frequency division multiplexing, and is therefore a highly potential waveform for sub-THz communications.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Research group: Wireless Communications and Positioning, Bell Labs

Contributors: Tervo, O., Levanen, T., Pajukoski, K., Hulkkonen, J., Wainio, P., Valkama, M.

Number of pages: 6

Publication date: 1 Mar 2020

#### **Host publication information**

Title of host publication: 2nd 6G Wireless Summit 2020 : Gain Edge for the 6G Era, 6G SUMMIT 2020

Publisher: IEEE

ISBN (Electronic): 9781728160474

ASJC Scopus subject areas: Artificial Intelligence, Hardware and Architecture, Signal Processing, Safety, Risk, Reliability and Quality, Computer Networks and Communications, Instrumentation

Keywords: 5G New Radio, 5G NR, Beyond 5G, DFT-s-OFDM, numerology, OFDM, Phase noise, PHY, physical layer, PN, PTRS, SC-FDMA, Spectrum availability, Sub-THz

DOIs:

10.1109/6GSUMMIT49458.2020.9083807

Source: Scopus

Source ID: 85086306147

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

### **Advancements in Solution Processable Devices using Metal Oxides For Printed Internet-of-Things Objects**

Internet-of-things (IoT) objects are expected to exceed 75 billion objects by 2020, and a large part of the expansion is expected to be at a finer granularity than existing silicon-based IoT objects (i.e. tablets and cell phones) can deliver [1]. Currently, placing a room light or a thermostat on the internet for remote control is considered progressive. However, if printed electronics can achieve performance increases, then IoT objects could be affixed to almost anything, such as coffee creamer cartons, cereal boxes, or that missing sock. Each of these IoT objects could be driving a sensor, perhaps position, temperature or pressure, essentially a multitude of applications. In order for IoT objects to emulate a simple postage stamp, with self-powering from energy scavenging and local energy storage, all housed in a non-toxic flexible form factor, advances in solution processable devices need to occur.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Ohio State University, Wayne State University

Contributors: Berger, P. R., Li, M., Mattei, R. M., Niang, M. A., Talisa, N., Tripepi, M., Harris, B., Bhalerao, S. R., Chowdhury, E. A., Winter, C. H., Lupo, D.

Number of pages: 3

Pages: 160-162

Publication date: 1 Mar 2019

#### **Host publication information**

Title of host publication: 2019 Electron Devices Technology and Manufacturing Conference, EDTM 2019

Publisher: IEEE

ISBN (Electronic): 9781538665084

ASJC Scopus subject areas: Electrical and Electronic Engineering, Electronic, Optical and Magnetic Materials, Instrumentation, Hardware and Architecture

Keywords: ALD, CMOS and SOI, energy scavenging, IoT, low-power electronics, Manufacturing, NDR, tunnel diodes  
DOIs:

10.1109/EDTM.2019.8731322

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

### **A Framework for Using Radar Measurements of Unknown Targets in Hierarchical Classification**

Real-life target recognition often requires appropriate processing of unknown targets. Such targets are the ones that the automatic target recognition system has not been trained to identify. These targets may, however, be interesting whereupon they should be further analyzed. In this paper, we propose a novel framework for analyzing radar measurements of unknown targets in order to incorporate them into a hierarchical target class taxonomy for the target recognition. Besides the preliminary information, a vital part in the analysis of the radar measurement is the comparison between the measured signature and the signatures of the known target types and categories. We use the results of such analysis to indicate potential spots in the class taxonomy where to add the unknown target. The framework allows identification of unknown target types that have been previously observed, when they are encountered again. We demonstrate the proposed framework through an experiment using the real data of a multi-radar system. In the experiments, we show the feasibility of our approach by examining target recognition in two cases: using our framework and without it. We find that the proposed framework enables enhanced processing of unknown targets in radar target recognition.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research group: MMDM, Tampere University

Contributors: Ruotsalainen, M., Perala, H., Vaila, M., Jylha, J., Kauhanen, M.

Number of pages: 8

Publication date: 2019

#### **Host publication information**

Title of host publication: FUSION 2019 - 22nd International Conference on Information Fusion

Publisher: IEEE

Article number: 9011387

ISBN (Print): 978-1-7281-1840-6

ISBN (Electronic): 9780996452786

ASJC Scopus subject areas: Information Systems, Instrumentation

URLs:

<https://ieeexplore.ieee.org/document/9011387>

URLs:

<http://www.scopus.com/inward/record.url?scp=85081789188&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

INT=comp,"Kauhanen, Mikko"

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

### **A novel technique for analysis of postural information with wearable devices**

These days, as many jobs involve sitting behind desks and working with computers for extended periods, more and more people are suffering from back problems. Maintenance of an appropriate posture may prevent future back problems. There are various medical methods for studying postures abnormalities of the back but most of these methods are limited to be utilized in diagnostics and follow-up of treatment and not used in a continuous or in a preventive manner. Therefore, designing and developing methods for measuring, analyzing and reporting of posture information, aimed for prevention of future back problems is of fundamental interest. In this work, a proof-of-concept system, including five accelerometer sensor units is presented. Additionally, an index, which we call spine inclination index (SII), is introduced and used for converting the raw data to meaningful presentable information. Initial evaluation includes measurements with six subjects. Subjects were asked to mimic accentuated kyphotic, straight and accentuated lordotic postures while sitting. Our results show that the designed device and SII index are able to distinguish between different postures very well. In addition, since this device measures the inclination angle of different spinal postures, its output can be directly compared with other widely used methods.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Faculty of Biomedical Sciences and Engineering, VTT Technical Research Centre of Finland, Tampere University Hospital

Contributors: Jeyhani, V., Mahdiani, S., Viik, J., Oksala, N., Vehkaoja, A.  
Number of pages: 4  
Pages: 30-33  
Publication date: 2 Apr 2018

#### Host publication information

Title of host publication: 2018 IEEE 15th International Conference on Wearable and Implantable Body Sensor Networks, BSN 2018

Publisher: IEEE

ISBN (Electronic): 9781538611098

ASJC Scopus subject areas: Health Informatics, Instrumentation, Computer Networks and Communications, Human-Computer Interaction, Biomedical Engineering

Electronic versions:

A Novel Technique for Analysis of Postural Information with Wearable Devices - post-print

DOIs:

10.1109/BSN.2018.8329651

URLs:

<http://urn.fi/URN:NBN:fi:tty-201809252338>

Source: Scopus

Source ID: 85049665171

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

#### Automatic detection of water inside concrete slabs using ground penetrating radar

Ground Penetrating Radar (GPR) is generally used as a non-destructive method of inspection for structures and for finding defects in concrete slabs. In this paper, GPR is used in the detection of water inside the cavities of concrete hollow core slabs. We propose an algorithm that determines the water level inside the concrete slab by analyzing the time delays of the reflections originating from inside the cavity. The algorithm is based on utilizing prior knowledge about the geometry of the hollow core slab. The presence of water was successfully detected and an estimate for the height of the water surface was obtained with a GPR system operating with a central frequency of 2.7 GHz. Based on the experiments, the proposed method holds promise in providing a robust and accurate method for the detection of water inside the concrete slabs. Results, possible future research and analysis of the feasibility of GPR systems in water detection are presented and discussed.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research group: MMDM

Contributors: Khan, M. A., Vehmas, R., Visa, A.

Publication date: 1 Apr 2019

#### Host publication information

Title of host publication: 2019 IEEE Radar Conference, RadarConf 2019

Publisher: IEEE

ISBN (Electronic): 9781728116792

ASJC Scopus subject areas: Computer Networks and Communications, Signal Processing, Instrumentation

DOIs:

10.1109/RADAR.2019.8835797

#### Bibliographical note

jufoid=57477

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

#### Automatic numerical differentiation by maximum likelihood estimation of a linear Gaussian state space model

A linear Gaussian state-space smoothing algorithm is presented for off-line estimation of derivatives from a sequence of noisy measurements. The algorithm uses numerically stable square-root formulas, can handle simultaneous independent measurements and non-equally spaced abscissas, and can compute state estimates at points between the data abscissas. The state space model's parameters, including driving noise intensity, measurement variance, and initial state, are determined from the given data sequence using maximum likelihood estimation computed using an expectation maximisation iteration. In tests with synthetic biomechanics data, the algorithm is found to be more accurate compared to a widely used open source automatic numerical differentiation algorithm, especially for acceleration estimation.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences  
Contributors: Piche, R.  
Number of pages: 5  
Pages: 1861-1865  
Publication date: 1 Jun 2019

#### Host publication information

Title of host publication: 2019 18th European Control Conference, ECC 2019  
Publisher: IEEE  
ISBN (Electronic): 9783907144008  
ASJC Scopus subject areas: Instrumentation, Control and Optimization  
Electronic versions:

ThA11.4\_Piche

DOIs:

10.23919/ECC.2019.8795960

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201910304221>

Source: Scopus

Source ID: 85071535987

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

#### Charge Storage Level Sensor RFID Tag: Impedance Matching and Experimental Characterisation

We present an RF energy harvesting system where two distinct passive UHF RFID microchips provide different tag IDs to detect low and high states of the harvester's charge storage. This enables the backend system to acknowledge when the harvesting system is ready for advanced power consuming operations. Overall, we were able to read the separate IDs of the tag at the distance of 3 m from an RFID reader that is emitting the regulated EIRP of 3.28 W and charging harvester's storage capacitor to 0.625 V through 8.7 dBi harvesting antenna.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group

Contributors: Pournoori, N., Ukkonen, L., Sydänheimo, L., Björninen, T.

Publication date: 1 Mar 2019

#### Host publication information

Title of host publication: 13th European Conference on Antennas and Propagation, EuCAP 2019

Publisher: IEEE

ISBN (Electronic): 9788890701887

ASJC Scopus subject areas: Computer Networks and Communications, Instrumentation

Keywords: Far-field RF energy harvesting, impedance matching, PIN diode, RF rectifier, RF switch, RFID

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

#### Chipless graphene tag and dual-CP reader for Internet of Things

This paper proposes a printable chipless tag that encodes more bits than a conventional tag, and also a dual circularly polarized (CP) reader that achieves high isolation as well as insensitive orientation. To demonstrate this concept, a radio-frequency identification (RFID) tag with a compact size of 12mm × 12mm is designed to encode 8 bits covering 6-9 GHz, and is investigated with dual-CP backscattering characteristics. Using conductive ink such as graphene, it is possible to directly print this kind of chipless tag on A4 papers, clothes, plastics, etc. This flexible low-cost tag and dual-CP reader are promising to significantly benefit the Internet of Things (IoT).

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Wireless Identification and Sensing Systems Research Group, BioMediTech, Southeast University, BioMediTech Institute

Contributors: Dong, G., Shen, Y., He, H., Virkki, J., Hu, S.

Publication date: 26 Sep 2017

#### Host publication information

Title of host publication: 2017 International Applied Computational Electromagnetics Society Symposium in China, ACES-China 2017

Publisher: IEEE

ISBN (Electronic): 9780996007856



ASJC Scopus subject areas: Electrical and Electronic Engineering, Computational Mathematics, Instrumentation, Computer Networks and Communications  
Keywords: Chipless tag, dual circular polarization, Internet of Things (IoT), radar cross section (RCS), radio-frequency identification (RFID)  
Source: Scopus  
Source ID: 85032786773  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Circularly Polarized Corner-Truncated and Slotted Microstrip Patch Antenna on Textile Substrate for Wearable Passive UHF RFID Tags**

We present a compact circularly polarized (CP) antenna for wearable passive UHF RFID tags. The antenna is a square-shaped microstrip patch antenna where we have applied corner truncation and slotting techniques in the top layer conductor for achieving the CP property and a shorting pin and loop structure for impedance matching. Despite using a lowpermittivity textile as antenna substrate, the antenna's footprint size is only 5-by-5 cm, which is approximately 15% of the operating wavelength. At the same time, the on-body measurements, the antenna's axial ratio is 0.9 dB and the measured attainable read range (reader's EIRP =3.28W) of the tag reaches 4.2 meters with a CP reader antenna and ranges from 2.9 meters to 3.4 meters for a linear reader antenna, depending on the rotation angle between the antennas.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group  
Contributors: Le, D., Ukkonen, L., Björninen, T.  
Number of pages: 5  
Publication date: 1 Mar 2020

#### **Host publication information**

Title of host publication: 14th European Conference on Antennas and Propagation, EuCAP 2020  
Publisher: IEEE  
ISBN (Electronic): 9788831299008

#### **Publication series**

Name: 14th European Conference on Antennas and Propagation, EuCAP 2020  
ASJC Scopus subject areas: Computer Networks and Communications, Signal Processing, Instrumentation, Radiation  
Keywords: circular polarization, RFID tag, UHF, wearable antenna  
DOIs:  
10.23919/EuCAP48036.2020.9135984  
Source: Scopus  
Source ID: 85088645766  
Research output: Chapter in Book/Report/Conference proceeding > Conference contribution > Scientific > peer-review

### **Circularly polarized shorted ring slot rectenna with a mesh design for optimized inkjet printing on paper substrate**

The design of a 2.45 GHz circularly polarized rectenna inkjet printed on paper is presented. The proposed antenna structure is a shorted ring slot with a modified ground plane where a mesh design is employed in order to reduce the required amount of silver nanoparticle ink that needs to be inkjet-printed. A meshed ground plane with 29 % conducting surface relative to a solid ground was demonstrated with a simulated gain of 2.2 dB, axial ratio of 0.6 dB at 2.45 GHz and a peak rectifier efficiency of 45 % for -15 dBm input received power at the antenna terminals.

#### **General information**

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Sensing Systems for Wireless Medicine (MediSense), Centre Tecnologic de Telecomunicacions de Catalunya, Georgia Institute of Technology, Herriot-Watt University, Technical University of Cartagena (UPCT)  
Contributors: Martinez, R., Kimionis, J., Georgiadis, A., Collado, A., Tentzeris, M., Goussetis, G., Tornero, J. L.  
Publication date: 27 Aug 2015

#### **Host publication information**

Title of host publication: 2015 9th European Conference on Antennas and Propagation, EuCAP 2015  
Publisher: Institute of Electrical and Electronics Engineers Inc.  
Article number: 7228814  
ISBN (Electronic): 9788890701856  
ASJC Scopus subject areas: Instrumentation, Radiation, Computer Networks and Communications  
Keywords: circularly polarized rectenna, Inkjet printing, paper substrate, slot antenna  
URLs:  
<http://www.scopus.com/inward/record.url?scp=84949643447&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84949643447

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

### **Circularly Polarized Textile Tag Antenna for Wearable Passive UHF RFID Systems**

We present a circularly polarized tag antenna using textile materials for wearable passive ultra high frequency (UHF) radio frequency identification (RFID) system. A corner-truncated square patch with a shorting pin and an inductive feed network are used to achieve circular polarization and conjugate impedance matching. The antenna has similar best axial ratio values of 2.1 dB and 2.2 dB for both in air and on-body conditions, and desirable corresponding read range of 9.1 m and 8.4 m.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Donghua University

Contributors: Kuang, Y., Ma, S., Ukkonen, L., Virkki, J., Björninen, T.

Publication date: 18 Mar 2019

#### **Host publication information**

Title of host publication: 2018 International Applied Computational Electromagnetics Society Symposium in China, ACES-China 2018

Publisher: IEEE

ISBN (Electronic): 9780996007849

ASJC Scopus subject areas: Computational Mathematics, Instrumentation, Electrical and Electronic Engineering, Computer Networks and Communications

Keywords: Circularly polarized antenna, Radio frequency identification, Wearable antenna

DOIs:

10.23919/ACCESS.2018.8669314

Source: Scopus

Source ID: 85063790306

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

### **Comparison of Human Head Phantoms with Different Complexities for Implantable Antenna Development**

Human body phantom with electrical properties is widely used in electromagnetics solvers to model the lossy human tissue environment. The selection of the phantoms affects the computational efficiency and results accuracy. In this work, we evaluated four human head phantoms with an intracranial implantable antenna. Results of phantom complexity and antenna parameters are compared to provide the reference in phantom selection for implantable antenna development.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech

Contributors: Ma, S., Ukkonen, L., Sydänheimo, L., Björninen, T.

Publication date: 18 Mar 2019

#### **Host publication information**

Title of host publication: 2018 International Applied Computational Electromagnetics Society (ACES) Symposium : 29 July-1 Aug. 2018, China

Publisher: IEEE

ISBN (Print): 978-1-5386-7187-0

ISBN (Electronic): 978-0-9960078-4-9

ASJC Scopus subject areas: Computational Mathematics, Instrumentation, Electrical and Electronic Engineering, Computer Networks and Communications

Keywords: anatomical head phantom, implantable antenna, multilayer head phantom

Electronic versions:

Comparison of Human Head Phantoms 2019

DOIs:

10.23919/ACCESS.2018.8669363

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202005155345>

Source: Scopus

Source ID: 85063771074

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

### **Composite nonlinear feedback control of a JIB trolley of a tower crane behaviors**

Cranes are required to lift and carry loads swiftly to desired positions without causing excessive swaying motion of the load. These are conflicting requirements, which make feedback control of crane systems challenging. Furthermore, variations in rope length and load mass complicate controller design, since they significantly influence swaying dynamics. This paper considers automatic control of Quanser 3DOF tower crane system using composite nonlinear feedback (CNF) methodology. To be more specific, a CNF controller is designed for the jib trolley position of the crane using partial state measurements. The performance of the CNF controller is compared with Quanser's built-in linear quadratic regulator (LQR) controller both in simulation and experimental setups. The results show that the CNF controller provides better load handling capability in terms of fast positioning of the jib trolley and damping of load swaying.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Automation Technology and Mechanical Engineering, Research group: Automation and Systems Theory

Contributors: Pyrhönen, V., Vilkkö, M. K.

Number of pages: 6

Pages: 1124-1129

Publication date: 1 Jun 2019

#### **Host publication information**

Title of host publication: 2019 18th European Control Conference, ECC 2019

Publisher: IEEE

Article number: 8796229

ISBN (Electronic): 9783907144008

ASJC Scopus subject areas: Instrumentation, Control and Optimization

Electronic versions:

Composite Nonlinear Feedback Control of a Jib Trolley of a Tower Crane

DOIs:

10.23919/ECC.2019.8796229

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201912106716>

Source: Scopus

Source ID: 85071530876

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

### **Dark solitons in nematic liquid crystals**

We demonstrate the formation of dark spatial solitons in nematic liquid crystals, with an azo-dye dopant providing the self-defocusing response. A collinear copolarized beam is used to probe the guiding properties of the soliton. NLO/ISOM/ODS

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Nonlinear Optics and OptoElectronics Lab, Beam Engineering for Advanced Measurements Co

Contributors: Piccardi, A., Alberucci, A., Assanto, G., Tabiryan, N.

Publication date: 2011

#### **Host publication information**

Title of host publication: Optics InfoBase Conference Papers

ISBN (Print): 9781557529152

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/NLO.2011.NWE4

URLs:

<http://www.scopus.com/inward/record.url?scp=84894332639&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84894332639

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

### **Detection of KC1 and KOH using collinear photofragmentation and atomic absorption spectroscopy**

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Physics, Photonics, Frontier Photonics, Optics Laboratory, Department of Physics, Tampere University of Technology

Contributors: Sorvajarvi, T., Rossi, J., Toivonen, J.

Publication date: 2013

#### Host publication information

Title of host publication: The European Conference on Lasers and Electro-Optics, CLEO\_Europe 2013

ISBN (Print): 9781479905942

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84898750873&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84898750873

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

#### Developing curiosity and multimedia skills with programming experiments

Browsers have become the most common communication channel. We spend hours using them to get news and communicate with friends, far more time than communicating face-to face. WWW-based communication and content-creation for www will be the most common job in future work life for students specializing in software engineering. We expect our screens to be colorful and animated, thus students should understand technologies, which are used for e.g. for painting jumping Mario to screen. But massive flow of new software engineering ideas, technologies and frameworks which appear in all-increasing temp tend to make students passive receivers of descriptions of new menus and commands without giving them any possibility to investigate and understand, what is behind these menus and commands, killing their natural curiosity. There should be time to experiment, compare formats, technologies and investigate their relations. In the presentation are described experiments used for investigating, how different formats for describing animation in HTML5 document influence animation rendering speed.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Software Engineering and Intelligent Systems, Pervasive Computing, Tallinn University of Technology, University of Lapland

Contributors: Henno, J., Jaakkola, H., Mäkelä, J.

Number of pages: 6

Pages: 694-699

Publication date: 10 Jul 2017

#### Host publication information

Title of host publication: 2017 40th International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9789532330922

ASJC Scopus subject areas: Computer Networks and Communications, Information Systems, Electrical and Electronic Engineering, Instrumentation

Electronic versions:

ce\_14\_4587

DOIs:

10.23919/MIPRO.2017.7973512

URLs:

<http://urn.fi/URN:NBN:fi:tyy-201712012297>

Source: Scopus

Source ID: 85027728907

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

#### Dilute nitride SOAs for high-speed data processing in variable temperature conditions

We present the first experimental study of a Dilute Nitride SOA with high-speed gain dynamics and attractive thermal characteristics as a data processing element at 10Gb/s and at different operating temperatures.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Optoelectronics Research Centre, Research group: Semiconductor Technology and Applications, Aristotle University of Thessaloniki, School of Electrical and Computer Engineering, National Technical

University of Athens

Contributors: Giannoulis, G., Korpijärvi, V. M., Iliadis, N., Mäkelä, J., Viheriälä, J., Apostolopoulos, D., Guina, M., Avramopoulos, H.

Publication date: 13 Mar 2015

#### Host publication information

Title of host publication: Optical Fiber Communication Conference, OFC 2015

Publisher: OSA - The Optical Society

ISBN (Print): 9781557529374

ASJC Scopus subject areas: Electronic, Optical and Magnetic Materials, Computer Networks and Communications, Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84930886920&partnerID=8YFLogxK> (Link to publication in Scopus)

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

#### Directional selectivity through the subwavelength slit in metallic gratings

An approach for obtaining strong directional selectivity through a single subwavelength slit in non-symmetric metallic gratings is shown theoretically and experimentally. Directionality effect originates from the different resonance frequencies of two interfaces.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Bilkent University, Nanotechnology Research Center

Contributors: Cakmakyapan, S., Caglayan, H., Serebryannikov, A., Ozbay, E.

Publication date: 2011

#### Host publication information

Title of host publication: CLEO: Applications and Technology

ISBN (Print): 9781557529107

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/CLEO\_AT.2011.JTuI67

URLs:

<http://www.scopus.com/inward/record.url?scp=84893621842&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893621842

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

#### Directional selectivity through the subwavelength slit in metallic gratings

An approach for obtaining strong directional selectivity through a single subwavelength slit in non-symmetric metallic gratings is shown theoretically and experimentally. Directionality effect originates from the different resonance frequencies of two interfaces.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Bilkent University, Nanotechnology Research Center

Contributors: Cakmakyapan, S., Caglayan, H., Serebryannikov, A., Ozbay, E.

Publication date: 2011

#### Host publication information

Title of host publication: CLEO: Science and Innovations 2011

ISBN (Print): 9781557529107

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/CLEO\_AT.2011.JTuI67

URLs:

<http://www.scopus.com/inward/record.url?scp=84893590543&partnerID=8YFLogxK> (Link to publication in Scopus)

#### Bibliographical note

EXT="Caglayan, Humeyra"

Source: Scopus

Source ID: 84893590543

### **Directional selectivity through the subwavelength slit in metallic gratings**

An approach for obtaining strong directional selectivity through a single subwavelength slit in non-symmetric metallic gratings is shown theoretically and experimentally. Directionality effect originates from the different resonance frequencies of two interfaces.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Bilkent University, Nanotechnology Research Center

Contributors: Cakmakyapan, S., Caglayan, H., Serebryannikov, A., Ozbay, E.

Number of pages: 3

Publication date: 2011

#### **Host publication information**

Title of host publication: Quantum Electronics and Laser Science Conference, QELS 2011

ISBN (Print): 9781557529107

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/CLEO\_AT.2011.JTuI67

URLs:

<http://www.scopus.com/inward/record.url?scp=84894054350&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

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

### **Double-side pumped membrane external-cavity surface-emitting laser (MECSEL) with increased efficiency emitting > 3 W in the 780 nm region**

We demonstrate a double-side pumped MECSEL emitting more than 3 W of output power in the 780 nm wavelength region. The laser exhibits an efficiency as high as 34.4 %.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics

Contributors: Kahle, H., Phung, H., Penttinen, J., Rajala, P., Tukiainen, A., Ranta, S., Guina, M.

Publication date: 1 May 2019

#### **Host publication information**

Title of host publication: 2019 Conference on Lasers and Electro-Optics, CLEO 2019 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781943580576

ASJC Scopus subject areas: Spectroscopy, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Management, Monitoring, Policy and Law, Electronic, Optical and Magnetic Materials, Radiology Nuclear Medicine and imaging, Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.23919/CLEO.2019.8749958

#### **Bibliographical note**

INT=phys,"Rajala, Patrik"

Source: Scopus

Source ID: 85069191246

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

### **Electromagnetism and cross-disciplinary problems**

Electromagnetic theory is a model of the electromagnetic phenomenon. As is well known, the model can be expressed in many different ways. All the formulations are, however, concretizations of the same so-called 'abstract general' of electromagnetism. In this paper we consider the Maxwell house as this abstract general. The motivation for this is, an increasing amount of progress in engineering science takes place on the interfaces between different fields. Cross-disciplinary results are best achieved by formalizing first the logical reasoning behind electromagnetism, as this then results in an unambiguous basis for cross-disciplinary communication.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electrical Engineering, Research area: Electromagnetics

Contributors: Kettunen, L., Kovanen, T.

Number of pages: 2

Pages: 500-501

Publication date: 19 Sep 2016

### Host publication information

Title of host publication: 2016 URSI International Symposium on Electromagnetic Theory, EMTS 2016

Publisher: IEEE

ISBN (Electronic): 9781509025022

ASJC Scopus subject areas: Instrumentation, Radiation

DOIs:

10.1109/URSI-EMTS.2016.7571436

Source: Scopus

Source ID: 84992161982

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

### Energy Detection-Based Spectrum Sensing over Fisher-Snedecor F Fading Channels

This paper investigates the performance of energy detection-based spectrum sensing over Fisher-Snedecor F fading channels. To this end, an analytical expression for the corresponding average detection probability is firstly derived and then this is extended to account for collaborative spectrum sensing. The complementary receiver operating characteristics (ROC) are analyzed for different conditions of the average signal-to-noise ratio (SNR), time-bandwidth product, multipath fading, shadowing and number of collaborating users. It is shown that the energy detection performance is strongly linked to the severity of the multipath fading and amount of shadowing, whereby even small variations in either of these physical phenomena significantly impact the detection probability. Also, the versatile modeling capability of the Fisher-Snedecor F distribution is verified in the context of energy detection based spectrum sensing as it provides considerably more accurate characterization than the conventional Rayleigh fading model. To confirm the validity of the analytical results presented in this paper, we compare them with the results of some simulations.

### 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, Centre for Wireless Innovation, Khalifa University, Department of Chemistry and Bioengineering, University of Surrey, German Jordanian University, Aristotle University of Thessaloniki

Contributors: Yoo, S. K., Cotton, S. L., Sofotasios, P. C., Muhaidat, S., Badarneh, O. S., Karagiannidis, G. K.

Publication date: 20 Feb 2019

### Host publication information

Title of host publication: 2018 IEEE Global Communications Conference

Publisher: IEEE

Article number: 8647778

ISBN (Electronic): 9781538647271

ASJC Scopus subject areas: Information Systems and Management, Renewable Energy, Sustainability and the Environment, Safety, Risk, Reliability and Quality, Signal Processing, Modelling and Simulation, Instrumentation, Computer Networks and Communications

DOIs:

10.1109/GLOCOM.2018.8647778

Source: Scopus

Source ID: 85063500863

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

### Error analysis of NOMA-based user cooperation with SWIPT

The present contribution analyzes the performance of non-orthogonal multiple access (NOMA)-based user cooperation with simultaneous wireless information and power transfer (SWIPT). In particular, we consider a two-user NOMA-based cooperative SWIPT scenario, in which the near user acts as a SWIPT-enabled relay that assists the farthest user. In this context, we derive analytic expressions for the pairwise error probability (PEP) of both users assuming the both amplify-and-forward (AF) and decode-and-forward (DF) relay protocols. The derived expressions are expressed in closed-form and have a tractable algebraic representation which renders them convenient to handle both analytically and numerically. In addition to this, we derive a simple asymptotic closed-form expression for the PEP in the high signal-to-noise ratio (SNR) regime which provide useful insights on the impact of the involved parameters on the overall system performance. Capitalizing on this, we subsequently quantify the maximum achievable diversity order of both users. It is shown that

numerical and simulation results corroborate the derived analytic expressions. Furthermore, the offered results provide interesting insights into the error rate performance of each user, which are expected to be useful in future designs and deployments of NOMA based SWIPT systems.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Wireless Communications and Positioning, Electrical Engineering, Taiyuan University of Science and Technology, Khalifa University, University of Surrey, Center on Cyber-Physical Systems, Simon Fraser University

Contributors: Li, S., Bariah, L., Muhaidat, S., Sofotasios, P., Liang, J., Wang, A.

Number of pages: 7

Pages: 507-513

Publication date: 1 May 2019

#### Host publication information

Title of host publication: Proceedings - 15th Annual International Conference on Distributed Computing in Sensor Systems, DCOSS 2019

Publisher: IEEE

ISBN (Electronic): 9781728105703

ASJC Scopus subject areas: Computer Networks and Communications, Computer Science Applications, Hardware and Architecture, Health Informatics, Instrumentation, Transportation, Communication

Keywords: NOMA, Wireless Power Transfer

DOIs:

10.1109/DCOSS.2019.00098

Source: Scopus

Source ID: 85071915507

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

#### Evaluating transparent liquid screen overlay as a haptic conductor: Method of enhancing touchscreen based user interaction by a transparent deformable liquid screen overlay

In line with our previous work, this research focuses on a method for attenuating acoustic components (noise) while providing enhanced vibrotactile feedback signals on mobile devices using, deformable touchscreen overlays. Traditional mechanism of providing tactile feedback to the fingertip via a flat rigid touchscreen is limited due to the dampening of the mechanoreceptors which are sensitive to static deformation and lie at the tips of the intermediate ridges in the epidermal-dermal junction. This tactile mechanism becomes useless when the fingertip acts against a ridged surface (chemically strengthened alkali-aluminosilicate glass). Furthermore, the actuation provided by most devices is indirect with little or no mediation mechanism, which results in filtering various signal frequencies, loss of signal intensity as well as creating acoustic noise. The resulting haptic signal is considerably inefficient and incongruent to the applied signal, which was designed to stimulate user skin contact. To resolve these issues we developed a unique transparent screen overlay conductor which contains an oil based composition (a low viscosity inert nonconductive liquid), that acts as a soft deformable interaction point, enhancing the ratio between tactile signals and the acoustic components, provided by haptic actuators. Using surface mounted and embedded actuators to the overlay, while being attached to an ExoPC Slate, we measured haptic signal to noise correlation, as well as signal efficiency and strength over multiple frequencies and concluded that the haptic conductor was able to limit auditory noise and mediate tactile signals more efficiently than traditional rigid glass based surfaces.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Augmented Human Activities (AHA), Fukoku-Rubber Co.

Contributors: Farooq, A., Evreinov, G., Raisamo, R., Takahata, D.

Publication date: 31 Dec 2015

#### Host publication information

Title of host publication: 2015 IEEE SENSORS - Proceedings

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7370186

ISBN (Electronic): 9781479982028

ASJC Scopus subject areas: Instrumentation, Electronic, Optical and Magnetic Materials, Spectroscopy, Electrical and Electronic Engineering

Keywords: haptic signal mediation, haptics user interface, Liquid transparent screen overlay, piezoelectric and voice coil actuators, vibrotactile mechano-transduction

DOIs:

10.1109/ICSENS.2015.7370186



URLs:

<http://www.scopus.com/inward/record.url?scp=84963615224&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84963615224

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

### **Exploiting the Momentary Dependence of Radar Observations for Non-Cooperative Target Recognition**

Multiple radar sensors can be used in collaboration to detect targets in an area of surveillance. In this paper, we consider a case, in which a target is detected by a network of radars producing multiple observations of the radar signature of the target during a short time window. Given that this time window is sufficiently narrow, the observations have a dependence between them momentarily related to the change in the orientation of the target. We propose the fusion of these interdependent observations to aid target identification by forming a joint multi-dimensional histogram of the radar cross section (RCS). In addition, we investigate the criteria for windowing the observations to ensure adequate interdependence. We present a case study to demonstrate the ability of the proposed approach to distinguish between different targets using the measured RCS collected by a multi-radar surveillance system. Based on the experiment, we analyze the criteria for the dynamic windowing and discuss the computational requirements of the proposed concept.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research group: MMDM

Contributors: Väilä, M., Jylhä, J., Ruotsalainen, M., Perälä, H.

Publication date: 1 Jul 2019

#### **Host publication information**

Title of host publication: FUSION 2019 - 22nd International Conference on Information Fusion

Publisher: IEEE

Article number: 9011215

ISBN (Electronic): 9780996452786

ASJC Scopus subject areas: Information Systems, Instrumentation

URLs:

<http://www.scopus.com/inward/record.url?scp=85081787402&partnerID=8YFLogxK> (Link to publication in Scopus)

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

### **Fabrication and reliability evaluation of passive UHF RFID T-shirts**

In this paper, we present textile antennas fabricated for T-shirt RFID applications by cutting from commercially available electro-textile, by sewing with conductive thread, and by 3D printing with stretchable silver ink on a 100 % cotton fabric. The ready tags with attached ICs are coated with a protective stretchable encapsulant. The wireless performance of the T-shirt tags is evaluated initially as well as after seven washing cycles, followed by nine washing-drying cycles in a household washing and drying machines. The initial read ranges of all kinds of tags, when measured on-body, are around 3.5 meters. Based on the reliability testing results, the coating effectively protects the components from cyclic washing and drying.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Faculty of Biomedical Sciences and Engineering, Research group: Wireless Identification and Sensing Systems Research Group, Department of Electronic Engineering, City University of Hong Kong

Contributors: Chen, X., He, H., Ukkonen, L., Virkki, J., Lu, Y., Lam, H.

Number of pages: 4

Pages: 1-4

Publication date: 8 Jun 2018

#### **Host publication information**

Title of host publication: 2018 IEEE International Workshop on Antenna Technology, iWAT2018 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781538618516

ASJC Scopus subject areas: Instrumentation, Computer Networks and Communications, Electronic, Optical and Magnetic Materials

Keywords: 3D Printing, electro-textiles, embroidery, passive UHF RFID, T-shirts, textiles, washing, wearable electronics

DOIs:

10.1109/IWAT.2018.8379146

#### **Bibliographical note**

jufoid=79362

Source: Scopus

Source ID: 85050037887

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

### **Frequency Comb Generation in a Continuous-Wave Pumped Second-Order Nonlinear Waveguide Resonator**

Optical frequency comb generation has been experimentally studied using an integrated system based on a lithium niobate waveguide resonator featuring a strong quadratic nonlinearity. Our theoretical model shows good agreement with the experimental results.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, Paderborn University, University of Helsinki, VTT Technical Research Centre of Finland

Contributors: Abdallah, Z., Stefszky, M., Ulvila, V., Silberhorn, C., Vainio, M.

Publication date: 1 May 2019

#### **Host publication information**

Title of host publication: 2019 Conference on Lasers and Electro-Optics, CLEO 2019 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781943580576

ASJC Scopus subject areas: Spectroscopy, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Management, Monitoring, Policy and Law, Electronic, Optical and Magnetic Materials, Radiology Nuclear Medicine and imaging, Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.23919/CLEO.2019.8750403

Source: Scopus

Source ID: 85069196416

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

### **Frequency domain penetration loss in the terahertz band**

Results on penetration loss measurements in the THz frequencies between 0.1-2 THz are reported. The measurements were conducted with time domain spectroscopy using the TeraView TeraPulse 4000 measurement equipment. We concentrate on the frequency-dependent penetration characteristics of various materials typical for indoor environments, providing both qualitative and quantitative assessment. The results show that the lower end of the THz band (<0.5 THz) suffers only modest loss in comparison to the higher frequencies. For the materials considered in this paper, plastic, glass and hard-board, the exact penetration properties are both frequency- and material-dependent. The incident angle to the material increases the penetration loss through increased path length inside the material. The exact values of these losses are provided.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electronics and Communications Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, University of Oulu

Contributors: Kokkonen, J., Lehtomäki, J., Petrov, V., Moltchanov, D., Juntti, M.

Publication date: 27 Jun 2016

#### **Host publication information**

Title of host publication: 2016 Global Symposium on Millimeter Waves (GSMM) & ESA Workshop on Millimetre-Wave Technology and Applications

Publisher: IEEE

ISBN (Electronic): 9781509013487

ASJC Scopus subject areas: Electrical and Electronic Engineering, Instrumentation, Radiation, Computer Networks and Communications

DOIs:

10.1109/GSMM.2016.7500309

Source: Scopus

Source ID: 84979518440

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

### **Headband Antenna for Wireless Power Transfer to Millimeter-Sized Neural Implants with Minimal Misalignment Effects**

We present a headband loop antenna for wireless power transfer to multiple IMDs located in the cranial cavity at the depth of 10 mm from the skin. We characterize the wireless power transfer link in terms of the power gain and the power delivered to the IMD, when maximum SAR compliant transmission power is fed to the headband antenna at frequency of 5

MHz. We also consider two types of the misalignments i.e. lateral and angular, between the IMD antenna and the headband antenna and discuss their impact on the transducer gain, impedance matching and on the power delivered to the IMD.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group

Contributors: Ahmed, S., Sydänheimo, L., Ukkonen, L., Björninen, T.

Number of pages: 4

Publication date: 1 Mar 2020

#### Host publication information

Title of host publication: 14th European Conference on Antennas and Propagation, EuCAP 2020

Publisher: IEEE

ISBN (Electronic): 9788831299008

#### Publication series

Name: 14th European Conference on Antennas and Propagation, EuCAP 2020

ASJC Scopus subject areas: Computer Networks and Communications, Signal Processing, Instrumentation, Radiation

Keywords: energy harvesting, implantable antenna, intracranial implants, power transfer efficiency., wireless inductive powering

DOIs:

10.23919/EuCAP48036.2020.9135977

Source: Scopus

Source ID: 85088647197

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

#### High power fiber lasers

Over 1 kW of output power has now been reached with nearly diffraction-limited ytterbium-doped fiber lasers. Amplifiers can reach comparable powers, even with single-frequency beams. We review these and other recent results and discuss the possibilities for further progress.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Optoelectronics Research Centre, Southampton Photonics, Inc., University of Southampton

Contributors: Nilsson, J., Sahu, J. K., Jeong, Y., Filippov, V. N., Soh, D. B. S., Codemard, C. A., Dupriez, P., Kim, J.,

Richardson, D. J., Malinowski, A., Piper, A. N., Price, J. H. V., Furusawa, K., Clarkson, W. A., Payne, D. N.

Publication date: 2006

#### Host publication information

Title of host publication: Optics InfoBase Conference Papers

Publisher: Optical Society of America

ISBN (Print): 1557528020, 9781557528025

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84899075367&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84899075367

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

#### High-Q resonance train in a plasmonic metasurface

We experimentally demonstrate a plasmonic surface that supports a series of high-quality-factor ( $Q \approx 100$ ) surface lattice resonances. These resonances are enabled by tuning the thickness of the top-cladding layer to confine higher order diffraction-orders.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, University of Ottawa, Canada, Iridian Spectral Technologies, University of Rochester Institute of Optics

Contributors: Saad-Bin-Alam, M., Reshef, O., Huttunen, M. J., Carlow, G., Sullivan, B., Menard, J. M., Dolgaleva, K., Boyd, R. W.

Publication date: 1 May 2019

### Host publication information

Title of host publication: 2019 Conference on Lasers and Electro-Optics, CLEO 2019 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781943580576

ASJC Scopus subject areas: Spectroscopy, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Management, Monitoring, Policy and Law, Electronic, Optical and Magnetic Materials, Radiology Nuclear Medicine and imaging, Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.23919/CLEO.2019.8750206

Source: Scopus

Source ID: 85069156893

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

### Humidity passive sensors based on UHF RFID using cork dielectric slabs

In this paper we show the design of passive UHF RFID tag antenna on cork substrate. Due to the cork sensitivity to humidity changes, we can use the developed sensor to sense changes in the relative humidity of the environment, without the need for batteries. The antenna is built using inkjet printing technology, which allows a good accuracy of the design manufacturing. The sensor proved usable for humidity changes detection with a variation of threshold power from 11 to 15 dB between 60 and near 100% humidity levels. Presenting, therefore, reading ranges between 3 to 5 meters.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Sensing Systems for Wireless Medicine (MediSense), Universidade de Aveiro, Instituto Superior de Engenharia de Lisboa, Georgia Institute of Technology

Contributors: Goncalves, R., Pinho, P., Carvalho, N. B., Tentzeris, M. M.

Publication date: 27 Aug 2015

### Host publication information

Title of host publication: 2015 9th European Conference on Antennas and Propagation, EuCAP 2015

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7228346

ISBN (Electronic): 9788890701856

ASJC Scopus subject areas: Instrumentation, Radiation, Computer Networks and Communications

Keywords: cork substrate, humidity sensor, RFID

URLs:

<http://www.scopus.com/inward/record.url?scp=84949672907&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84949672907

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

### Impact of Different Concrete Types on Radio Propagation: Fundamentals and Practical RF Measurements

By the 1960's, European countries faced a massive housing shortage due to changes in social structure and migration from rural areas to towns. This led to a rapid growth of suburban areas in the 1960's and 1970's. Concrete, as a building material became popular as the prefabrication techniques of precast concrete structures developed rapidly during this era, and these trends continue even today. In the near future, the number of frequency bands used by mobile wireless communication systems will increase and, in general, the trend is towards higher frequencies. This paper presents the results of measurements in which the RF attenuations of several different concrete types were determined on the basis of the permittivity of the material samples. The frequency ranges used in the measurements were 4.5 to 19 GHz and 26 to 40 GHz. In particular, at higher frequencies, the attenuation of various concrete grades is very different, and the level of RF attenuation of the outer wall cannot be predicted without knowing the age of the building and the concrete quality used in the element.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Tampere University, VTT Technical Research Centre of Finland

Contributors: Asp, A., Hentilä, T., Valkama, M., Pikkuvirta, J., Hujanen, A., Huhtinen, I.

Publication date: 1 Jun 2019

### Host publication information

Title of host publication: 2019 4th International Conference on Smart and Sustainable Technologies, SpliTech 2019

Publisher: IEEE

Editors: Rodrigues, J. J., Solic, P., Perkovic, T., Vukojevic, K., Rodrigues, J. J., Patrono, L., Nizetic, S.

ISBN (Electronic): 9789532900910

ASJC Scopus subject areas: Artificial Intelligence, Computer Networks and Communications, Instrumentation, Energy Engineering and Power Technology, Renewable Energy, Sustainability and the Environment

Keywords: energy-efficient buildings, outdoor-To-indoor propagation, penetration loss, plastering net, Radiowave propagation, RF measurements

DOIs:

10.23919/SpliTech.2019.8783022

### Bibliographical note

INT=ceng,"Pikkuvirta, Jussa"

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

### Improved Session Continuity in 5G NR with Joint Use of Multi-Connectivity and Guard Bandwidth

The intermittent millimeter-wave radio links as a result of human-body blockage are an inherent feature of the 5G New Radio (NR) technology by 3GPP. To improve session continuity in these emerging systems, two mechanisms have recently been proposed, namely, multi-connectivity and guard bandwidth. The former allows to establish multiple spatially-diverse connections and switch between them dynamically, while the latter reserves a fraction of system bandwidth for sessions changing their state from non-blocked to blocked, which ensures that the ongoing sessions have priority over the new ones. In this paper, we assess the joint performance of these two schemes for the user- and system-centric metrics of interest. Our numerical results reveal that the multi-connectivity operation alone may not suffice to increase the ongoing session drop probability considerably. On the other hand, the use of guard bandwidth significantly improves session continuity by somewhat compromising new session drop probability and system resource utilization. Surprisingly, the 5G NR system implementing both these techniques inherits their drawbacks. However, complementing it with an initial AP selection procedure effectively alleviates these limitations by maximizing the system resource utilization, while still providing sufficient flexibility to enable the desired trade-off between new and ongoing session drop probabilities.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Department of Chemistry and Bioengineering, Peoples' Friendship University of Russia

Contributors: Kovalchukov, R., Moltchanov, D., Begishev, V., Samuylov, A., Andreev, S., Koucheryavy, Y., Samouylov, K.  
Publication date: 20 Feb 2019

### Host publication information

Title of host publication: 2018 IEEE Global Communications Conference, GLOBECOM 2018

Publisher: IEEE

ISBN (Electronic): 9781538647271

ASJC Scopus subject areas: Information Systems and Management, Renewable Energy, Sustainability and the Environment, Safety, Risk, Reliability and Quality, Signal Processing, Modelling and Simulation, Instrumentation, Computer Networks and Communications

Electronic versions:

Improved Session Continuity in 5G NR 2019

DOIs:

10.1109/GLOCOM.2018.8647608

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001281600>

Source: Scopus

Source ID: 85063532495

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

### Incorporating Aircraft Kinematics and Radar Cross Section into the Performance Prediction of Air Surveillance

The evolution of modern radar is heading toward a networked, multifunctional, adaptive, and cognitive system. The network of software-controllable fast-adapting radars follows a highly complex control and operation logic. It is not straightforward to assess its instantaneous capability to detect, track, and recognize targets. To be able to predict or optimize the system performance, one has to understand its behavior not only on a general level, but also in various operating conditions and considering the target behavior and properties accurately. In this paper, we propose the fusion of radar and tracker recordings with an extensive database of cooperative aircraft navigation recordings and radar cross section data to assess and learn the performance measures for the air surveillance. The main contribution of this paper is the incorporation of the aircraft kinematics, orientation, and radar cross section into an automated measurement-based analysis. We consider the employment of the measurement-based metrics and machine learning in the performance prediction. Simulations and experiments with real-life data demonstrate the feasibility and potential of the proposed concept.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Computing Sciences, Research group: MMDM  
Contributors: Jylhä, J., Ruotsalainen, M., Väilä, M., Perälä, H.  
Publication date: 1 Jul 2019

### Host publication information

Title of host publication: FUSION 2019 - 22nd International Conference on Information Fusion  
Publisher: IEEE  
ISBN (Electronic): 9780996452786  
ASJC Scopus subject areas: Information Systems, Instrumentation  
Keywords: artificial intelligence, machine learning, radar, radar cross sections, system analysis and design, systems modeling  
Electronic versions:  
Air\_surveillance\_perf  
URLs:  
<http://urn.fi/URN:NBN:fi:tuni-202005145300>  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Inertial Odometry on Handheld Smartphones

Building a complete inertial navigation system using the limited quality data provided by current smartphones has been regarded challenging, if not impossible. This paper shows that by careful crafting and accounting for the weak information in the sensor samples, smartphones are capable of pure inertial navigation. We present a probabilistic approach for orientation and use-case free inertial odometry, which is based on double-integrating rotated accelerations. The strength of the model is in learning additive and multiplicative IMU biases online. We are able to track the phone position, velocity, and pose in realtime and in a computationally lightweight fashion by solving the inference with an extended Kalman filter. The information fusion is completed with zero-velocity updates (if the phone remains stationary), altitude correction from barometric pressure readings (if available), and pseudo-updates constraining the momentary speed. We demonstrate our approach using an iPad and iPhone in several indoor dead-reckoning applications and in a measurement tool setup.

### General information

Publication status: Published  
MoE publication type: A4 Article in a conference publication  
Organisations: Signal Processing, Research group: Artificial Intelligence and Vision - AIV, Aalto University  
Contributors: Solin, A., Cortes, S., Rahtu, E., Kannala, J.  
Number of pages: 8  
Pages: 1361-1368  
Publication date: 5 Sep 2018

### Host publication information

Title of host publication: 2018 21st International Conference on Information Fusion, FUSION 2018  
Publisher: IEEE  
Article number: 8455482  
ISBN (Print): 9780996452762  
ASJC Scopus subject areas: Computer Vision and Pattern Recognition, Signal Processing, Statistics, Probability and Uncertainty, Instrumentation  
DOIs:  
10.23919/ICIF.2018.8455482  
Source: Scopus  
Source ID: 85054102788  
Research output: Chapter in Book/Report/Conference proceeding › Conference contribution › Scientific › peer-review

### Inertial Sensor-Based State Estimation of Flexible Links Subject to Bending and Torsion

In this study, we propose an observer design based on inertial sensors and the finite element (FE) method to estimate the flexural states of a long-reach and highly flexible manipulator in a 3D plane of motion. Vertical and lateral dynamic bendings are considered, along with deformation due to torsion. The aim is to achieve accurate end-point positioning by using the estimated flexural degrees-of-freedom, which are formulated using an FE model. The states are reconstructed based on angular velocity measurements, which are obtained from strap-on inertial sensors placed along the flexible link. For validation, a motion-capture setup consisting of three OptiTrack cameras is used. The experiments are conducted on a hydraulic manipulator that has a single 4.5-m long flexible link with a tip mass. The validation is carried out by comparing the estimates to the OptiTrack reference measurements. The results demonstrate that this method provides satisfactory end-point positioning, while also being convenient for use in heavy-duty mobile manipulators.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Automation and Hydraulic Engineering, Research group: Innovative Hydraulic Automation

Contributors: Mäkinen, P., Mononen, T., Mattila, J.

Number of pages: 8

Publication date: 27 Aug 2018

### Host publication information

Title of host publication: 2018 14th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications, MESA 2018

Publisher: IEEE

Article number: 8449188

ISBN (Print): 9781538646434

ASJC Scopus subject areas: Control and Optimization, Computer Science Applications, Electrical and Electronic Engineering, Mechanical Engineering, Instrumentation

Keywords: finite element method, inertial sensors, state estimation

Electronic versions:

Inertial Sensor-Based State Estimation of FlexibleLinks Subject to Bending and Torsion 2018

DOIs:

10.1109/MESA.2018.8449188

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202001271550>

Source: Scopus

Source ID: 85053925148

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

### Inkjet-printed dual microfluidic-based sensor integrated system

Demonstrated is a novel method to the fabrication of microfluidic devices utilizing a dual-sensor approach. The fabrication incorporates the use of poly(methyl-methacrylate) (PMMA) and inkjet-printing techniques. PMMA, a low-cost, robust material with low dielectric loss, is ideal for sensor fabrication. In addition, inkjet-printing polymer (SU-8) as a bonding layer dramatically improves the bonding strength and pressure handling. Furthermore, this system integrates two independent sensors in the same circuit, enabling concurrent calibration of two fluids. Based on the reaction in one sensor, response in another sensor for the same fluid can be predicted. The two sensors both have a sensitivity over 21 %/log(r) and a good independence in calibrating fluids. The sensor system works at microwave frequency, enabling applications in wireless sensing including various chemical analysis.

### 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, School of Electrical and Computer Engineering, University of Perugia

Contributors: Su, W., Cooper, J. R., Cook, B. S., Tentzeris, M. M., Mariotti, C., Roselli, L.

Publication date: 31 Dec 2015

### Host publication information

Title of host publication: 2015 IEEE SENSORS - Proceedings

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7370300

ISBN (Electronic): 9781479982028

ASJC Scopus subject areas: Instrumentation, Electronic, Optical and Magnetic Materials, Spectroscopy, Electrical and Electronic Engineering

Keywords: additive manufacturing, inkjet printing, microfluidics

DOIs:

10.1109/ICSENS.2015.7370300

URLs:

<http://www.scopus.com/inward/record.url?scp=84963626729&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84963626729

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

### Light beam hysteresis in liquid crystals

We investigate optical bistability with light beams propagating in reorientational nematic liquid crystals. In a given interval of input powers, light beams can propagate in either diffracting or soliton states, depending on the 'history' of the system. We use biased planar samples exhibiting an abrupt self-focusing response with threshold.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, University of Southampton, United Kingdom

Contributors: Piccardi, A., Alberucci, A., Kravets, N., Assanto, G., Buchnev, O., Kaczmarek, M.

Publication date: 2014

### Host publication information

Title of host publication: 2014 Fotonica AEIT Italian Conference on Photonics Technologies, Fotonica AEIT 2014

Publisher: IEEE COMPUTER SOCIETY PRESS

Article number: 6843888

ISBN (Print): 9788887237177

ASJC Scopus subject areas: Instrumentation

Keywords: Hysteresis, Nematic liquid crystal, Optical bistability, Spatial soliton

DOIs:

10.1109/Fotonica.2014.6843888

URLs:

<http://www.scopus.com/inward/record.url?scp=84904488923&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84904488923

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

### Location-based beamforming architecture for efficient farming applications with drones

This paper proposes a drone-based architecture with location-based beamforming (LBBF) and edge computing support for efficient crop harvesting and management in order to reduce the food waste in the food chain in farming applications.

Monitoring the crop is a crucial part in the food chain. In this work, for monitoring purpose we consider synthetic aperture radar (SAR) mounted on the unmanned aerial vehicles (UAVs). In order to provide the edge computing information with good reliability, small latency and good throughput, we introduce a LBBF technique for the uplink connectivity. Firstly, the LBBF algorithm is proposed for the scenario where a single user is connected to the base station under analog beamforming scheme. Secondly, in the context of LBBF, we apply an optimization of the antenna size under the uniform rectangular array (URA) assumption. Thirdly, we implement a numerical analysis to compare LBBF with the traditional channel state information (CSI)-based beamforming. We show that the LBBF outperforms the CSI-based beamforming in the noisy environments according to the investigated performance metrics, namely the reliability of the connectivity and the capacity. In addition, the LBBF also has smaller latency than CSI-based beamforming.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Research group: Wireless Communications and Positioning

Contributors: Wang, W., Okati, N., Tanash, I., Riihonen, T., Lohan, E.

Publication date: 4 Jul 2019

### Host publication information

Title of host publication: 2019 International Conference on Localization and GNSS, ICL-GNSS 2019

Publisher: IEEE

Editors: Lohan, E., Rugamer, A., Nurmi, J., Koch, W., Heuberger, A.

ISBN (Electronic): 9781728124452

ASJC Scopus subject areas: Computer Networks and Communications, Aerospace Engineering, Instrumentation

Keywords: Farming, Location-based beamforming (LBBF), Unmanned aerial vehicles (UAVs)

Electronic versions:

Location-based Beamforming Architecture 2019

DOIs:

10.1109/ICL-GNSS.2019.8752698

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002192199>

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

### Low-cost microfluidics-enabled tunable loop antenna using inkjet-printing technologies

A low-cost and disposable loop antenna is proposed, which consists of a microfluidics-enabled tunable square loop and a microfluidics-enabled tunable balun to guarantee a similar radiation pattern over a reconfigurable 'liquid-controlled' frequency range. By inserting different fluids over partial sections of the loop and the balun, the proposed antenna can achieve a frequency range of 2.28 GHz for water filled channel to 2.45 GHz for empty channel. The proposed antenna is fabricated in a low-cost and non-cleanroom process by integrating inkjet-printing with laser-etching techniques. This antenna can be used as a fluid sensor for biomedical or chemical assay, as well as a tunable antenna for communication



applications. The microfluidics-enabled tunable embedded balun can be applied independently as a wideband balun for various communication, sensing and biomonitoring applications.

#### 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, School of Electrical and Computer Engineering

Contributors: Su, W., Cook, B. S., Tentzeris, M. M.

Publication date: 27 Aug 2015

#### Host publication information

Title of host publication: 2015 9th European Conference on Antennas and Propagation, EuCAP 2015

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7228990

ISBN (Electronic): 9788890701856

ASJC Scopus subject areas: Instrumentation, Radiation, Computer Networks and Communications

Keywords: additive manufacturing, inkjet printing, loop antenna, microfluidics, tunable antenna, tunable balun

URLs:

<http://www.scopus.com/inward/record.url?scp=84949664380&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84949664380

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

#### Measurements of Reflection and Penetration Losses in Low Terahertz Band Vehicular Communications

The beyond-5G vehicular communications are expected not only to utilize the already explored millimeter-wave band but also to start harnessing the higher frequencies above 100 GHz ultimately targeting the so-called low terahertz band, 300 GHz-1 THz. In this paper, we perform a set of propagation measurements at 300 GHz band in representative vehicular environments. Particularly, we report on the reflection losses from the front, rear, and side of a regular vehicle. In addition, the penetration losses when propagating through, over, and under the vehicle are presented. Our study reveals that the vehicle body is extremely heterogeneous in terms of the propagation losses: the attenuation heavily depends on the trajectory of the 300 GHz signal through the vehicle. The reported measurement data may be used as a reference when developing the vehiclespecific channel and interference models for future wireless communications in the low terahertz band.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Research group: Emerging Technologies for Nano-Bio-Info-Cogno, Technische Universität Braunschweig

Contributors: Petrov, V., Eckhardt, J. M., Moltchanov, D., Koucheryavy, Y., Kurner, T.

Number of pages: 5

Publication date: 1 Mar 2020

#### Host publication information

Title of host publication: 14th European Conference on Antennas and Propagation, EuCAP 2020

Publisher: Institute of Electrical and Electronics Engineers Inc.

ISBN (Electronic): 9788831299008

#### Publication series

Name: 14th European Conference on Antennas and Propagation, EuCAP 2020

ASJC Scopus subject areas: Computer Networks and Communications, Signal Processing, Instrumentation, Radiation

Keywords: low terahertz, penetration losses, Propagation measurements, reflection losses, vehicular communications.

DOIs:

10.23919/EuCAP48036.2020.9135389

Source: Scopus

Source ID: 85088642836

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

#### Methods for long-term GNSS clock offset prediction

Clock offset predictions along with satellite orbit predictions are used in self-assisted GNSS to reduce the Time-to-First-Fix of a satellite positioning device. This paper compares three methods for predicting GNSS satellite clock offsets: polynomial regression, Kalman filtering and support vector machines (SVM). The regression polynomial and support vector machine model are trained from past offsets. The Kalman filter uses past offsets to estimate the clock offset coefficients. In tests with GPS and GLONASS data, it is found that all three methods significantly improve the clock predictions relative to extrapolation with the basic clock model of the last obtained broadcast ephemeris (BE). In particular, the 68% quantile of 7

day clock offset errors of GPS satellites was reduced by 66% with polynomial regression, 69% with Kalman filtering and 56% with SVM on average.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, Research group: Automation and Systems Theory, Automation Technology and Mechanical Engineering, Research group: Positioning

Contributors: Pihlajasalo, J., Leppäkoski, H., Kuismanen, S., Ali-Löytty, S., Piche, R.

Publication date: 1 Jun 2019

#### Host publication information

Title of host publication: 2019 International Conference on Localization and GNSS, ICL-GNSS 2019 : 4-6 June 2019, Nuremberg, Germany

Publisher: IEEE

Editors: Nurmi, J., Lohan, E., Rugamer, A., Heuberger, A., Koch, W.

ISBN (Print): 978-1-7281-2446-9

ISBN (Electronic): 9781728124452

#### Publication series

Name: International Conference on Localization and GNSS

Publisher: IEEE

ISSN (Print): 2325-0747

ISSN (Electronic): 2325-0771

ASJC Scopus subject areas: Computer Networks and Communications, Aerospace Engineering, Instrumentation

DOIs:

10.1109/ICL-GNSS.2019.8752725

URLs:

<http://urn.fi/URN:NBN:fi:tuni-201912056638>

#### Bibliographical note

int=comp,"Kuismanen, Saara"

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

#### Monitoring pH, temperature and humidity in long-term stem cell culture in CO<sub>2</sub> incubator

Cell culture in stem cell research is on the rise, not only for basic research but also for its potential medical and therapeutic applications. Monitoring culture process using sensors throughout the culture helps to optimize culture conditions for optimal growth and maximize yield from the cells. Further, the sensor data gives insight into developing better cell culture systems. Typical stem cell culture platforms, e.g. well plates or flasks, cannot be easily equipped with sensors and impose many challenges in periodic process measurements in a CO<sub>2</sub> incubator. We present an incubator compatible modular measurement system with three sensors, to monitor pH, temperature and humidity continuously throughout the culture. Sensors are assembled around a flow through cuvette for highly sterile non-contact measurements. No sample preparation or sample extraction from the incubator is needed and the measurements are carried out in a closed flow loop without wasting any medium. The modular assembly is novel, reusable and feasible for humid incubator environments. The system has been tested, validated and used in mesenchymal stem cell expansion and differentiation, for periods ranging from two to three weeks. Once the measurement has commenced at the beginning of culture, continuous measurements without sensor recalibration or special manual attention are carried out till the end of the culture. Measurement data clearly show the interplay between measured parameters, indicating a few stress sources present all through the culture. Additionally, it gives an overall picture of behavior of critical control parameters in an incubator and points out the need for bioprocess systems with automatic process monitoring and smart control for maximum yield, optimal growth and maintenance of the cells.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Faculty of Biomedical Sciences and Engineering, Research area: Microsystems, Research group: Sensor Technology and Biomeasurements (STB)

Contributors: Rajan, D. K., Verho, J., Kreutzer, J., Valimaki, H., Ihalainen, H., Lekkala, J., Patrikoski, M., Miettinen, S.

Number of pages: 5

Pages: 470-474

Publication date: 19 Jul 2017

#### Host publication information

Title of host publication: 2017 IEEE International Symposium on Medical Measurements and Applications (MeMeA)

Publisher: IEEE

ISBN (Electronic): 9781509029839

ASJC Scopus subject areas: Instrumentation, Computer Science Applications, Medicine (miscellaneous)  
Keywords: cell culture incubator environmental monitoring, incubator compatible sensors, long-term cell culture measurements, long-term optical cell culture pH measurements, non-contact cell culture measurements  
DOIs:

10.1109/MeMeA.2017.7985922

Source: Scopus

Source ID: 85027990253

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

### **Multifrequency PolSAR Image Classification Using Dual-Band 1D Convolutional Neural Networks**

In this work, we propose a novel classification approach based on dual-band one-dimensional Convolutional Neural Networks (1D-CNNs) for classification of multifrequency polarimetric SAR (PolSAR) data. The proposed approach can jointly learn from C- and L-band data and improve the single band classification accuracy. To the best of our knowledge, this is the first study that introduces 1D-CNNs to land use/land cover classification domain using PolSAR data. The proposed approach aims to achieve maximum classification accuracy by one-time training over multiple frequency bands with limited labelled data. Moreover, the proposed dual-band 1D-CNN approach yields a superior computational efficiency compared to the deep 2D-CNN based approaches. The performed experiments using AIRSAR PolSAR image over San Diego region at C- and L-bands have shown that the proposed approach is able to simultaneously learn from the C- and L-band SAR data and achieves an elegant classification performance with minimal complexity.

#### **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, Izmir University of Economics

Contributors: Ahishali, M., Kiranyaz, S., Ince, T., Gabbouj, M.

Number of pages: 4

Pages: 73-76

Publication date: 1 Mar 2020

#### **Host publication information**

Title of host publication: 2020 Mediterranean and Middle-East Geoscience and Remote Sensing Symposium, M2GARSS 2020 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781728121901

ASJC Scopus subject areas: Management, Monitoring, Policy and Law, Instrumentation, Earth and Planetary Sciences (miscellaneous), Atmospheric Science, Computers in Earth Sciences, Earth-Surface Processes, Aerospace Engineering, Global and Planetary Change

Keywords: 1D Convolutional Neural Networks, land use/land cover classification, multifrequency classification, Polarimetric Synthetic Aperture Radar (PolSAR)

DOIs:

10.1109/M2GARSS47143.2020.9105312

#### **Bibliographical note**

EXT="Kiranyaz, Serkan"

EXT="Ince, Turker"

Source: Scopus

Source ID: 85086740246

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

### **Multimode waveguides in nematic liquid crystals**

We report on the first experimental observation of higher-order modes guided by soliton-induced waveguides in nematic liquid crystals, identifying the power domains where guided modes are supported.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Australian National University, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Izdebskaya, Y. V., Desyatnikov, A. S., Assanto, G., Kivshar, Y. S.

Number of pages: 2

Pages: 1912-1913

Publication date: 2011

#### **Host publication information**

Title of host publication: Conference on Lasers and Electro-Optics/Pacific Rim, CLEOPR 2011

ISBN (Print): 9780977565771

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84893575091&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893575091

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

### **Nematicon routing in liquid crystal light valve**

Using external beams on the photoconductive layer of a liquid crystal light valve we demonstrate all-optical control of soliton induced waveguides in nematics. Using this approach we implement a half-adder and a 3-bit demultiplexer.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, CNRS

Contributors: Piccardi, A., Alberucci, A., Bertolozzo, U., Residori, S., Assanto, G.

Publication date: 2010

#### **Host publication information**

Title of host publication: Optics InfoBase Conference Papers

ISBN (Print): 9781557528964

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84896750605&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84896750605

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

### **Observation of defect formation in metamaterials**

We report subwavelength localization of electromagnetic fields within cavities based on metamaterials. Cavity resonances are observed in the transmission spectrum of a split ring resonator and composite metamaterials cavity structures. These cavity resonances are shown to exhibit high quality factors. Since the unit cells of metamaterials are much smaller than the operation wavelength, subwavelength localization is possible within these metamaterial cavity structures. In the present paper, we show that the electromagnetic field is localized into a region of  $\lambda/8$ , where  $\lambda$  is the cavity resonance wavelength.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Nanotechnology Research Center-NANOTAM, Bilkent University, Harvard University

Contributors: Caglayan, H., Bulu, I., Loncar, M., Ozbay, E.

Number of pages: 2

Publication date: 2008

#### **Host publication information**

Title of host publication: Plasmonics and Metamaterials 2008

Publisher: Optical Society of America

Article number: MMC7

ISBN (Print): 9781557528612

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/META\_PLAS.2008.MMC7

URLs:

<http://www.scopus.com/inward/record.url?scp=84898623312&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

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

### **On prediction of DCT-based denoising efficiency under spatially correlated noise conditions**

In this paper, results of image denoising efficiency prediction for filter based on discrete cosine transform (DCT) for the case of spatially correlated additive Gaussian Noise (SCGN) are given. The considered noise model is analyzed for

different degrees of spatial correlation that produce varying non-homogeneous spectrum of the noise. PSNR metric is exploited to assess denoising efficiency. It is shown in this paper, that a prediction of denoising efficiency has high accuracy for data distorted by noise with different degrees of spatial correlation, and require low computational resources.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

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

Contributors: Rubel, O., Lukin, V., Egiazarian, K.

Number of pages: 5

Pages: 750-754

Publication date: 12 Apr 2016

#### Host publication information

Title of host publication: 2016 13th International Conference on Modern Problems of Radio Engineering, Telecommunications and Computer Science (TCSET)

Publisher: IEEE

ISBN (Print): 9786176078067

ASJC Scopus subject areas: Computer Networks and Communications, Electrical and Electronic Engineering, Instrumentation, Radiation, Computer Science (miscellaneous), Signal Processing, Modelling and Simulation

Keywords: Denoising, Efficiency Prediction, Fitting, Spatially Correlated Noise

DOIs:

10.1109/TCSET.2016.7452171

Source: Scopus

Source ID: 84969277857

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

#### Open data based value networks: Finnish examples of public events and agriculture

In recent years, several countries have placed strong emphasis on openness, especially open data, which can be shared and further processed into various applications. Based on studies, the majority of open data providers are government organizations. This study presents two cases in which the data providers are companies. The cases are analyzed using a framework for open data based business models derived from the literature and several case studies. The analysis focuses on the beginning of the data value chain. As a result, the study highlights the role of data producers in the ecosystem, which has not been the focus in current frameworks.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Software Engineering and Intelligent Systems, Pervasive Computing, Research group: Business Ecosystems, Networks and Innovations

Contributors: Linna, P., Mäkinen, T., Yrjökoski, K.

Number of pages: 6

Pages: 1448-1453

Publication date: 10 Jul 2017

#### Host publication information

Title of host publication: 2017 40th International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9789532330922

ASJC Scopus subject areas: Computer Networks and Communications, Information Systems, Electrical and Electronic Engineering, Instrumentation

DOIs:

10.23919/MIPRO.2017.7973649

#### Bibliographical note

INT=tie,"Mäkinen, T."

Source: Scopus

Source ID: 85027692081

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

#### Optical Frequency Comb Photoacoustic Spectroscopy

We combine for the first time a mid-infrared optical frequency comb Fourier transform spectrometer with cantilever-enhanced photoacoustic detection and measure high-resolution broadband spectra of the fundamental band of methane in a few milliliter sample volume.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Physics, Energy Technology and Thermal Process Chemistry, University of Helsinki

Contributors: Sadiek, I., Mikkonen, T., Vainio, M., Toivonen, J., Foltynowicz, A.

Publication date: 1 May 2019

### Host publication information

Title of host publication: 2019 Conference on Lasers and Electro-Optics, CLEO 2019 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9781943580576

ASJC Scopus subject areas: Spectroscopy, Industrial and Manufacturing Engineering, Safety, Risk, Reliability and Quality, Management, Monitoring, Policy and Law, Electronic, Optical and Magnetic Materials, Radiology Nuclear Medicine and imaging, Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.23919/CLEO.2019.8749688

Source: Scopus

Source ID: 85069190764

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

### Optimization of RFID-Based Tunnel Access Monitoring System Antenna Reading Areas

This work focuses on a nuclear waste storage facility's RFID (Radio Frequency Identification)-based access monitoring system and especially on antenna reading area mapping results. The objective of this research is to find out the effects of sprayed concrete bedrock caverns and height of reader antennas on RFID antenna reading areas. First, we will shortly introduce the access monitoring system, equipment, and program that have been developed for the tunnel system. Next, we describe the research area, the locations of the antennas, and the study protocol. Finally, we discuss the effects of sprayed concrete and antenna height on the antenna reading areas. Further, we introduce other noted factors that affect the reading area sizes, for example bedrock fractures and fillings. Based on the results, a sprayed concrete surface improves the reflectiveness of the radio signal and thus the reading capabilities of the ID (Identification)-cards. Another clear result was that the higher the antenna or ID-card was placed, the longer the MRRR (Maximum Reliable Read Range) range was.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Cimcorp Oy, Posiva Oy, Aitosolutions Oyj

Contributors: Kordelin, K., Virkki, J., Kordelin, J., Kuusman, J., Mattila, J., Johansson, M., Ukkonen, L., Sydänheimo, L.

Publication date: 1 Mar 2019

### Host publication information

Title of host publication: 13th European Conference on Antennas and Propagation, EuCAP 2019

Publisher: IEEE

Article number: 8739592

ISBN (Electronic): 9788890701887

ASJC Scopus subject areas: Computer Networks and Communications, Instrumentation

Keywords: Antenna, Measurement, RFID, Tunnel system

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

### Passive RFID-based Textile Touchpad

This paper presents the first prototype of a passive RFID-based textile touchpad. Our unique solution takes advantage of ICs from passive UHF RFID technology. These components are combined into a textile-integrated IC array, which can be used for handwritten character recognition. As the solution is fully passive and gets all the needed energy from the RFID reader, it enables a maintenance-free and cost-effective user interface that can be integrated into clothing and into textiles around us.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group, Computing Sciences, Research group: Machine Learning Group MLG, Research group: Vision

Contributors: He, H., Chen, X., Raivio, L., Huttunen, H., Virkki, J.

Number of pages: 4

Publication date: 2020

### Host publication information

Title of host publication: 14th European Conference on Antennas and Propagation, EuCAP 2020

Publisher: IEEE

Article number: 9135201

ISBN (Print): 978-1-7281-3712-4

ISBN (Electronic): 9788831299008

ASJC Scopus subject areas: Computer Networks and Communications, Signal Processing, Instrumentation, Radiation

Keywords: passive UHF RFID, textile electronics, touchpad, user interface, wearable electronics

DOIs:

10.23919/EuCAP48036.2020.9135201

Source: Scopus

Source ID: 85088635326

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

### **Path Loss Characterization for Intra-Vehicle Wearable Deployments at 60 GHz**

In this work, we present the results of a wide-band measurement campaign at 60 GHz conducted inside a Linkker electric city bus. Targeting prospective millimeter-wave (mmWave) public transportation wearable scenarios, we mimic a typical deployment of mobile high-end consumer devices in a dense environment. Specifically, our intra-vehicle deployment includes one receiver and multiple transmitters corresponding to a mmWave access point and passengers' wearable and handheld devices. While the receiver is located in the front part of the bus, the transmitters repeat realistic locations of personal devices (i) at the seat level (e.g., a hand-held device) and (ii) at a height 70 cm above the seat (e.g., a wearable device: augmented reality glasses or a head-mounted display). Based on the measured received power, we construct a logarithmic model for the distance-dependent path loss. The parametrized models developed in the course of this study have the potential to become an attractive ground for the link budget estimation and interference footprint studies in crowded public transportation scenarios.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, Université catholique de Louvain, Aalto University

Contributors: Semkin, V., Ponomarenko-Timofeev, A., Karttunen, A., Galinina, O., Andreev, S., Koucheryavy, Y.

Publication date: 1 Mar 2019

#### **Host publication information**

Title of host publication: 13th European Conference on Antennas and Propagation, EuCAP 2019

Publisher: IEEE

ISBN (Electronic): 9788890701887

ASJC Scopus subject areas: Computer Networks and Communications, Instrumentation

Keywords: 60 GHz, intra-vehicle deployment, millimeter-wave, public transportation, wearable devices

Electronic versions:

Path Loss Characterization for Intra-Vehicle 2019

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202002242315>

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

### **Position Estimation for Drones based on Visual SLAM and IMU in GPS-denied Environment**

Due to the increased rate of drone usage in various commercial and industrial fields, the need for their autonomous operation is rapidly increasing. One major aspect of autonomous movement is the ability to operate safely in an unknown environment. The majority of current works are persistently using a global positioning system (GPS) to directly find the absolute position of the drone. However, GPS accuracy might be not suitable in some applications and this solution is not applicable to all situations. In this paper, a positioning system based on monocular SLAM and inertial measurement unit (IMU) is presented. The position is calculated through the semi-direct visual odometry (SVO) method alongside IMU data, and is integrated with an extended Kalman filter (EKF) to enhance the efficiency of the algorithm. The data is then employed to control the drone without any requirement to any source of external input. The experiment results for long-distance flying paths is very promising.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, K. N. Toosi University of Technology

Contributors: Motlagh, H. D. K., Lotfi, F., Taghirad, H. D., Germi, S. B.

Number of pages: 5

Pages: 120-124

Publication date: 1 Nov 2019

### Host publication information

Title of host publication: ICRoM 2019 - 7th International Conference on Robotics and Mechatronics

Publisher: IEEE

ISBN (Electronic): 9781728166049

ASJC Scopus subject areas: Artificial Intelligence, Computer Science Applications, Electrical and Electronic Engineering, Mechanical Engineering, Control and Optimization, Instrumentation

Keywords: Kalman filtering, monocular camera, Position estimation, SLAM, UAV

DOIs:

10.1109/ICRoM48714.2019.9071826

Source: Scopus

Source ID: 85084362481

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

### Protective Coating Methods for Glove-Integrated RFID Tags - A Preliminary Study

In this study, machine washing durability of working glove-integrated passive RFID tags is evaluated. These glove-tags are embedded inside 3D-printed thermoplastic polyurethane platforms. The results are compared to platforms embedded inside brush-painted encapsulant platforms. For a preliminary washing reliability evaluation, both types of glove-integrated platforms are washed in a washing machine for 5 times. Although both platforms can protect glove-tags from the effects of water, the main reliability challenge is found to be the fragile antenna-IC attachments. This paper introduces the two platform materials and the achieved washing test results. These preliminary results determine the future direction of this research: The next step is to study suitable methods to strengthen the interconnections, so that these glove-tags can survive the harsh environment inside a washing machine.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group

Contributors: Khan, Z., He, H., Chen, X., Ukkonen, L., Virkki, J.

Publication date: 1 Mar 2020

### Host publication information

Title of host publication: 14th European Conference on Antennas and Propagation, EuCAP 2020

Publisher: IEEE

Article number: 9135632

ISBN (Electronic): 9788831299008

### Publication series

Name: 14th European Conference on Antennas and Propagation, EuCAP 2020

ASJC Scopus subject areas: Computer Networks and Communications, Signal Processing, Instrumentation, Radiation

Keywords: Gloves, passive UHF RFID, protective coatings, reliability evaluation, washing

DOIs:

10.23919/EuCAP48036.2020.9135632

Source: Scopus

Source ID: 85088649095

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

### Real-time and Robust Collaborative Robot Motion Control with Microsoft Kinect ® v2

Recent development in depth sensing provide various opportunities for the development of new methods for Human Robot Interaction (HRI). Collaborative robots (co-bots) are redefining HRI across the manufacturing industry. However, little work has been done yet in the field of HRI with Kinect sensor in this industry. In this paper, we will present a HRI study using nearest-point approach with Microsoft Kinect v2 sensor's depth image (RGB-D). The approach is based on the Euclidean distance which has robust properties against different environments. The study aims to improve the motion performance of Universal Robot-5 (UR5) and interaction efficiency during the possible collaboration using the Robot Operating System (ROS) framework and its tools. After the depth data from the Kinect sensor has been processed, the nearest points differences are transmitted to the robot via ROS.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation, Signal Processing, Research group: Vision

Contributors: Teke, B., Lanz, M., Kämäräinen, J., Hietanen, A.

Number of pages: 6

Publication date: 27 Aug 2018



### Host publication information

Title of host publication: 2018 14th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications, MESA 2018

Publisher: IEEE

Article number: 8449156

ISBN (Print): 9781538646434

ASJC Scopus subject areas: Control and Optimization, Computer Science Applications, Electrical and Electronic Engineering, Mechanical Engineering, Instrumentation

Keywords: collaborative robots, human-robot collaboration, Human-robot interaction, Microsoft Kinect v2, ROS, trajectory planning

Electronic versions:

08449156

DOIs:

10.1109/MESA.2018.8449156

URLs:

<http://urn.fi/URN:NBN:fi:tty-201907151956>

### Bibliographical note

INT=mei,"Teke, Burak"

Source: Scopus

Source ID: 85053893135

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

### Role-based visualization of industrial IoT-based systems

The competition among manufacturers in the global markets calls for the enhancement of the agility and performance of the production process and the quality of products. As a result, the production systems should be designed in such a way to provide decision makers with visibility and analytics. To fulfill these objectives, the development of information systems in manufacturing industries has intensified in the past few years. On the other hand, the volume of data which is being generated on the shop floor is rising. To improve the efficiency of manufacturing processes, this amount of data should be analyzed by decision makers. To cope with this challenge, advanced visualization is needed to assist users to gain insight into data and make effective decisions faster. This paper describes an approach for building a role-based visualization of industrial IoT. We propose an extendible architecture that anticipates the future growth of data. By using the IoT platform introduced in this paper, selected Key Performance Indicators(KPI) can be monitored by different levels of enterprise. The prototype IoT dashboard has been implemented for a pilot production line 'Festo didactic training line' located in Seinäjoki University of Applied Sciences(SeAMK) and results have been validated.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation, Seinäjoki University of Applied Sciences

Contributors: Mahmoodpour, M., Lobov, A., Lanz, M., Mäkelä, P., Rundas, N.

Number of pages: 8

Publication date: 27 Aug 2018

### Host publication information

Title of host publication: 2018 14th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications, MESA 2018

Publisher: IEEE

Article number: 8449183

ISBN (Print): 9781538646434

ASJC Scopus subject areas: Control and Optimization, Computer Science Applications, Electrical and Electronic Engineering, Mechanical Engineering, Instrumentation

Keywords: Data Collection, Information Visualization, Internet of Things (IoT)

DOIs:

10.1109/MESA.2018.8449183

Source: Scopus

Source ID: 85053938410

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

### Routing light with nematicons: Light localization and steering in liquid crystals

Liquid crystals in the nematic phase support light self-confinement via reorientational nonlinearity and nonlocality, yielding robust spatial solitons which can trap, switch and route optical signals. We review the major achievements in the field.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Nonlinear Optics and OptoElectronics Lab, CNISM and University of Rome, INRS-EMT Université du Québec

Contributors: Assanto, G., Peccianti, M., Alberucci, A., Piccardi, A.

Number of pages: 2

Pages: 2281-2282

Publication date: 2009

### Host publication information

Title of host publication: Optics InfoBase Conference Papers

Publisher: Optical Society of America

ISBN (Print): 9781557528698

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/IQEC.2009.ITuG1

URLs:

<http://www.scopus.com/inward/record.url?scp=84897963487&partnerID=8YFLogxK> (Link to publication in Scopus)

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

### Secure environmental monitoring for industrial internet of things: From framework to live implementation

Worldwide changes in climate and increasing pollution level are tremendously affecting the need for environmental monitoring solutions. Recent activities in wireless sensor networks (WSNs) together with Cloud computing paradigm brought an entirely new perspective on monitoring as part of the Industrial Internet of Things (IIoT). However, most of the systems developed today are still facing lack of flexibility and security. This work presents the results of prototyping the IIoT wireless environmental monitoring system from both hardware and software sides. The developed mechanisms enable connectivity in infrastructure and mesh-like modes, where each sensor could act as relay allowing for improved node-failure resistance and scalability. Next, the authentication mechanism is proposed to enable transparent migration of any node between different network segments while keeping the overall operation secure. Finally, proof of the concept prototype deployment in real-life conditions shows the potential of metropolitan-scale utilization of the developed system.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Electrical Engineering, St. Petersburg State University of Aerospace Instrumentation, ITMO University

Contributors: Bezzateev, S., Voloshina, N., Zhidanov, K., Ometov, A.

Number of pages: 5

Publication date: 1 Jun 2019

### Host publication information

Title of host publication: 2019 International Conference on Localization and GNSS, ICL-GNSS 2019

Publisher: IEEE

Editors: Lohan, E., Rugamer, A., Nurmi, J., Koch, W., Heuberger, A.

ISBN (Electronic): 9781728124452

ASJC Scopus subject areas: Computer Networks and Communications, Aerospace Engineering, Instrumentation

Keywords: Authentication, Environmental monitoring, IIoT, Prototype, Security, Sensor network

Electronic versions:

Secure Environmental Monitoring for Industrial Internet of Things from Framework to Live Implementation

DOIs:

10.1109/ICL-GNSS.2019.8752764

URLs:

<http://urn.fi/URN:NBN:fi:tuni-202008266696>

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

### Self-assembled monolayers (SAMs) of porphyrin deposited inside solid-core photonic crystal fibre (SCPCF)

Photochemical and physical properties of solid-core photonic crystal fibre (SCPCF) modified inside with porphyrin films attached via self-assembled monolayer (SAM) technique are reported. Porphyrins can be utilized to develop different gas sensors.

### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Chemistry and Bioengineering, Chemistry and Bioengineering, Optoelectronics Research Centre, Frontier Photonics, Russian Academy of Sciences

Contributors: Veselov, A., Efimov, A., Chamorovskiy, A., Okhotnikov, O., Kosolapov, A., Levchenko, A., Lemmetyinen, H., Tkachenko, N.  
Publication date: 2011

#### Host publication information

Title of host publication: Access Networks and In-house Communications, ANIC 2011

ISBN (Print): 9781557529138

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84893608733&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893608733

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

### Single KTiOPO4 nanocrystals for nonlinear probing of local optical fields and interaction with a metallic nanostructure

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: ESPCI, Laboratoire de Physique de la Matière Condensée-Ecole Polytechnique-CNRS, ENS de Cachan, Laboratoire de Photonique Quantique et Moléculaire UMR 8537, Laboratoire Photons Et Matière-UPR A0005, Ecole Polytechnique, Cristal Laser S.A., Laboratoire de Photonique Quantique et Moléculaire-ENS Cachan

Contributors: Le Xuan, L., Slablab, A., Zhou, C., Chauvat, D., De Wilde, Y., Perruchas, S., Tard, C., Gacoin, T., Villeval, P., Roch, J. F.

Publication date: 2009

#### Host publication information

Title of host publication: Optics InfoBase Conference Papers

Publisher: Optical Society of America

ISBN (Print): 9781424440801

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84898050536&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84898050536

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

### Soliton self-deflection via power-dependent walk-off

We demonstrate and model power-dependent self-bending of spatial solitons in nematic liquid crystals. The deflection is explained by nonlinear changes in walk-off, as induced by the rotation of the optic axis via reorientation.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University "Roma Tre", Nonlinear Optics and OptoElectronics Lab

Contributors: Piccardi, A., Alberucci, A., Assanto, G.

Publication date: 2010

#### Host publication information

Title of host publication: Optics InfoBase Conference Papers

ISBN (Print): 9781557528964

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/NP.2010.NMD1

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

### Spatial solitons carrying phase singularities in nematic liquid crystals

We demonstrate self-trapped laser beams carrying optical vortices in nematic liquid crystals. We experimentally observe astigmatic transformations of vortex beams into spiralling dipole azimuthons accompanied by a nontrivial power-dependent charge-flipping of on-axis phase dislocations.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, Australian National University, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Izdebskaya, Y. V., Desyatnikov, A. S., Assanto, G., Kivshar, Y.

Number of pages: 2

Pages: 444-445

Publication date: 2011

#### Host publication information

Title of host publication: Conference on Lasers and Electro-Optics/Pacific Rim, CLEOPR 2011

ISBN (Print): 9780977565771

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84893535991&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893535991

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

#### Spatial solitons in a self-focusing medium with tunable nonlinearity

We employ a suitably designed planar cell with inter-digitated electrodes and nematic liquid crystals to investigate the role of nonlinearity in generation and propagation of spatial solitons.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Frontier Photonics, University "Roma Tre", Nonlinear Optics and OptoElectronics Lab, University of Southampton, United Kingdom

Contributors: Piccardi, A., Alberucci, A., Assanto, G., Kaczmarek, M.

Publication date: 2011

#### Host publication information

Title of host publication: Optics InfoBase Conference Papers

ISBN (Print): 9781557529152

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/NLO.2011.NWE7

Source: Scopus

Source ID: 84894325209

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

#### Strain Reliability of Embroidered Passive UHF RFID Tags on 3D-printed Substrates

Flexible electronics is an emerging field where the electronic components, antennas, and interconnections can endure significant mechanical stresses. This paper presents the fabrication and strain reliability evaluation of embroidered passive UHF RFID tags on 3D-printed (NinjaFlex) substrates. Based on the achieved results, these wireless platforms can withstand increases up to 14 % in length and remain functional. These preliminary results are promising, considering the current trend towards flexible and stretchable electronics structures.

#### General information

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: BioMediTech, Research group: Wireless Identification and Sensing Systems Research Group, Prenta Oy

Contributors: Khan, Z., Rizwan, M., Rusanen, R., Ukkonen, L., Virkki, J.

Publication date: 1 Mar 2019

#### Host publication information

Title of host publication: 13th European Conference on Antennas and Propagation, EuCAP 2019

Publisher: IEEE

ISBN (Electronic): 9788890701887

ASJC Scopus subject areas: Computer Networks and Communications, Instrumentation

Keywords: 3D Printing, embroidery, flexible electronics, NinjaFlex, passive RFID, strain reliability, stretchable electronics

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

#### Texture region detection by trained neural network

In this paper we consider an important practical aspect of texture region detection in remote sensing images. One specific feature of our study is that we assume a processed image noisy with a priori known type and parameters of the noise.

Another specific feature is that we try to detect textural regions for a wide variety of textures without having a priori knowledge of their properties. The considered task is solved by means of trained neural networks. In the paper, we analyze the aspects of choosing input local parameters used in detection (recognition) and carrying out training. The verification results provide valuable conclusions for these aspects.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Signal Processing, Research group: Computational Imaging-CI, National Aerospace University (KhAI), Dept of Transmitters

Contributors: Naumenko, A., Krivenko, S., Lukin, V., Egiazarian, K.

Publication date: 9 Aug 2016

#### **Host publication information**

Title of host publication: 9th International Kharkiv Symposium on Physics and Engineering of Microwaves, Millimeter and Submillimeter Waves, MSMW 2016

Publisher: IEEE

ISBN (Electronic): 9781509022663

ASJC Scopus subject areas: Radiology Nuclear Medicine and imaging, Instrumentation, Computer Networks and Communications, Radiation

Keywords: image, noise, remote sensing, texture detection

DOIs:

10.1109/MSMW.2016.7538174

#### **Bibliographical note**

EXT="Lukin, V."

Source: Scopus

Source ID: 84988036836

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

#### **The educators' telescope to the future of technology**

We live in a world of accelerating changes, where technology plays an important role as an enabler. Looking ahead means being prepared for these changes. Preparedness may be reactive - reacting to the situation at the moment something happens; proactive - being prepared in advance for a situation that may happen; or preactive - being able in advance to affect something that may happen in the future and how it happens. Forecasting the future helps us to be prepared for new situations. It is based on making predictions that are derived from understanding past and present data. Known data is organized in the form of trends and further extrapolated to cover the future. From the technical point of view, there are a variety of approaches for forecasting: algorithmic, simulation, statistical analysis etc. The methods used may be quantitative (future data is seen as a function of past data) or qualitative (subjective, based on the opinion or judgment of the target group used in the analysis). Technology is an essential part of education, both in supporting effective learning and as a content of teaching itself. As a result, every educator needs skills to analyze the future of relevant technologies. In this paper, we introduce a framework that can be used in analysis of the importance of technological changes in education and as a part of curricula. The approach is based on trend analysis and classification of the relevant technologies to take into account the time span of their effects in society. The question we answer in this paper is How can an educator analyze the consequences of technological changes in their work?.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Software Engineering and Intelligent Systems, Pervasive Computing, Tallinn University of Technology, Computer Science Institute, University of Lapland

Contributors: Jaakkola, H., Henno, J., Thalheim, B., Mäkelä, J.

Number of pages: 6

Pages: 660-665

Publication date: 10 Jul 2017

#### **Host publication information**

Title of host publication: 2017 40th International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9789532330922

ASJC Scopus subject areas: Computer Networks and Communications, Information Systems, Electrical and Electronic Engineering, Instrumentation

Electronic versions:

Telescope

DOIs:

10.23919/MIPRO.2017.7973506

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712012294>

Source: Scopus

Source ID: 85027689985

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

### **Theory of near-IR metatronic nanocircuits using transparent conducting oxides (TCO)**

We theoretically investigate TCO nanorods functioning as optical nanocircuits in NIR regimes. Using the circuit theory and FDTD simulations, we explore the nanoscale circuit element functionalities controlled by the polarization of incident E-field.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Electrical and Systems Engineering, University of Pennsylvania

Contributors: Caglayan, H., Engheta, N.

Publication date: 2011

#### **Host publication information**

Title of host publication: Frontiers in Optics 2011

Publisher: Optical Society of America

ISBN (Print): 9781557529176

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

DOIs:

10.1364/FIO.2011.FTuG2

URLs:

<http://www.scopus.com/inward/record.url?scp=84893520875&partnerID=8YFLogxK> (Link to publication in Scopus)

#### **Bibliographical note**

EXT="Caglayan, Humeyra"

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

### **The variation of air and surface temperatures in London within a 1km grid using vehicle-transect and ASTER data**

Urbanisation can modify the local climate, increasing the temperature of cities compared to rural areas. This phenomenon is known as the Urban Heat Island (UHI), and this paper introduces a methodology to investigate the spatial variability of air and surface temperatures across London. In particular, this study aims to investigate if a widely used spatial resolution (1 km) is appropriate for heat-related health risk studies. Data from vehicle-transect and ASTER thermal images were overlaid on a reference grid of 1 km, used by UHI simulation models. The results showed higher variability of air temperature within some specific modelled grid cells in the city centre, while surface temperatures presented higher variability in the London borders. This investigation suggests that LST has larger variation levels and more grid cells with sub-grid variation above 1°C compared to air temperature measurements.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: University College London, London School of Hygiene and Tropical Medicine

Contributors: Dos Santos, R. S., Taylor, J., Davies, M., Mavrogianni, A., Milner, J.

Publication date: 10 May 2017

#### **Host publication information**

Title of host publication: 2017 Joint Urban Remote Sensing Event, JURSE 2017

Publisher: Institute of Electrical and Electronics Engineers Inc.

Article number: 7924613

ISBN (Electronic): 9781509058082

#### **Publication series**

Name: 2017 Joint Urban Remote Sensing Event, JURSE 2017

ASJC Scopus subject areas: Signal Processing, Urban Studies, Management, Monitoring, Policy and Law, Instrumentation

DOIs:

10.1109/JURSE.2017.7924613

URLs:

<http://www.scopus.com/inward/record.url?scp=85020236643&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 85020236643

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

### **Third harmonic generation enhancement in nematic liquid crystals via nonlocal solitons propagation**

We demonstrate type I third harmonic generation enhanced by the tight localization of fs laser light in nonlocal spatial solitons excited in nematic liquid crystals.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Department of Physics, Frontier Photonics, Sapienza University, INRS Énergie, Matériaux et Télécommunications, Nonlinear Optics and OptoElectronics Lab, University "Roma Tre"

Contributors: Peccianti, M., Pasquazi, A., Assanto, G., Morandotti, R.

Publication date: 2011

#### **Host publication information**

Title of host publication: CLEO: Science and Innovations, CLEO\_SI 2011

ISBN (Print): 9781557529107

ASJC Scopus subject areas: Instrumentation, Atomic and Molecular Physics, and Optics

URLs:

<http://www.scopus.com/inward/record.url?scp=84893600063&partnerID=8YFLogxK> (Link to publication in Scopus)

Source: Scopus

Source ID: 84893600063

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

### **Today is the future of yesterday; What is the future of today?**

In the educational context, understanding the future is important for two reasons. First, we are educating people for future tasks, which need skills that are useful in the future. Secondly, educators have to be able to select the most promising tools and technologies to apply in their work. The problem is that there is no clear way to weigh the importance of the alternatives - what the real importance of a certain technology will be in the near future and especially in the long term. In our paper, we focus on analyzing selected technologies. Our approach applies the framework developed by the authors. The promising technologies are reviewed by a systematic literature study, focusing on and restricted to the information and communication technology (ICT) sector. The findings are classified according to their importance and the time span of their effectiveness. The question we answer is What should every educator know about changes in technology?

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Research group: Software Engineering and Intelligent Systems, Pervasive Computing, Tallinn University of Technology, University of Lapland, Computer Science Institute

Contributors: Jaakkola, H., Henno, J., Mäkelä, J., Thalheim, B.

Number of pages: 9

Pages: 635-643

Publication date: 10 Jul 2017

#### **Host publication information**

Title of host publication: 2017 40th International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2017 - Proceedings

Publisher: IEEE

ISBN (Electronic): 9789532330922

ASJC Scopus subject areas: Computer Networks and Communications, Information Systems, Electrical and Electronic Engineering, Instrumentation

Electronic versions:

ce\_04\_4369

DOIs:

10.23919/MIPRO.2017.7973502

URLs:

<http://urn.fi/URN:NBN:fi:tty-201712012296>

Source: Scopus

Source ID: 85027689860

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

### **Towards Asteroid Tomography: Modellings and Measurements Using an Analogue Model**

The interior structures of the comets and asteroids, still poorly known, might hold a unique key to understand the early Solar System. Considering the interaction of an illuminated electromagnetic wave with this kind of targets, these 'objects' are very large compared to the applicable wavelength. Consequently, tomographic imaging of such targets, i.e., reconstructing their interior structure via multiple measurements, constitutes a challenging inverse problem. To reach this objective and to develop and test inverse algorithms, we need to investigate electromagnetic fields that have interacted with structures analogous to real asteroids and comets. In this study, we focus on the acquisition of these fields considering three methods: calculated fields obtained with (1) time and (2) frequency domain methods and (3) microwave measurements performed for an analogue model, i.e., a small-scale asteroid model.

#### **General information**

Publication status: Published

MoE publication type: A4 Article in a conference publication

Organisations: Computing Sciences, UMR 7249, G2Elab/Institut Néel

Contributors: Eyraud, C., Sorsa, L. I., Herique, A., Geffrin, J. M., Pursiainen, S., Kofman, W.

Number of pages: 4

Publication date: 1 Mar 2020

#### **Host publication information**

Title of host publication: 14th European Conference on Antennas and Propagation, EuCAP 2020

Publisher: IEEE

ISBN (Electronic): 9788831299008

#### **Publication series**

Name: 14th European Conference on Antennas and Propagation, EuCAP 2020

ASJC Scopus subject areas: Computer Networks and Communications, Signal Processing, Instrumentation, Radiation

Keywords: 3D inversion, Analogue model, Electromagnetic wave, Large targets, Microwave analogy, Microwave imaging  
DOIs:

10.23919/EuCAP48036.2020.9136060

Source: Scopus

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### **User Positioning in mmW 5G Networks Using Beam-RSRP Measurements and Kalman Filtering**

In this paper, we exploit the 3D-beamforming features of multi-antenna equipment employed in fifth generation (5G) networks, operating in the millimeter wave (mmW) band, for accurate positioning and tracking of users. We consider sequential estimation of users' positions, and propose a two-stage extended Kalman filter (EKF) that is based on reference signal received power (RSRP) measurements. In particular, beamformed downlink (DL) reference signals (RSs) are transmitted by multiple base stations (BSs) and measured by user equipments (UEs) employing receive beamforming. The so-obtained beam-RSRP (BRSRP) measurements are reported to the BSs where the corresponding directions of departure (DoDs) are sequentially estimated by a novel EKF. Such angle estimates from multiple BSs are subsequently fused on a central entity into 3D position estimates of UEs by means of another (second-stage) EKF. The proposed positioning scheme is scalable since the computational burden is shared among different network entities, namely transmission/reception points (TRPs) and 5G-NR Node B (gNB), and may be accomplished with the signalling currently specified for 5G. We assess the performance of the proposed algorithm on a realistic outdoor 5G deployment with a detailed ray tracing propagation model based on the METIS Madrid map. Numerical results with a system operating at 39 GHz show that sub-meter 3D positioning accuracy is achievable in future mmW 5G networks.

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