Model-based force and position tracking control of a multi-pressure hydraulic cylinder

This article presents a force control solution for a throttle-free multi-pressure hydraulic cylinder actuator. A model-based force controller was developed and the position and velocity tracking control was implemented using low-order linear controllers. Special attention was paid to robustness against variations in the load mass, bulk modulus, and system delay. Experimental results demonstrated excellent energy efficiency and robustness, and acceptable tracking performance.

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Organisations: Automation and Hydraulic Engineering, Research group: Innovative Hydraulic Automation
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Scopus rating (2013): SJR 0.486 SNIP 0.895 CiteScore 1.3
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Scopus rating (2011): SJR 0.298 SNIP 0.75 CiteScore 0.79
Scopus rating (2010): SJR 0.346 SNIP 0.926
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Scopus rating (2002): SJR 0.297 SNIP 0.6
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Analysis of common rail pressure signal of dual-fuel large industrial engine for identification of injection duration of pilot diesel injectors

In this paper, we address the problem of identification of injection duration of common rail (CR) diesel pilot injectors of dual-fuel engines. In these pilot injectors, the injected volume is small and the repeatability of injections and identification of drifts of injectors are important factors, which need to be taken into account in order to achieve good repeatability (shot-to-shot with every cylinder) and therefore a well-balanced engine and furthermore reduced overall wear. This information can then be used for calibration and diagnostics purposes to guarantee engine longevity facilitated by consistent operating conditions throughout the life of the unit. A diagnostics method based on analysis of CR pressure with experimental results is presented in this paper. Using the developed method, the relative duration of injection events can be identified for multiple injectors. We use the phenomenon of drop in rail pressure due to an injection event as a feature of the injection process. The method is based on filtered CR pressure data during and after the injection event. First, the pressure signal during injection is extracted after control of each injection event. After that, the signal is normalized and filtered. Then a derivative of the filtered signal is calculated. Change in the derivative of the filtered signal larger than a predefined threshold indicates an injection event that can be detected and its relative duration can be identified. We present the experimental results and demonstrate the efficacy of the proposed methods using two different
types of pressure sensors. We are able to properly identify a change of ≥10 μs (2%, 500 μs) in injection time. This shows that the developed method detects drifts in injection duration and the magnitude of drift. This information can be used for adaptive control of injection duration, so that finally the injected fuel volume is the same as the original.

General information
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Ministry of Education publication type: A1 Journal article-refereed
Organisations: Automation and Hydraulic Engineering
Authors: Krogerus, T., Hyvönen, M., Huhtala, K.
Pages: 1-9
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Peer-reviewed: Yes

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Scopus rating (2014): SJR 1.667 SNIP 2.331 CiteScore 4.14
Scopus rating (2013): SJR 1.811 SNIP 2.595 CiteScore 4.31
Scopus rating (2012): SJR 1.852 SNIP 2.465 CiteScore 3.99
Scopus rating (2011): SJR 2.093 SNIP 2.427 CiteScore 4.1
Scopus rating (2010): SJR 1.984 SNIP 2.319
Scopus rating (2009): SJR 2.012 SNIP 2.277
Scopus rating (2008): SJR 1.635 SNIP 2.184
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Scopus rating (2006): SJR 1.278 SNIP 1.64
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Scopus rating (2004): SJR 1.273 SNIP 1.883
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Proceedings of the 2nd Annual SMACC Research Seminar 2017
The Annual SMACC Research Seminar is a forum for researchers from VTT Technical Research Centre of Finland Ltd, Tampere University of Technology (TUT) and industry to present their research in the area of smart machines and manufacturing. The 2nd seminar is held in 7th of November 2017 in Tampere, Finland.

The objective of the seminar is to publish results of the research to wider audiences and to offer researchers a forum to discuss their research and to find common research interests and new research ideas.

Smart Machines and Manufacturing Competence Centre - SMACC is joint strategic alliance of VTT Ltd and TUT in the area of intelligent machines and manufacturing. SMACC offers unique services for SME’s in the field of machinery and manufacturing - key features are rapid solutions, cutting-edge research expertise and extensive partnership networks. SMACC is promoting digitalization in mechanical engineering and making scientific research with domestic and international partners in several different topics (www.smacc.fi).

General information
State: Published
Ministry of Education publication type: C2 Edited books
Organisations: Mechanical Engineering and Industrial Systems
A Miniature On/Off Valve Concept for High Performance Water Hydraulics

Digital hydraulic control valve technology has shown its strengths in providing reliable, leak-tight and high performance valve control regardless of the pressure medium used, oil or water. This is enabled by the intelligent use of robust on/off seat valves. However, the availability of these valves for water hydraulics is limited, especially that of compact valves, which are needed for digital valve systems. Thus, with the aim to create a compact digital water hydraulic valve system, this paper presents the development process of a water hydraulic miniature valve. The starting point for the development is a previously developed miniature valve for oil hydraulics. Experimental results with the new prototype show that good performance can be achieved for the miniature valve even with using stainless steel materials. This enables high-performance digital water hydraulic control.

General information
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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Automation and Hydraulic Engineering, Research group: Digital hydraulics
Authors: Paloniitty, M., Linjama, M.
Number of pages: 8
Publication date: 19 Oct 2017

Hydraulic Damper Concept for Thruster Ice Impact Load Reduction

Steerable thrusters are used to maneuver a vessel in open sea environment. The harsh environment of arctic seas introduces certain challenges with propellers hitting ice and decreasing lifetime of the system, as the loads generated by ice impacts are significantly higher than nominal loads. Damping of an ice impact load is a difficult task since the impacts have high torsional loads and they occur only in a fraction of the lifetime of the system. Commercial dampers are hard to find since they do not generally have the capacity for damping such high loads. The proposed active hydraulic damper reduces ice impact loads by accelerating and decelerating the shaft line. The lack of space and commercial components narrow down the possibilities but simulation results with the system show some positive effects in typical ice impact scenario. The system also recuperates most of the used energy and stores it to accumulator.

General information
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Ministry of Education publication type: A4 Article in a conference publication
Authors: Siivonen, L., Huhtala, K.
Number of pages: 10
Publication date: 19 Oct 2017
Engineering design analysis tool for early design phase with low-fidelity models – a case of hydraulic crane

Model-based product design using computer simulation has become a standard design practice in most companies in mechanical engineering. However, there is a need for efficient simulation tools that can provide design-supporting information already at early design phase when the most important decisions are made. Design process and design tools need to be agile and enable iterative process where the design and its requirements can effectively be iterated. Low-fidelity models can be part of the solution for time issue in early design phase. Low-fidelity prototypes are simplified representations of functions and concepts in the virtual prototype. Axiomatic design with low-fidelity modelling approach is a promising concept for achieving design-supporting information in an efficient way. In this method, there is a linear mapping between design parameters and system characteristics. Non-linear models of the system are linearized at the nominal point. An engineering design analysis tool (EDA tool) to enhance EDA is constructed and presented in this paper. For evaluation of the usefulness of this tool, a case study is presented. The case study deals with a simple hydraulic crane that is manufactured from steel plate. The results of the case study design are compared with results achieved with conventional CAD and FEM tools. Modelling accuracy and required modelling and simulation efforts are compared in both cases.
Study of Energy Losses in Digital Hydraulic Multi-Pressure Actuator

A digital hydraulic multi-pressure actuator is a new actuator concept, which aims at lowering energy losses and decreasing dynamic requirements of a prime mover in mobile hydraulic applications. The actuator consists of an integrated hydraulic accumulator, which serves as an energy storage and a number of asymmetric cylinders acting as discrete pressure transformers. Leak-free on/off-valves are used to direct flow from the discrete pressure transformers to the actuator. Input power is supplied by charging the local accumulator with a small fixed displacement pump. Thus, the actuator requires only mean input power, while the output power peaks can be multifold. This paper concentrates on studying the controllability of the actuator concept and analyses the power losses and their sources through experimental study. The energy losses of the concept are measured in a mobile hydraulic boom mock-up and compared to earlier measured losses of a load sensing proportional valve based system. The measurements show that up to 77 % of the losses can be avoided by using the new concept. Three controller types are studied numerically and experimentally and their effect on control resolution and energy efficiency is evaluated.

General information
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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Automation and Hydraulic Engineering, Research group: Innovative Hydraulic Automation
Authors: Huova, M., Aalto, A., Linjama, M., Huhtala, K.
Pages: 214-223
Publication date: 8 Jun 2017

Apparent electrical energy storages in groundwood mills and their utilization in demand response

General information
State: Published
Ministry of Education publication type: D3 Professional conference proceedings
Authors: Björkqvist, T., Korpela, T., Majanne, Y., Vilkko, M., Tuovinen, O.
Number of pages: 2

The effects of air compressibility, viscosity, and turbulent kinetic energy production modeling are studied in the case of round high-speed subsonic wall impinging jet heat transfer. A vorticity based turbulence kinetic energy production term is implemented in the k-ω-SST model and the implementation is validated with experimental data. Compressible flow model results are compared with incompressible flow model results for more than 80 cases with pressure ratios up to 1.65 (Ma ≈ 0.85). The practical application considered in the present paper is the cooling section of a glass tempering machine. The vorticity based model performs better near stagnation point and second peak. The peak values affect visual quality of tempered glass through residual stresses. Glass initial temperature in the cooling section is about 600 °C and high-speed jets are produced with 1-3 mm nozzles. Validation is done with larger nozzles and slower jets as no suitable experimental data is available. The mean and maximum heat transfer rate resulting from choosing a constant viscosity at glass temperature and using an incompressible flow model differs less than 20 % from the compressible model results with locally modelled viscosity in all the studied cases. All the modeling is done with OpenFOAM and the modified code is published in GitHub.
An investigation of fatigue damage development under complete contact fretting test conditions

In this paper evolution equation based multiaxial fatigue model is applied to the analysis of fretting fatigue of a cantilever test specimen made of EN 10083-1 steel. The adopted high-cycle fatigue model is based on the concept of evolving endurance surface and damage evolution equation. For the endurance surface a simple linear relationship between the hydrostatic stress and the reduced deviatoric stress is used. It is observed that such a simple relationship does not model the fretting fatigue phenomena properly due to the high compressive hydrostatic stress state at the contact region. Also stress gradient effects should be taken into account in a more rigorous manner.

General information
State: Published
Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics, Department of Materials Science, Research group: Tribology and Machine Elements, Department of Civil Engineering
Authors: Holopainen, S., Juoksukangas, J., Kouhia, R., Lehtovaara, A., Saksala, T.
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Original language: English
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Links:
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One basic question in non-linear continuum mechanics is related to the measurement of deformation, which as a geometrical concept can be defined in several different ways. The purpose of this paper is to clarify the meaning of some commonly used strain measures.

On optimisation of structures under stability constraints - a simple example
In this paper some basic questions on optimisation of structures prone to instability behaviour are addressed by using a simple example consisting only one state variable. A multi-criteria optimisation problem, where both the material cost and imperfection sensitivity are minimized, is formulated.
Stability-Guaranteed Nonlinear Model-Based Control of Hydraulic Robotic Manipulators

Robotics technology is booming and it is projected to dominate in the coming decade. Although robotics has already made a considerable impact on many aspects of modern life, advanced robotics is still in its infancy. However, applications of robots are increasing all the time, and their structures are becoming more complex. This increasing complexity creates new challenges in control design, and with the advent of more advanced and more demanding operations, new solutions for controlling robots are needed.

Hydraulic actuators can benefit robotic systems because, compared to electric actuators, they can produce significant forces and torques for their size. Thus, typical operations with hydraulic robotic systems are contact tasks in which heavy objects are handled or in which forces are generated on the environment (e.g., excavation). However, in contact tasks, the control system stability (which is the primary requirement for all control systems) has drawn considerable attention since the installation of the first industrial robots, and numerous reasons for unstable responses have been identified. One of the most significant reasons for instability is that a robot’s nonlinear dynamics are not considered rigorously. However, rigorously addressing robot dynamics is one of the fundamental challenges in highly nonlinear hydraulic robotic systems, and this issue has also slowed the spread of their closed-loop control solutions. To address the highly nonlinear dynamics of hydraulic robotic systems, nonlinear model-based (NMB) control methods can be used. However, a stability-guaranteed NMB control design for hydraulic robotic systems has remained an open problem in contact tasks.

This thesis studies a high-performance NMB control method for hydraulic robotic manipulators and provides a rigorous solution for the above open problem. In this thesis, a novel subsystem-dynamics-based virtual decomposition control (VDC) approach is used as an underlying control design framework. The unique features of VDC enable the system’s control design and stability analysis at the subsystem level, without imposing additional approximations. This thesis also studies another fundamental challenge of the lack of energy efficiency in hydraulic systems and a force-sensorless contact force estimation for hydraulic robotic manipulators. For energy-efficient control of hydraulic systems, the control design principles of VDC are extended from robotic systems to a broader group of dynamic systems.

This compendium thesis is composed of four publications and one unpublished manuscript. The publications extend the state of the art in the control of hydraulic robotic manipulators in free-space motion and in constrained motion. To provide a possibility for reducing energy consumption, the unpublished manuscript proposes an adaptive and NMB controller for variable displacement axial piston pumps (VDAPPs), whose dynamic behaviour is highly nonlinear in the fourth order, for the first time without using any linearization or order reduction. All control designs in this thesis are stability-guaranteed NMB controls.

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Ministry of Education publication type: G5 Doctoral dissertation (article)
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Mobile manipulation
Authors: Koivumäki, J.
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Application oriented wear testing of wear resistant steels in mining industry

Tampere Wear Center have developed several high-stress wear testers that utilize large sized abrasive particles of natural origin and thus are able to simulate demanding applications of the mining industry. In this work, a versatile high speed slurry-pot wear tester was
developed. Research questions studied are: 1) How to set up a wear test method for simulating the real applications?, 2) What are the wear mechanisms in high-stress wear?, and 3) What is the role of microstructure and chemical composition on wear performance of wear resistant steels?

The high speed slurry-pot tester was developed for application oriented erosion wear testing of materials used in mineral handling and processing. It enables tests in demanding high-stress abrasive and erosive environments simulating wear, for example, in slurry pumps, tanks and pipes, dredging, mineral crushing and grinding, screening, loader buckets, and rock drilling. The key design features of the test method are the possibility to use up to 10 millimeter sized large abrasives and sample speeds up to 20 m/s in conditions ranging from wet slurry environments to dry sand or gravel.

The work has been done in FIMECC DEMAPP and DIMECC BSA projects, the focus is in the application oriented wear testing of materials intended for demanding wear related applications.

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Authors: Ojala, N.
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Research output: Scientific › Paper, poster or abstract

**Proceedings of the 1st Annual SMACC Research Seminar 2016**
The Annual SMACC Research Seminar is a new forum for researchers from VTT Technical Research Centre of Finland Ltd, Tampere University of Technology (TUT) and industry to present their research on the area of smart machines and manufacturing. The 1st seminar is held on 10th of October 2016 in Tampere, Finland. The objective of the seminar is to publish results of the research to wider audiences and to offer researchers a new forum for discussing methods, outcomes and research challenges of current research projects on SMACC themes and to find common research interests and new research ideas. Smart Machines and Manufacturing Competence Centre - SMACC is joint strategic alliance of VTT Ltd and TUT in the area of intelligent machines and manufacturing. SMACC offers unique services for SME’s in the field of machinery and manufacturing – key features are rapid solutions, cutting-edge research expertise and extensive partnership networks. SMACC is promoting digitalization in mechanical engineering and making scientific research with domestic and international partners in several different topics (www.smacc.fi).

**General information**
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Ministry of Education publication type: D6 Edited professional books
Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Design, Development and LCM, Research area: Life-cycle Management, Research area: Engineering Intelligence, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY
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Solar Panel Breakage During Heavy Rain Caused by Thermal Stress

Solar panels and thermal collectors are increasingly popular. There is practical experience of large numbers of solar panel glasses being broken during heavy rain. The present paper studies the role of mean heat transfer between rain and the glass on the breaking. Thin tempered glass is preferred for its low weight, durability, and good optical quality. However, thin glass tempering is expensive and by understanding relevant stresses costs can be avoided. The heat transfer between a solid surface and rain is studied experimentally using a hot copper block and free falling drops. The thermal stresses are solved using a one-dimensional theory and the measured mean heat transfer coefficient.

The thermal stresses depend on rain rate, surface inclination, glass thickness and temperature difference. The results show that, expect for word record approaching rain rates, the thermal stresses are below 10 MPa. A non-heat treated soda-lime glass should withstand this stress without breaking. The used rain rates were $R = 1100$, 340, 110 mm/h and the maximum mean heat transfer coefficients $h = 600$, 250, 140 W/m² K, respectively. All else being equal, the maximum mean heat transfer was observed for surfaces that were inclined 15° from horizontal. Based on the results in the present paper the mean rain heat transfer causes no need to temper soda-lime glass to be use in solar panels. However, one should remember that thermal stresses must be added to all the other stresses.

Model-based force and position tracking control of an asymmetric cylinder with a digital hydraulic valve

This paper presents a model-based control solution for large inertia systems controlled by a fast digital hydraulic valve. The solution is based on model-based force control and it is shown that the cylinder chamber pressures have first order dynamics with the proper parameter selection. The robust stability is analyzed under unknown load mass, bulk modulus, and delay, and it is shown that a simple cascaded P + PID controller results in good control performance and robustness. The simulated results show smooth and stable response with good tracking performance despite large variations in the load mass and bulk modulus.
Plastic deformation of powder metallurgy tungsten alloy foils for satellite enclosures

Radiation shielding is one of the most crucial features of enclosure materials in spacecraft. The attenuation of electron radiation in hybrid materials, which consist mainly of carbon-fiber-reinforced plastics (CFRP), can be improved by laminating thin tungsten foils between the CFRP layers. In this paper, we study tensile behavior of thin foils to understand the plastic deformation of pure tungsten (W) foils and sintered tungsten heavy alloy (WHA) foils. The performed tests are simulated using the finite element (FE) method. Full 3-D FE models of tungsten and CFRP hybrids are generated to study the non-linearity response of different tungsten material models.
A conceptual modeling and simulation framework for system Design
This article presents the dimensional analysis conceptual modeling (DACM) framework, intended as a conceptual modeling mechanism for lifecycle systems engineering. DACM is a novel computer-aided method originally developed for military projects, but it's now available for other applications, too. The DACM framework is a powerful approach for specifying, discovering, validating, and reusing building blocks as well as analyzing system behavior in early development stages. This framework is based on dimensional analysis combined with causal graphs to represent the interactions and interdependencies among system variables. The framework's algorithms are codified into software applications to facilitate its use. This article provides a practical presentation of the steps that encompass the transformation from problem to solution space, key system variables extraction, causal ordering, clustering of variables, and qualitative analyses. The authors provide two examples that cover in detail the DACM's mathematic machinery for deriving a system's behavioral laws from a causal graph. The entire DACM approach is supported by a computer-based application that integrates all the steps of the framework presented in this article.

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Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation
 Authors: Coatanea, E., Roca, R., Mokhtarian, H., Mokammel, F., Ikkala, K.
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Scopus rating (2013): SJR 0.47 SNIP 1.458 CiteScore 1.55
Scopus rating (2012): SJR 0.518 SNIP 1.571 CiteScore 1.69
Scopus rating (2011): SJR 0.425 SNIP 1.208 CiteScore 1.42
Scopus rating (2010): SJR 0.309 SNIP 0.989
Scopus rating (2009): SJR 0.421 SNIP 0.923
Scopus rating (2008): SJR 0.379 SNIP 0.738
Scopus rating (2007): SJR 0.359 SNIP 0.891
Scopus rating (2006): SJR 0.389 SNIP 0.812
Scopus rating (2005): SJR 0.363 SNIP 0.903
Scopus rating (2004): SJR 0.44 SNIP 1.205
Scopus rating (2003): SJR 0.368 SNIP 0.889
Scopus rating (2002): SJR 0.296 SNIP 0.622
Scopus rating (2001): SJR 0.261 SNIP 0.489
Scopus rating (2000): SJR 0.47 SNIP 0.701
Original language: English
DOIs:
10.1109/MCSE.2016.75
Energy efficient tracking control of a mobile machine boom mockup

Energy efficiency of hydraulic machinery is an important trend. Another trend is more automatic machines, which sets new demands for the controllability of hydraulic actuators. High-performance distributed valve systems can satisfy these requirements. Recently, the authors have developed a new high performance digital hydraulic tracking control solution for force, velocity and position tracking. This paper further develops the solution by improving energy efficiency. A new method to control supply pressure is developed. Experimental results with a 1-DOF boom show that the new control solution can combine good controllability and energy efficiency.

General information
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Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Digital hydraulics, Research group: Fluid power automation in mobile machines
Authors: Linjama, M., Huova, M., Karhu, O., Huhtala, K.
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Publication date: 24 May 2016

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Keywords: Energy efficiency, tracking control, Digital hydraulics
Research output: Scientific › Conference contribution

On the numerical solution of steady-state equations of digital hydraulic valve-actuator system

Digital valve system uses plurality of simple on/off valves instead of proportional or servo valves in the implementation of high performance and energy efficient valve controlled hydraulic actuators. Typical digital valve system consists of 20 valves each having two states, which yields the over one million possible control combinations. A potential way to control this kind of system is the model based control utilizing the steady-state model of the system. The solution of the steady-state system equations must be made numerically because no analytical solution exists. This paper analyses the steady-state system equations, develops the condition for existence and uniqueness of the solution, and studies different iteration algorithms. The new results of the paper are: 1) system equations can be transformed into scalar form, 2) the solution exist and is unique if a simple necessary and sufficient condition holds, and 3) Ridders' method is fast and robust method for this problem.

General information
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Keywords: Digital hydraulics, Ridders' method
Research output: Scientific › Conference contribution

Tuntemalla olosuhteet voit optimoida materiaalit kulutussovelluksin

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science, Research group: Materials Characterization
Wear resistance of HVOF sprayed coatings from mechanically activated thermally synthesized Cr3C2–Ni spray powder

In the current study a Cr3C2–Ni spray powder was produced by mechanically activated thermal synthesis. The following aspects were studied: (a) production and characteristics of spray powders, (b) spraying and characteristics of coatings by HVOF, and (c) abrasive wear resistance. A HVOF spray system Diamond Jet Hybrid 2700 (propane hybrid gun from Sulzer Metco) was used for deposition. Coating thickness was approximately 350–400 μm. The structure and composition of the coatings were determined by SEM and the phase composition by XRD methods. Coating surface hardness and microhardness in the cross-section were measured. Abrasive rubber-wheel wear (ARWW) and abrasive erosive wear (AEW) were tested. The wear resistance of the coatings produced from an experimental powder was comparable to that of a similar commercial one.
Corrosion Behavior of WC-FeCrAl Coatings Deposited by HVOF and HVAF Thermal Spraying Methods
The present work compares the mechanical properties and corrosion resistance of WC-FeCrAl coatings manufactured using high-velocity oxygen fuel (HVOF) technology equipped with DJ2700 spraying gun and high-velocity air fuel (HVAF) equipment using M3 supersonic spraying gun. The results indicated that decarburization of carbide phase occurred in both. It was found out that the deposition velocity is an important factor influencing the density of the coating and thus the amount of porosity. The HVAF sprayed WC-FeCrAl coating revealed the lowest degree of porosity, higher hardness and lower degree of decarburization, achieving the best properties in terms of electrochemical corrosion resistance compared to HVOF sprayed coating.

Exercise loading history and femoral neck strength in a sideways fall: A three-dimensional finite element modeling study.
Over 90% of hip fractures are caused by falls. Due to a fall-induced impact on the greater trochanter, the posterior part of the thin superolateral cortex of the femoral neck is known to experience the highest stress, making it a fracture-prone region. Cortical geometry of the proximal femur, in turn, reflects a mechanically appropriate form with respect to habitual exercise loading. In this finite element (FE) modeling study, we investigated whether specific exercise loading history is associated with femoral neck structural strength and estimated fall-induced stresses along the femoral neck. One hundred and eleven three-dimensional (3D) proximal femur FE models for a sideways falling situation were constructed from magnetic resonance (MR) images of 91 female athletes (aged 24.7±6.1years, >8years competitive career) and 20 non-competitive habitually active women (aged 23.7±3.8years) that served as a control group. The athletes were divided into five distinct groups based on the typical loading pattern of their sports: high-impact (H-I: triple-jumpers and high-jumpers), odd-impact (O-I: soccer and squash players), high-magnitude (H-M: power-lifters), repetitive-impact (R-I: endurance runners), and repetitive non-impact (R-NI: swimmers). The von Mises stresses obtained from the FE models were used to estimate mean fall-induced stresses in eight anatomical octants of the cortical bone cross-sections at the proximal, middle, and distal sites along the femoral neck axis. Significantly (p<0.05) lower stresses compared to the control group were observed: the H-I group - in the superoposterior (10%) and posterior (19%) octants at the middle site, and in the...
superoposterior (13%) and posterior (22%) octants at the distal site; the O-I group - in the superior (16%), superoposterior (16%), and posterior (12%) octants at the middle site, and in the superoposterior (14%) octant at the distal site; the H-M group - in the superior (13%) and superoposterior (15%) octants at the middle site, and a trend (p=0.07, 9%) in the superoposterior octant at the distal site; the R-I group - in the superior (14%), superoposterior (23%) and posterior (22%) octants at the middle site, and in the superoposterior (19%) and posterior (20%) octants at the distal site. The R-NI group did not differ significantly from the control group. These results suggest that exercise loading history comprising various impacts in particular is associated with a stronger femoral neck in a falling situation and may have potential to reduce hip fragility.

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Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics, Department of Electronics and Communications Engineering, Research group: Computational Biophysics and Imaging Group, BioMediTech, UKK Inst Hlth Promot Res, UKK Institute, University of Jyväskylä
Authors: Abe, S., Narra, N., Nikander, R., Hyttinen, J., Kouhia, R., Sievänen, H.
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Scopus rating (2013): SJR 1.843 SNIP 1.73 CiteScore 4.55
Scopus rating (2012): SJR 1.644 SNIP 1.591 CiteScore 4.09
Scopus rating (2011): SJR 1.82 SNIP 1.628 CiteScore 4.33
Scopus rating (2010): SJR 1.785 SNIP 1.657
Scopus rating (2009): SJR 1.759 SNIP 1.593
Scopus rating (2008): SJR 1.848 SNIP 1.515
Scopus rating (2007): SJR 1.841 SNIP 1.52
Scopus rating (2006): SJR 1.758 SNIP 1.517
Scopus rating (2005): SJR 1.671 SNIP 1.646
Scopus rating (2004): SJR 1.329 SNIP 1.483
Scopus rating (2003): SJR 1.456 SNIP 1.344
Scopus rating (2002): SJR 1.511 SNIP 1.551
Scopus rating (2001): SJR 1.479 SNIP 1.666
Scopus rating (2000): SJR 1.411 SNIP 1.438
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Original language: English
ASJC Scopus subject areas: Orthopedics and Sports Medicine, Biochemistry, medical, Physical Therapy, Sports Therapy and Rehabilitation
Keywords: Bone strength, Finite element analysis, Exercise, Falling, OSTEOPOROSIS, Hip fracture
DOIs: 10.1016/j.bone.2016.07.021
Research output: Scientific - peer-review › Article

Friction characteristics of a multi-chamber cylinder for digital hydraulics
This paper deals with the issue of defining friction characteristics of a multi-chamber cylinder for digital hydraulics. Using a multi-chamber cylinder under a set of supply pressures, friction characteristics are experimentally investigated for a range of velocity according to load conditions. A binary digit-based pressure e.g., high pressure or low pressure has been applied to each chamber. The friction force is measured based on the equation of motion using measured values of the pressures in the chambers of the multi-chamber cylinder and the position of the piston. As a mechanism to load the multi-chamber cylinder, a 1-Degree of Freedom (DOF) boom mockup mimicking a medium-sized mobile machine boom has been constructed. Then it has been utilized to test the motion of the cylinder under different mass-load conditions. It is
shown that the cylinder states do not dominantly affect the friction force of a multi-chamber cylinder, comparing the effect of other parameter such as mass load and velocity, which is expected to be useful for the secondary control of digital hydraulic systems.

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Organisations: Department of Intelligent Hydraulics and Automation, Research group: Digital hydraulics, Department of Mechanical and System Design Engineering, Hongik University, Seoul
Authors: Cho, S. H., Niemi-Pynttäri, O., Linjama, M.
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Peer-reviewed: Yes
Early online date: 2 Mar 2015

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Scopus rating (2014): SJR 0.407 SNIP 0.848 CiteScore 0.77
Scopus rating (2013): SJR 0.377 SNIP 0.821 CiteScore 0.79
Scopus rating (2012): SJR 0.4 SNIP 0.949 CiteScore 0.75
Scopus rating (2011): SJR 0.324 SNIP 0.835 CiteScore 0.67
Scopus rating (2010): SJR 0.325 SNIP 0.932
Scopus rating (2009): SJR 0.293 SNIP 0.593
Scopus rating (2008): SJR 0.245 SNIP 0.584
Scopus rating (2007): SJR 0.3 SNIP 0.573
Scopus rating (2006): SJR 0.384 SNIP 0.881
Scopus rating (2005): SJR 0.429 SNIP 0.688
Scopus rating (2004): SJR 0.353 SNIP 0.7
Scopus rating (2003): SJR 0.292 SNIP 0.745
Scopus rating (2002): SJR 0.328 SNIP 0.754
Scopus rating (2001): SJR 0.426 SNIP 0.933
Scopus rating (2000): SJR 0.637 SNIP 1.205
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Keywords: Digital hydraulics, Multi-chamber cylinder, Cylinder friction
DOI: 10.1177/0954406215575414
Research output: Scientific - peer-review › Article

Reiänlaajennustesti - voidaanko sen tulos ennustaa vetokokeen perusteella?

General information
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Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science, Research group: Metals Technology, Research group: Materials Characterization
Authors: Peura, P., Chufan, S., Hokka, M., Minkkinen, A.
Number of pages: 6
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Publication information
Journal: Ohutlevy-lehti
The cross-sectional area of the gluteus maximus muscle varies according to habitual exercise loading: Implications for activity-related and evolutionary studies

Greater size of the gluteus maximus muscle in humans compared to non-human primates has been considered an indication of its function in bipedal posture and gait, especially running capabilities. Our aim was to find out how the size of the gluteus maximus muscle varies according to sports while controlling for variation in muscle strength and body weight. Data on gluteus maximus muscle cross-sectional area (MCA) were acquired from magnetic resonance images of the hip region of female athletes (N = 91), and physically active controls (N = 20). Dynamic muscle force was measured as counter movement jump and isometric knee extension force as leg press. Five exercise loading groups were created: high impact (volleyball players and high-jumpers), odd impact (soccer and squash players), high magnitude (power-lifters), repetitive impact (endurance runners) and repetitive non-impact (swimmers) loadings. Individuals in high impact, odd impact or high-magnitude loading groups had greater MCA compared to those of controls, requiring powerful hip extension, trunk stabilization in rapid directional change and high explosive muscle force. Larger body size and greater muscle strength were associated with larger MCA. An increase in dynamic force was associated with larger MCA, but the strength of this relationship varied with body weight. Thus, gluteal adaptation in humans promotes powerful lower limb movements required in sprinting and rapid changes in direction, as well as maintenance and stabilization of an erect trunk which also provides a platform for powerful motions of the upper limbs. These movements have likely evolved to facilitate food acquisition, including hunting.
The effects of microstructure on erosive-abrasive wear behavior of carbide free bainitic and boron steels

The wear resistance of carbide free bainitic (CFB) microstructures have shown to be excellent in sliding, sliding-rolling and erosive-abrasive wear. Whereas, boron steels are often an economically favorable alternative used in applications subjected to erosive and abrasive wear. In this study the erosive-abrasive wear resistance of CFB and boron steels with different heat treatments were compared and the effect of microstructure on wear was investigated. An application oriented dry-pot laboratory test method with 8-10 mm granite gravel was used to produce erosive-abrasive wear environment. The tested materials were CFB and boron steels. The CFB steels had hardness values of 500 and 600 HV. The boron steels, both quenched and quenched and tempered, had a hardness of 500 HV. The influence of the microstructures on wear was studied by wear test results as well as by optical and scanning electron microscopy. The phase compositions were determined by XRD. The effect of wear, in addition to weight loss was also characterized by surface profilometry, hardness and hardness profile determinations. The wear resistance of the steels was compared with results achieved in a field test in an industrial mining application. Moreover, the effect of the different microstructures on wear behavior is discussed. The carbide free bainitic steels showed better wear performance than the martensitic boron steels. The boron steels were subjected to microcutting and microploughing, whereas the CFB steels exhibited more shallow impact craters with thin platelets.
Service-based Fault Tolerance for Cyber-Physical Systems: A Systems Engineering Approach

Cyber-physical systems (CPSs) comprise networked computing units that monitor and control physical processes in feedback loops. CPSs have potential to change the ways people and computers interact with the physical world by enabling new ways to control and optimize systems through improved connectivity and computing capabilities. Compared to classical control theory, these systems involve greater unpredictability which may affect the stability and dynamics of the physical subsystems. Further uncertainty is introduced by the dynamic and open computing environments with rapidly changing connections and system configurations. However, due to interactions with the physical world, the dependable operation and tolerance of failures in both cyber and physical components are essential requirements for these systems.

The problem of achieving dependable operations for open and networked control systems is approached using a systems engineering process to gain an understanding of the problem domain, since fault tolerance cannot be solved only as a software problem due to the nature of CPSs, which includes close coordination among hardware, software and physical objects. The research methodology consists of developing a concept design, implementing prototypes, and empirically testing the prototypes. Even though modularity has been acknowledged as a key element of fault tolerance, the fault tolerance of highly modular service-oriented architectures (SOAs) has been sparsely researched, especially in distributed real-time systems. This thesis proposes and implements an approach based on using loosely coupled real-time SOA to implement fault tolerance for a teleoperation system.

Based on empirical experiments, modularity on a service level can be used to support fault tolerance (i.e., the isolation and recovery of faults). Fault recovery can be achieved for certain categories of faults (i.e., non-deterministic and aging-related) based on loose coupling and diverse operation modes. The proposed architecture also supports the straightforward integration of fault tolerance patterns, such as FAIL-SAFE, HEARTBEAT, ESCALATION and SERVICE MANAGER, which are used in the prototype systems to support dependability requirements. For service failures, systems rely on fail-safe behaviours, diverse modes of operation and fault escalation to backup services. Instead of using time-bounded reconfiguration, services operate in best-effort capabilities, providing resilience for the system. This enables, for example, on-the-fly service changes, smooth recoveries from service failures and adaptations to new computing environments, which are essential requirements for CPSs.

The results are combined into a systems engineering approach to dependability, which includes an analysis of the role of safety-critical requirements for control system software architecture design, architectural design, a dependability-case development approach for CPSs and domain-specific fault taxonomies, which support dependability case development and system reliability analyses. Other contributions of this work include three new patterns for fault tolerance in CPSs: DATA-CENTRIC ARCHITECTURE, LET IT CRASH and SERVICE MANAGER. These are presented together with a pattern language that shows how they relate to other patterns available for the domain.
On-Board Electronic Control Systems of Future Automated Heavy Machinery

The level of automation and wireless communication has increased in heavy machinery recently. This requires utilizing new devices and communication solutions in heavy machinery applications which involve demanding operating conditions and challenging life-cycle management. Therefore, the applied devices have to be robust and hardware architectures flexible, consisting of generic modules. In research and development projects devices that have various communication interfaces and insufficient mechanical and electrical robustness need to be applied. Although this thesis has its main focus on machines utilized as research platforms, many of the challenges are similar with commercial machines.

The applicability of typical solutions for data transfer is discussed. Controller area network with a standardized higher level protocol is proposed to be applied where data signalling rates above 1 Mb/s are not required. The main benefits are the availability of robust, generic devices and well-established software tools for configuration management. Ethernet can be utilized to network equipment with high data rates, typically used for perception. Although deterministic industrial Ethernet protocols would fulfil most requirements, the conventional internet protocol suite is likely to be applied due to device availability.

Sometimes sensors and other devices without a suitable communication interface need to be applied. In addition, device-related real-time processing or accurate synchronization of hardware signals may be required. A small circuit board with a microcontroller can be utilized as a generic embedded module for building robust, small and cost-efficient prototype devices that have a controller area network interface. Although various microcontroller boards are commercially available, designing one for heavy machinery applications, in particular, has benefits in robustness, size, interfaces, and flexible software development. The design of such a generic embedded module is presented.

The device-specific challenges of building an automated machine are discussed. Unexpected switch-off of embedded computers has to be prevented by the control system to avoid file system errors. Moreover, the control system has to protect the batteries against deep discharge when the engine is not running. With many devices, protective enclosures with heating or cooling are required.

The electronic control systems of two automated machines utilized as research platforms are presented and discussed as examples. The hardware architectures of the control systems are presented, following the proposed communication solutions as far as is feasible. Several applications of the generic embedded module within the control systems are described. Several research topics have been covered utilizing the automated machines. In this thesis, a cost-efficient operator-assisting functionality of an excavator is presented and discussed in detail.

The results of this thesis give not only research institutes but also machine manufacturers and their subcontractors an opportunity to streamline the prototyping of automated heavy machinery.
Digital image correlation method in hydro turbine shaft torque and vibration monitoring

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Organisations: Department of Mechanical Engineering and Industrial Systems, Research group: Kokeellinen virtaustekniikka, Research area: Applied Mechanics, Department of Materials Science, Research group: Tribology and Machine Elements, Fortum Power and Heat Oy
Authors: Saarenrinne, P., Miettinen, J., Ylönen, M., Kokko, V.
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Bibliographical note
ISBN puuttuu, kysytty / TL

Productivity measurement at the factory level
The objective of this study was to develop a new partial productivity measurement method for the case company. The scope of this study was limited to factory-level productivity measurement. Material costs and value of inventory were excluded from them. Labor productivity and capital productivity are the focus of the new method. The case company uses a make-to-order production approach, and it belongs to the mechanical engineering sector, as so many other companies in Finland do.
The developed model includes two main components: ROA and the capacity model. The Gold’s model and the American Productivity and Quality Center model (APQC model) have had the greatest influences on the structure of presented model. The model has been tested with data covering the last four years.
Strictly interpreted, the final result describes the impact of the combined effect of productivity changes and input price changes. The company representatives argued that it is crucial for them to know whether the efficiency of operations will increase, at least in such a way that it will at least cover inflation.
Realized productivity development was a pleasant surprise for the steering group. The fear that the intake of total assets would have decreased productivity proved to be wrong. The level of productivity changed nearly every month. One of the main driving forces behind the change is capacity.

General information
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Organisations: Department of Industrial Management, Research group: Cost Management Center, Department of Mechanical Engineering and Industrial Systems, Research area: Manufacturing and Automation
Authors: Paranko, J., Paranko, B., Huhtala, P.
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Links:
http://tarc.syskonf.pl/Programme

Bibliographical note
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ORG=tta,0.8
Clean Components of Fluid Power System Reduce Maintenance Costs

General information
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Organisations: Department of Intelligent Hydraulics and Automation, Research group: Condition monitoring of hydraulic components and systems
Authors: Rinkinen, J., Elo, L.
Number of pages: 8
Publication date: 1 Oct 2015

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Article number: 2 (2015-10-01)
ISBN (Print): 978-951-98113-7-6
Research output: Scientific › Conference contribution

Production of sulfonated polyetheretherketone/polypropylene fibers for photoactive textiles
New photocatalytic fibers made of sulfonated polyetheretherketone (SPEEK)/polypropylene (PP) are melt compounded and melt spun, first on laboratory scale and then on a semi-industrial scale. Fiber spinnability is optimized and the fibers are characterized using mechanical testing, electron paramagnetic resonance (EPR) spectroscopy, and scanning electron microscopy (SEM). According to the results, the fiber spinnability remains at a good level up to 10 wt % SPEEK concentration. Optimal processing temperature is 200°C due to the thermal degradation at higher temperatures. EPR measurements show good and long-lasting photoactivity after the initial irradiation but also decay in the radical intensity during several irradiation cycles. Mechanical tenacity of the SPEEK/PP 5:95 fiber is approximately 20% lower than for otherwise similar PP fiber. The fiber is a potential alternative to compete against TiO2-based products but more research needs to be done to verify the real-life performance.

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Organisations: Department of Materials Science, Research group: Plastics and Elastomer Technology, Department of Mechanical Engineering and Industrial Systems, Research area: Sustainable Machine Systems, University College of Borås, Högskolan i Borås, Next Technology Tecnotessile Società Nazionale di Ricerca S.r.l., Department of Biotechnology, Chemistry and Pharmacy, University of Siena
Authors: Mylläri, V., Fatarella, E., Ruzzante, M., Pogni, R., Baratto, M. C., Skrifvars, M., Syrjälä, S., Järvelä, P.
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Scopus rating (2014): SJR 0.658 SNIP 0.964 CiteScore 1.76
Scopus rating (2013): SJR 0.628 SNIP 1.085 CiteScore 1.71
Scopus rating (2012): SJR 0.658 SNIP 1.081 CiteScore 1.57
Scopus rating (2011): SJR 0.601 SNIP 0.965 CiteScore 1.45
Scopus rating (2010): SJR 0.679 SNIP 0.909
Scopus rating (2009): SJR 0.697 SNIP 0.825
Scopus rating (2008): SJR 0.647 SNIP 0.822
Scopus rating (2007): SJR 0.678 SNIP 0.931
Scopus rating (2006): SJR 0.782 SNIP 1.145
Scopus rating (2005): SJR 0.779 SNIP 0.912
ESD and Disturbance Cases in Electrostatic Protected Areas

Electrostatic protected area (EPA) can effectively prevent ESD failures from charged operators, work benches and tools. However, electrical disturbances and ESD events from other sources can still exist in well-built EPAs. In this paper failures found in electronic assembly environments are analyzed to improve coverage of ESD control programs.

General information

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Number of pages: 7
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ASJC Scopus subject areas: Engineering(all)
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Links:
http://urn.fi/URN:NBN:fi-tyy-201603013599
Research output: Scientific - peer-review › Conference contribution

Effects of surface cracks and strain rate on the tensile behavior of Balmoral Red granite

This paper presents an experimental procedure for studying the effects of surface cracks on the mechanical behavior of Balmoral Red granite under dynamic and quasi-static loading. Three different thermal shocks were applied on the surface of the Brazilian Disc test samples by keeping a flame torch at a fixed distance from the sample surface for 10, 30, and 60 seconds. Microscopy clearly shows that the number of the surface cracks increases with the duration of the thermal shock. After the thermal shock, the Brazilian Disc tests were performed using a servohydraulic materials testing machine and a compression Split Hopkinson Pressure Bar (SHPB) device. The results show that the tensile strength of the rock decreases and the rate sensitivity of the rock increases as more cracks are introduced to the structure. The DIC analysis of the Brazilian disc tests shows that the fracture of the sample initiates at the center of the samples or slightly closer to the incident bar contact point. This is followed by crushing of the samples at both contact points with the stress bars.
Modelling and control of vertical oscillation in overhead cranes

Overhead cranes are widely used in industry for lifting and moving various loads. Right before lifting a heavy load from the ground the crane bridge slightly bends, which makes the load oscillate vertically during the lifting. Vertical oscillations may introduce unnecessary stress to the crane metal structures and hoisting machinery, and thus reduce the lifetime of the crane. Furthermore, vertical oscillations make the load handling and positioning more difficult, thus decreasing the performance of operations. Nevertheless, study of vertical oscillations in overhead cranes has been neglected in literature.

In this paper, a model for analyzing vertical oscillations and for control design is developed. Oscillation control, based on rope force measurement, is developed to decrease maximal forces and to reduce the time of oscillation. The resulting controller is tested with a real overhead crane having nominal load of five tons.

High temperature erosion wear of cermet particles reinforced self-fluxing alloy HVOF sprayed coatings

The resistance of high velocity oxy-fuel (HVOF) sprayed TiC-NiMo and Cr3C2-Ni cermet particles reinforced NiCrSiB self-fluxing alloy coatings to high temperature erosion wear was studied. Microstructure of the coatings was examined by SEM, phase composition was determined by XRD. A four-channel centrifugal particle accelerator was applied to study the high temperature erosion wear of the coatings. The angles of impingement were 30° and 90°, initial particle velocity was 50 m/s, the average temperature of the test – 650 °C. Volume wear of the coatings was calculated and compared to the respective values of the reference materials. Wear mechanisms were studied by SEM. HVOF sprayed coatings exhibited lower wear, than WC-15Co hardmetal and steel HARDOX 400, but higher wear than steel AISI 304. TiC-NiMo particles reinforced self-fluxing alloy coating demonstrated virtually the same wear resistance, as the Cr3C2-Ni particles reinforced self-fluxing alloy coating, at 30° and the better wear resistance at 90°.
Vision-based path coordination for multiple mobile robots with four steering wheels using an overhead camera

In this paper, we extend our previous work to introduce a vision-based path coordination method for multiple mobile robots with four steering wheels to avoid mutual collisions, so that the generated paths are always in the visibility range of the overhead camera. The proposed algorithm generates the synchronized trajectories for all wheels belonging to each mobile robot, with respect to its inertial-frame, relying on only one calibrated camera. These synchronized trajectories reduce the complexity of the robot kinematic model to plan maximum allowable bounded driving and steering velocities for each mobile robot. The main contribution of the proposed method is coordinating the trajectories for multiple mobile robots to avoid intersection boundaries that are obtained by generated geometrical traces in real world coordinates. Our experimental results are presented to illustrate the efficiency of the proposed method for the path coordination of multiple mobile robots with four steering wheels to avoid mutual collision.

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ISBN (Print): 978-1-4673-9107-8
Keywords: cameras, collision avoidance, mobile robots, robot kinematics, robot vision, steering systems, trajectory control, calibrated camera, multiple mobile robots, overhead camera, robot kinematic model, steering wheels, synchronized trajectories, vision-based path coordination, Cameras, Collision avoidance, Mobile robots, Robot kinematics, Trajectory, Wheels, Four steering wheels, Intersection region, Multiple mobile robots, Nonholonomic mobile robots, Path coordination, Steering and driving velocity, Vision-based method
Systematic search for design contradictions in systems' architecture: Toward a computer aided analysis

Time pressure imposed to the engineering design process is one fundamental constraint pushing engineers to rush into known solutions, to avoid analysing properly the environment of a design problem, to avoid modelling design problems and to take decision based on isolated evidences. Early phases in particular have to be kept short despite the large impact of decisions taken at this stage. Significant efforts are currently spent within different engineering communities to develop a model-based design approach adapted to conceptual stages. Developing such type of models is also challenging due to the fuzziness of the information and due to the complexity of the concepts and processes manipulated at this stage. Currently few support tools are really capable of really supporting an analysis of the early design concepts and architectures. Simultaneously the approach should be fast, easy to use and should provide a real added-value to efficiently support the decision and the design process. The present article is presenting a framework based on a progressive transformation of the design concepts. The final material generated by this transformation process is an oriented graph with different types of classified variables. This graph can be processed as described in the article to automatically exhibit the conflicts or contradictions present in the design concept architecture. The article is proposing two main contributions which are a real move toward model development at conceptual stage and the possibility to process those models to detect solution weaknesses. The discussion is presenting further developments and possibilities associated with this method.
Transpositions and duals high-order tensors. On theory and applications in mechanics

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Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics
Authors: Holopainen, S.
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Editor: Kouhia, R.
ISBN (Print): 978-952-93-5608-9

Publication series
Name: Journal of Structural Mechanics
Publisher: Rakenteiden mekaniikan seura r.y.
Links:
Research output: Scientific › Conference contribution

Education and Materials Joining Research methods at Tampere University of Technology
At Tampere University of Technology (TUT), education and research related to joining technologies are performed by two university departments, the Department of Materials Science (DMS) and the Department of Mechanical Engineering and Industrial Systems (MEI). Many of the research activities are conducted via close collaboration between these two units.

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Authors: Peura, P., Vuoristo, P., Vihinen, J.
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On the direct solution of critical equilibrium states

Brownfield Process: A Method for the Rationalisation of Existing Product Variety towards a Modular Product Family

The purpose of the research is to define what kind of design information is needed when existing non-modular product elements are designed towards a modular product family that enables product configuration — and what kinds of steps facilitate this kind of design. Thus this thesis poses two research questions: RQ1. How to structure the design information needed in the designing of modular product families? RQ2. How to create the design information needed in the rationalisation of existing product variety towards a modular product family? The research approach includes application of Design Research Methodology (DRM) as originated by Blessing & Chakrabarti (2009). This research includes four main stages (Research Clarification, Descriptive Study I, Descriptive Study II), all focusing on the defining of influencing factors and their impacts, as DRM suggests. This thesis considers that design reuse, product variety, standardisation, modularisation, product platforms, product families and product configuration are all main product structuring topics when an existing product assortment should be rationalised. Consideration of these topics makes up an effective tactic for the enabling of product variants to be provided for customers, without forgetting the benefits of design reuse and commonality in an industrial environment. The contribution of the research suggests that there are five key factors from a design information perspective that are essential in modular product family development aimed at product configuration. These elements are also the answer to RQ1: - Partitioning logic defines viewpoints that affect product structuring decisions from both a business and customer perspective. - A set of modules includes building blocks of product variants of a product family. - Interfaces (standardised) enable efficient defining of product variants in the order/sales-delivery process. - Architecture describes how modules and their interfaces are related to each other. Architecture also considers layout issues such as space reservations. - Configuration knowledge describes the relations between product family elements and customer needs that create a need for variety. Configuration knowledge can also present compatibilities of product elements or customer needs. The thesis also suggests a design process known as the Brownfield Process (the BfP), and includes ten steps in which design information related to the above key factors is defined. This is the suggested answer to RQ2. - Step 1: Target setting based on business environment - Step 2: Generic element model of the Module System - Step 3: Architecture: generic elements and interfaces - Step 4: Target setting based on customer environment - Step 5: Preliminary product family description - Step 6: Configuration knowledge: generic elements and customer needs - Step 7: Modular architecture: modules and interfaces - Step 8: Configuration knowledge: module variants and customer needs - Step 9: Product family documentation - Step 10: Business impact analysis The role of the BfP within the context of design research is discussed. From an academic viewpoint, there is a lack of these kinds of modularisation methods that aim at configurable products, although single aspects and key factors of the proposed method have been often discussed and their benefits and importance are emphasised separately in the literature. From an industrial viewpoint, the steps of the method can be applied in a real life environment based on the case studies. Thus contribution of the thesis can be considered worthwhile and an important addition in this research field.
Hybrid pump drive

The number of applications with rotational speed controlled fixed hydraulic pumps is increasing because they offer good controllability and efficiency compared to conventional fixed speed pump drives. Both electric motors and pumps are dimensioned according to maximum power/torque. Consequently, the electric motor is significantly larger than the hydraulic pump. This paper introduces a double pump system with connection to additional hydraulic supply creating a hybrid drive. The power/torque demand can be reduced making it possible to choose a smaller electric motor without sacrificing performance while increasing power density. The connection to two energy sources results in a flexible energy supply and makes it possible to recover either hydraulically or electrically. Simulated results show that the studied circuit enables electric motor size reduction as much as 50% when the bottom of the cylinder is the load side and the second pump is connected to the accumulator or pressure source. This is applicable in applications where the rod side loading is remarkably lower as well as in other applications that have a minor extending load.
Concept design of the DEMO divertor cassette-to-vacuum vessel locking system adopting a systems engineering approach

This paper deals with pre-concept studies of DEMO divertor cassette-to-vacuum vessel locking system under the work program WP13-DAS-07-T06: Divertor Remote Maintenance System pre-concept study. An iterative design process, consistent with Systems Engineering guidelines and named Iterative and Participative Axiomatic Design Process (IPADeP), is used in this paper to propose new innovative solutions for divertor locking system, which can overcome the difficulties in applying the ITER principles to DEMO. The solutions conceived have been analysed from the structural point of view using the software Ansys and, eventually, evaluated using the methodology known as Fuzzy-Analytic Hierarchy Process. Due to the lack and the uncertainty of the requirements in this early conceptual design stage, the aim is to cover a first iteration of an iterative and incremental process to propose an innovative design concept to be developed in more details as the information will be completed. (C) 2015 Elsevier B.V. All rights reserved.
Photoelastic Stress Evaluation and Mechanical Testing of Hybrids
To produce parts having complicated geometry with low cost and fast processing hybrid structures of metals embedded in polymer offer advantages. Such structures which can be regarded as macrocomposites need good understanding of the interfacial properties and residual stresses in order to be used in demanding applications. We used photoelastic stress analysis and strain gauge measurements to examine internal stresses in a stainless steel-epoxy hybrid component, internal stresses include both the residual stresses due to cure shrinkage of the resin and the changing internal stress state during mechanical loading. The effect of adhesion between steel inserts and epoxy on the durability under static and impact loading was studied. Internal digital image correlation (DIC) technique was also developed and used to evaluate deformation behavior and fracture mechanisms of the hybrids. We used epoxy block samples with thin stainless steel plate inserts that were fabricated by resin casting into flexible molds fabricated from a 3D-printed model of needed geometry.

High performance nonlinear motion/force controller design for redundant hydraulic construction crane automation
In this paper, a stability-guaranteed Cartesian free-space motion control for the redundant articulated hydraulic construction crane is addressed in order to increase system safety and productivity. To cope with the nonlinearities of coupled mechanical linkage dynamics of articulated systems and the inherently strong nonlinearities of hydraulic actuator dynamics, the proposed controller is designed based on the recently introduced Virtual Decomposition Control (VDC) approach. The VDC approach, which was developed especially for the control of complex robotic systems, allows the conversion of the control problem of the entire system to a control problem of individual subsystems, while rigorously guaranteeing the stability of the entire hydraulic system. In the experiments it is demonstrated that, the proposed controller is able to extensively cope with the highly nonlinear nature of the articulated hydraulic system, and an improved control performance is achieved compared to the current state-of-the-art studies in the category of the hydraulic robot manipulators.
This paper publishes the results of interviews regarding shop-floor-level control of 18 Finnish manufacturing companies. The interviews had 17 open questions relating to demand characteristics, shop floor-level control issues, production flexibility, inventory control, and potential development areas. In order to get insights from the interviews, this paper analyses the answers from the interviews and categorises them into typical answers. The companies that were interviewed are also categorised as small companies with their own end products, subcontractors, or large companies with their own end products, and the emphasis of the analysis is on how companies differ in their shop floor-level control. The results show that different types of companies have different characteristics. Small companies are characterised by constant workflow, seasonal trends in demand, and the use of forecasts. Subcontractors have great daily variation in their demand and processing times. Large companies tend to focus on inventory issues.

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Authors: Tokola, H., Järvenpää, E., Salonen, T., Lanz, M., Koho, M., Niemi, E.
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Hydrofluoric-nitric-sulphuric-acid surface treatment of tungsten for carbon fibre-reinforced composite hybrids in space applications

Hybrid material systems, such as combinations of tungsten foils and carbon fibre-reinforced plastic (CFRP), are replacing metal alloy concepts in spacecraft enclosures. However, a good adhesion between the tungsten oxide scale and the epoxy resin used is required. Here, the effects of a hydrofluoric-nitric-sulphuric-acid (HFNS) treatment on tungsten oxides and subsequent adhesion to CFRP are analysed using atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS) and fracture testing. The work shows that HFNS treatment results in decreased oxygen content, over 50% thinner tungsten trioxide (WO3) layer and increased nano-roughness on thin tungsten foils. Fracture testing established a 39% increase in the average critical strain for tungsten-CFRP specimens after HFNS treatment was carried out on tungsten. The effect of the oxide scale modification regarding the critical strain energy release rate was Delta Gc approximate to 8.4 J/m(2). (C) 2014 Elsevier By. All rights reserved.
Modeling and Experimental Characterization of Pressure Drop in Gravity-Driven Microfluidic Systems

Passive pumping using gravity-driven flow is a fascinating approach for microfluidic systems. When designing a passive pumping system, generated flow rates should be known precisely. While reported models used to estimate the flow rates do not usually consider capillary forces, this paper shows that their exclusion is unrealistic in typical gravity-driven systems. Therefore, we propose a new analytical model to estimate the generated flow rates. An extensive set of measurements is used to verify that the proposed model provides a remarkably more precise approximation of the real flow rates compared to the previous models. It is suggested that the developed model should be used when designing a gravity-driven pumping system.
Towards a concept for realizing sustainability in the manufacturing industry

This study summarizes the current state of manufacturing companies and challenges related to sustainable manufacturing and outlines a concept for measuring, improving, and managing sustainability performance. Reviews of the current state of sustainable development at global and company level show that manufacturing companies need support and guidance if they are to realize the objectives of sustainable development. The challenges and barriers faced by manufacturing companies in this respect are therefore clarified, making used of surveys, interviews, and workshops. This is then followed by a proposal for a concept that aims to overcome these challenges and to support manufacturing companies in realizing and managing sustainable development and sustainable production. The concept focuses especially on measuring, improving.

Abstract Additive manufacturing (AM) is expanding the manufacturing capabilities. However, quality of AM produced parts is dependent on a number of machine, geometry and process parameters. The variability of these parameters affects the manufacturing drastically and therefore standardized processes and harmonized methodologies need to be developed to characterize the technology for end use applications and enable the technology for manufacturing. This research proposes a composite methodology integrating Taguchi Design of Experiments, multi-objective optimization and statistical process control, to optimize the manufacturing process and fulfill multiple requirements imposed to an arbitrary geometry. The proposed methodology aims to characterize AM technology depending upon manufacturing process variables as well as to perform a comparative assessment of three AM technologies (Selective Laser Sintering, Laser Stereolithography and Polyjet). Results indicate that only one machine, laser-based Stereolithography, was feasible to fulfill simultaneously macro and micro level geometrical requirements but mechanical properties were not at required level. Future research will study a single AM system at the time to characterize AM machine technical capabilities and stimulate pre-normative initiatives of the technology for end use applications.

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Research output: Scientific - peer-review › Article

An anisotropic continuum damage model for concrete
In this paper, a thermodynamic formulation for modelling anisotropic damage of elastic brittle materials based on Ottosen's 4-parameter failure surface is proposed. The model is developed by using proper expressions for Gibb's free energy and the complementary form of the dissipation potential. The formulation predicts the basic characteristic behaviour of concrete well and results in a realistic shape for the damage surface.

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Authors: Yaghoubi, S. T., Hartikainen, J., Kolari, K., Kouhia, R.
Number of pages: 56
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An experimental and numerical study of the dynamic Brazilian disc test on Kuru granite

This paper deals with numerical modeling of the dynamic tensile strength of Kuru granite and corresponding experiments with the dynamic Brazilian Disc (BD) tests using the Split Hopkinson Pressure Bar apparatus (SHPB). It was found that the indirect tensile strength of the Kuru granite increased from the static value of 13 MPa to 36 MPa when the impact velocity reached 20 m/s. A numerical method was developed for simulations of these tests. The method includes a material model based on the rate-dependent isotropic compliance damage and embedded discontinuity concepts for rock and an FEM based explicit time marching technique for simulating the dynamics of the SHPB apparatus. Simulation results are in decent agreement with the experiments.

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Authors: Mardoukhi, A., Saksala, T., Hokka, M., Kuokkala, V.
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Anomaly Detection and Diagnostics of a Wheel Loader Using Dynamic Mathematical Model and Joint Probability Distributions

In this paper, we present anomaly detection and diagnostics for articulated frame steered hydraulic wheel loader. The presented methodology is based on the analysis and comparison of the responses of a dynamic mathematical model and a real wheel loader using a joint probability distribution of correlation coefficients of multiple variables. The behaviour of an undamaged machine is modelled by probability density functions of the correlation coefficients using histograms and test how well the future behaviour fits the model. First, the time series data of multiple variables are segmented into segments of the same length. Correlation coefficients are then calculated for each segment and the distributions of the correlation coefficients are estimated by computing probability density functions using histograms. Finally, the joint probabilities that the correlations in the data segments of the time series data are observed are calculated using the already computed histograms. The diagnostics is based on the combination of static threshold and threshold based on mean value of joint probabilities. The dynamic mathematical model of the wheel loader is presented with verification results. A jammed flushing valve of the hydrostatic transmission was used as an anomaly to study the changes in the joint probability values. Finally, the efficiency of the presented method is presented with good results regarding detection of anomalies and diagnostics of the wheel loader.

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Organisations: Department of Intelligent Hydraulics and Automation, Research group: Fluid power automation in mobile machines, Research group: Field robotics and control
Authors: Krogerus, T., Hyvönen, M., Backas, J., Huhtala, K.
A Novel Coaxially Laser-Assisted (COLA) Cold Spray System

Laser-assisted cold-spray has been recognized for over a decade as a technique capable of depositing high quality coatings. By laser heating (and hence softening) the surface being coated, deposition can occur at particle velocities lower than those normally associated with the cold spray process. This can be used to increase deposition rate. However, it can also be used to facilitate the deposition of higher hardness material combinations, normally more out of the reach of the conventional cold spray process. Laser heating can also reduce the requirements of the process on gas usage and gas heating for a given combination, making it more cost-effective. In the work reported below, the capability of a novel coaxially laser-assisted system (COLA) to deposit higher hardness materials, relevant to a range of different industrial applications, has been evaluated. This system can be retro-fitted to cold spray equipment.

Ballistic and numerical simulation of impacting goods on conveyor belt rubber

Impact loading is an important process in the transport industry as it causes wear and failure of critical components. Conveyor belts are of particular importance as they are used in practically every industry where large quantities of goods are moved over short (<10 m) or long distances (>1 km). To investigate stress levels inside the material during impact loading, a gas gun was utilized to shoot 9 mm spherical steel balls onto the surface of a rubber conveyor belt. A high speed video recording system was employed in order to determine penetration depth and dissipated energy of the steel ball. Maximal penetration depths of up to 3.9 mm and maximal dissipated energies of up to 86.8 % were measured. Additionally, a numerical simulation using smooth particle applied mechanics was conducted and compared to the experimental results obtained with the gas gun. The calculated von Mises stresses affected the conveyor belts up to a maximum depth of 8.8 mm with at least 20 MPa. Maximum von Mises stresses were calculated to reach 60 MPa.
Brownfield process for the rationalisation of existing product variety towards a modular product family

Modularisation, product platforms, product families and product configuration are efficient product structuring tactics for providing of product variants for customers. This paper studies how the design information related to designing of modular product family that supports product configuration can be structured and how to support defining of this kind of design information in a design situation in which existing product assortment should be rationalised towards a modular product family that supports product configuration. Research approach bases on literature review and empirical findings. Categorisation to five design information elements including partitioning logic, set of modules, interfaces, architecture and configuration knowledge is suggested. Existing methods consider partly or as different combinations these elements but considering of all of them is rare although all of them have been recognised as important. Thus a design method known as the Brownfield Process is introduced. Steps of the method are tested in industrial cases. As a conclusion we state that the method can be applied also to other cases in which rationalisation of existing product assortment is sought.
This article presents a phenomenological damage-viscoplastic model based on the empirical Hoek-Brown criterion for numerical modeling of rock fracture. The viscoplastic part of the model is formulated in the spirit of the consistency model by Wang (1997). Isotropic damage model with separate damage variables in tension and compression is employed to describe the stiffness and strength degradation. The model is implemented with the FE method using the constant strain
triangle elements. The equations of motion are solved with the explicit time marching scheme. In the numerical examples, after demonstrating the model response at the material point level, confined compression and uniaxial tension tests on rock are simulated as quasi-static problems. Moreover, the dynamic three-point bending of a notched semicircular disc test is simulated in order to demonstrate the model predictions under dynamic loading conditions.

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**Effect of heat transfer on glass quality in tempering**

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Authors: Karvinen, R., Mikkonen, A.
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Research output: Scientific › Conference contribution

**Gain Scheduling Full State Feedback with D-Implementation for Velocity Tracking of Hydrostatic Drive Transmission**
This paper presents a gain-scheduling based velocity controller for hydrostatic drive transmissions (HSD). We design our controller based a model of the system which captures most of the nonlinear effects and parameter variation. Therefore, we can obtain much better performance compared to existing linear controllers. Our control strategy is based on full state feedback whose gains are scheduled on measured states which are speed and volume pressures, and estimated hydraulic flow. To implement standard state feedback, we would need to calculate operating points of all the states at all time. However, due to modelling uncertainty (specially unknown frictions) pressure equilibrium calculation will be very inaccurate. We will employ D implementation methodology to remedy this problem.

For the proof of concept, we show the efficacy of the controller using a validated simulator of a wheel loader with real machine parameters. The experiments are performed both on flat terrain and slope. The results demonstrate that the performance of velocity tracking is high and the controllability of the machine is maintained in every situation.

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Authors: Backas, J., Ghabcheloo, R., Huhtala, K.
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Guidelines for Designing Human-friendly User Interfaces for Factory Floor Manufacturing Operators

Agility and fast reaction to changes is required in today's turbulent manufacturing environment. Unfortunately, the commonly used user interfaces (UIs) on the factory floor don't support such rapid reaction. Even though the human involvement improves agility and reactivity of production systems, it is also a source of uncertainty, especially when it comes to information inputting. Therefore, specific attention should be placed on human-friendly UI design, in order to improve the reliability of collected data and productivity of operations, as well as to make the workplaces more attractive for the future operators. This paper gives generic guidelines for human-friendly UI design and represents a case study in the context of manufacturing IT-system design.

Hydraulic Cylinder Models for Flexible Multibody System Simulation

Hydraulic Cylinder Models for Flexible Multibody System Simulation
The properties of wood must be considered when designing mechanical pulping machinery. The composition of wood within the annual ring is important. This paper proposes a novel image-based method to measure stress and planar strain distribution in soft, heterogeneous materials. The main advantage of this method in comparison to traditional methods that are based on strain gauges is that it captures local strain gradients and not only average strains. Wood samples were subjected to compression at strain rates of 1000-2500 s\(^{-1}\) in an encapsulated split-Hopkinson device. High-speed photography captured images at 50 000-100 000 Hz and different magnifications to achieve spatial resolutions of 2.9 to 9.7 μm pixels\(^{-1}\). The image-based analysis utilized an image correlation technique with a method that was developed for particle image velocimetry. The image analysis gave local strain distribution and average stress as a function of time. Two stress approximations, using the material properties of the split-Hopkinson bars and the displacement of the transmitter bar/sample interface, are presented. Strain gauges on the bars of the split-Hopkinson device give the reference average stress and strain. The most accurate image-based stress approximation differed from the strain gauge result by 5%.
Increasing Employee Involvement in Socially Sustainable Manufacturing: Two Methods for Capturing Employees’ Tacit Knowledge to Improve Manufacturing Processes

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Micro-factories

Micro- and desktop factories are small-size production systems suitable for the manufacture of small products with micro- and/or macro-size features. The development originates in Japan, where small machines were developed in order to save resources when producing small products. In the late 1990s, the research spread around the world, and since then multiple miniaturized production systems, both academic and commercial, have been developed. Academic research literature speculates with several advantages of using miniaturized production equipment ranging from reduced use of energy and other resources to better operator ergonomics, and from greater equipment flexibility to ubiquitous manufacturing (manufacturing on the spot). This paper will give a thorough introduction to existing micro-factory solutions and their potential application areas. It will also discuss the benefits of miniaturized production systems compared to traditional larger scale systems from three sustainability perspectives, namely environmental, economic, and social ones.
deformation and particle boundaries whereas particle bonding was evaluated with cavitation-erosion test. Density was proven with Corrodokte test and impermeable HPCS NiCu+Al2O3 coating structures were achieved. Furthermore, cavitation-erosion resistance of NiCu coating was improved by heat treatment.

**General information**

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- Scopus rating (2010): SJR 1.155 SNIP 1.66
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- Scopus rating (2008): SJR 1.479 SNIP 1.564
- Scopus rating (2007): SJR 1.165 SNIP 1.509
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- Scopus rating (2002): SJR 1.208 SNIP 1.183
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**Numerical modelling of rock fracture with the embedded discontinuity approach incorporating heterogeneity**

In this paper, the embedded discontinuity approach is applied to finite element modeling of rock fracture. A rate-dependent constitutive model based on the embedded displacement discontinuity theory is developed to describe the mode I, mode II and mixed mode fracture of rock in tension and compression. The bulk material is described as linear elastic until reaching the elastic limit. Beyond this limit, a rate-dependent exponential softening law governs the evolution of the embedded displacement jump. The present approach incorporates the rock heterogeneity by random description of the mineral texture of rock. Moreover, the inherent initial microcrack populations of natural rocks are accounted for as randomly oriented embedded discontinuities. Numerical examples demonstrate the model behavior in uniaxial compression and tension. The effect of loading rate and confining pressure is tested as well in 2D numerical simulations. These simulations show that the model captures the main features of rock in confined compression and uniaxial tension. The developed method has the computational efficiency of continuum plasticity models. However, it has an important advantage of accounting for the orientation of introduced microcracks.
On the effect of damping on stability of non-conservative systems
Anomalous damping-induced destabilization is investigated in a simple, small system consisting of a double pendulum with springs. Linearized and fully non-linear results are presented.

Production planning and control in Finnish manufacturing companies – Current state and challenges
In today's highly dynamic manufacturing environment smooth information flow between different operational levels, especially planning and shop floor-level, is essential to ensure rapid reaction to changes. Unfortunately, the manufacturing companies are facing challenges with their manufacturing operations and management practices and associated information systems. This came clear during the interviews conducted among 25 Finnish manufacturing companies between the late fall 2013 and spring 2014. This paper discusses the results from those company interviews, highlighting the current practices and challenges of manufacturing operations management in Finnish manufacturing companies. The main findings are the following. The production planning and control on the factory floor level are not widely supported by proper IT-tools. Utilisation of Manufacturing Operations Management (MOM) systems, including Manufacturing Execution Systems (MES) and Advanced Planning and Scheduling (APS) systems, is still rare. The detailed production scheduling, dispatching and operations control are commonly performed by various MS Excel spreadsheets and paper documents, which are not integrated with other company IT-systems and do not support rapid reaction to changes and disturbances.
Some aspects on efficient solution of creep problems
Integration of inelastic constitutive models by implicit schemes, require local Newton's iteration to solve the discretized non-linear evolution equations at the integration point level. Choice of the starting values in the Newton's iteration affects on the success of the iteration at the local integration point level. This note describes a simple modification on the approach proposed by Schreyer giving increased robustness on the local iteration process. Also the effect of line search and quasi-Newton methods in the solution of the global equilibrium iterations is investigated.

Abstract This paper presents three interconnected developments made during the course of a recent collective research work, the development of a systematic graph-based search tool for physical contradictions, a ranking approach for defining the order of criticality of the design contradictions and the associated analysis of the different design strategies that can be used to solve those contradictions or to enhance performance indicators. The systematic graph-based search for physical contradictions is using the set of elementary variables necessary to describe the system as basic input. The initial set is extracted based on taxonomy of variables combining classification work from NIST and classification of variables derived from the Bond Graph theory. The contradiction search method is in a second step classifying the set of variables into three categories: the constraint variables imposed to the designers by the context and the environment, the design variables on which the designer as the possibility to act and the performance variables that are used to evaluate the performance of the designed system. In a third step, interactions between variables are searched using two possibilities: a causal ordering algorithm developed during the course of the research or via a collective work of experts. The result of this step is a directed graph starting from the constraints variables and ending with the performance variables. In the fourth step objectives have to be assigned to the performance variables (minimal value, maximal value or target value). Those objectives are propagated back into the graph by analyzing the impact of the variables interacting with the performance variables. A physical contradiction is detected each time it is discovered that a design variable is associated with two contradictory objectives. Following this approach, a contradiction is represented as a node in the directed graph. It is possible to systematically map the different design strategies that can be used and to rank the possible impact of those design strategies. The article presents a concrete application of the approach on the case study of an air bearing and demonstrates the novelty of the approach to generate new viewpoints and insight in the analysis of the early stages of the development process. The potential impact of such type of design support is potentially very important. A future step will consists of developing a computer aided tool implementing the method.
Teollinen internet täydentää pk-yritysten palveluita

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Industrial Management, Research group: Center for Research on Operations Projects and Services, Department of Mechanical Engineering and Industrial Systems, Research area: Life-cycle Management, Research area: Engineering Intelligence
Authors: Väliaho, V., Martinsuo, M., Koskinen, K., Aaltonen, J.
Number of pages: 3
Pages: 36-38
Publication date: 2015
Peer-reviewed: Unknown

Publication information
Journal: Promaint
Volume: 29
Issue number: 5
ISSN (Print): 1797-2000
Original language: Finnish

Bibliographical note
ORG=tta,0.8
ORG=mei,0.2
Research output: Professional › Article

The Fourteenth Scandinavian International Conference on Fluid Power, SICFP15: Proceedings
At this time the conference includes various themes like hybrids, drives, digital hydraulics and pneumatics. Special attention in the program is given for energy efficiency, renewable energy production and energy recovery. They are reflecting well the situation, where environmental issues and energy saving are increasingly important issues.

General information
State: Published
Ministry of Education publication type: C2 Edited books
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Fluid power automation in mobile machines
Authors: Laamanen, A. (ed.), Huhtala, K. (ed.)
Number of pages: 835
Publication date: 2015

Publication information
Publisher: Tampere University of Technology. Department of Intelligent Hydraulics and Automation
Original language: English

Publication series
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Publisher: Tampere University of Technology
ISSN (Print): 2342-2726
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Two models for hydraulic cylinder

General information
State: Published
Ministry of Education publication type: D3 Professional conference proceedings
Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics, Department of Civil Engineering, Research group: Mechanics of Structures
Authors: Ylinen, A., Kouhia, R., Mäkinen, J.
Number of pages: 2
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http://www.gf.unsa.ba/eccomas-msf-2015/

Bibliographical note
Ei löydy isbn
ORG=mei,0.5
ORG=rak,0.5
Research output: Professional › Conference contribution

Vision-based trajectories planning for four wheels independently steered mobile robots with maximum allowable velocities

In this paper, we extend our previous work to introduce a novel vision-based trajectories planning method for four-wheel-steered mobile robots. Relying only on the overhead camera and by utilizing artificial potential fields and visual servoing concepts, we simultaneously, generate the synchronized trajectories for all wheels in the world coordinates with sufficient number of trajectories midpoints. The synchronized trajectories are used to provide the robot's kinematic variables and robotinstantaneous-center of rotation to reduce the complexity of the robot kinematic model. Therefore, we plan maximum allowable velocities for all wheels so that at least one of the actuators is always working at maximum velocity. Experiment results are presented to illustrate the efficiency of the proposed method for four-wheel-steered mobile robot called iMoro.

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Mobile manipulation
Authors: Ziaei, Z., Oftadeh, R., Mattila, J.
Number of pages: 7
Pages: 303-309
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ISBN (Print): 97833192224152

Publication series
Name: Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Wood compression model for radial compression of earlywood and latewood

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Authors: Moilanen, C., Björkqvist, T., Saarenrinne, P.
Number of pages: 6
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Title of host publication: Proceedings of the XII Finnish Mechanics Days
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ORG=mei,0.5
ORG=ase,0.5
Research output: Scientific › Conference contribution

Method and apparatus for cooling material by atomised spray
The invention relates to a method and apparatus for tempering material. According to the invention, one or more liquids are atomized by at least one sprayer into droplets which are guided towards a surface of a hot material so that at least some of the droplets collide with the surface of the hot material and evaporate, thus removing thermal energy from the surface layer of the hot material. Impact members may be used to further reduce the size of the droplets. The droplets may be guided to the surface by a separate guiding gas flow.

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State: Published
Ministry of Education publication type: H1 Granted patent
Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Applied Mechanics, Research group: Lämpö- ja virtaustekniikka, BENEQ OY
Authors: Ahonen, S., Karvinen, R., Vainio, T.
Publication date: 31 Dec 2014

Publication information
IPC: C03B 27/ 02 A I
Patent number: CN102803520
Priority date: 15/06/10
Priority number: WO2010FI50499
Original language: English
Source: espacenet
Source-ID: CN102803520
Research output: Scientific › Patent
Versatile erosion wear testing with the high speed slurry-pot

The high speed slurry-pot tester was developed for application oriented erosion wear testing of materials used in mineral handling and processing. It enables tests in demanding high stress abrasive and erosive environments simulating wear, for example in slurry pumps, tanks and pipes, mineral crushing and grinding, loader buckets, dredging, and drilling. The key design features of the test method are the possibility to use up to 10 millimeter sized particles and sample speeds up to 20 m/s in conditions ranging from wet slurry environments to dry sand or gravel.

The tester has been used to test many different material types, including conventional steels, surface treated steels, cast irons, thick and thin coatings, ceramics, hybrid materials, polymers and elastomers. With the high speed slurry-pot tester, samples of various types and sizes can be tested.

In the FIMECC BSA/P2/SP3 project, the focus is in the testing of materials intended for demanding wear related applications. Moreover, the test system is further developed for various wear conditions, including slurry-erosion, grinding abrasion, and sub-zero temperatures.

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ASJC Scopus subject areas: Materials Science(all)
Keywords: Wear testing, Wear resistant steel, Application oriented, Materials, Material characterization, Wear, Polymer, Ceramic, Coatings, mining
Electronic versions:
TWC 2014 poster_Niko Ojala
Research output: Scientific › Paper, poster or abstract

Competence needs and a model for the teaching strategy development of mechanical designers in product development

Engineers' product development (PD) skills are the key success factors for companies in countries like Finland. Universities need to regularly update their learning outcome targets to match them with the needs of the industrial sector under consideration. These targets form the basis for the development of the curriculum and the relevant courses of engineering education. The main research problem is "What are the contentual and pedagogical demands to optimise learning results in the field of mechanical engineering for the higher education of PD at Universities of Applied Sciences (UAS) in Finland?" so that graduating engineers are competent to meet the PD challenges of the Finland-based companies in the Technology Industries. The word "optimise" here means that the aim is to reach the best possible learning results with the resources available at the university. A case study research has been made to find the most important competence needs of mechanical designers working in PD in Finnish mechanical workshops. The results of this case study establish the customer needs for the curriculum and course development process in the field of PD. A comprehensive and systematic method to develop the whole teaching and learning process of a course has been introduced. The teaching strategy of a course has been defined as a modular service product which includes five modules from the targets for learning outcomes to learning and teaching assessment. A model based on the stage-gate type PD process, widely and successfully used in the industry, has been applied to the course teaching strategy development. The detailed guidelines together with the phase tasks and the main outcomes for the phases give the information needed to use the model; including those teachers who are not familiar with the PD process. The author's twenty year's PD work experience in Finnish companies has created a solid base for the study. The important PD tools, such as the stage-gate type PD process and the product modularization, have become well known to the author during those years. This PD work experience also helped a lot when organizing and carrying out the case study research. The research has utilized the industrial development methodologies in the university environment. The illustrative application of the model to a PD course for mechanical designers at the Finnish Universities of Applied Sciences as well as the comparison of the model with existing models show that it is an effective tool for the comprehensive and transparent development of courses in the field of engineering.

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Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Nevaranta, J.
Number of pages: 141
Publication date: 31 Oct 2014

Publication information
Effects of composition and microstructure on the abrasive wear performance of quenched wear resistant steels

Wear resistant steels are commonly categorized by their hardness, and in the case of quenched wear resistant steels, their Brinell hardness grades are widely considered almost as standards. In this study, the abrasive wear performance of 15 commercially available 400 HB grade quenched wear resistant steels from all over the world were tested with granite gravel in high stress conditions. The aim was to evaluate the real wear performance of nominally similar steels. Also properties such as hardness, hardness profiles, microstructures and chemical compositions of the steels were studied and reasons for the differences in their wear performance further discussed. In terms of mass loss, over 50% differences were recorded in the abrasive wear performance of the studied steels. Variations in the chemical compositions were linked to the auto-tempered microstructures of the steels, and the microstructural characteristics were further linked to their ultimate wear behavior. © 2014 Elsevier B.V.

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Scopus rating (2015): SJR 1.527 SNIP 2.017 CiteScore 2.73
Scopus rating (2014): SJR 1.715 SNIP 2.38 CiteScore 2.46
Scopus rating (2013): SJR 1.319 SNIP 2.416 CiteScore 2.37
Scopus rating (2012): SJR 1.36 SNIP 2.178 CiteScore 1.85
Scopus rating (2011): SJR 1.547 SNIP 2.865 CiteScore 2.43
Scopus rating (2010): SJR 1.509 SNIP 2.153
Scopus rating (2009): SJR 1.684 SNIP 2.07
Scopus rating (2008): SJR 1.597 SNIP 1.863
Scopus rating (2007): SJR 1.286 SNIP 1.889
Scopus rating (2006): SJR 1.435 SNIP 2.036
Scopus rating (2005): SJR 1.473 SNIP 2.007
Scopus rating (2004): SJR 1.335 SNIP 1.965
A Semantically Enhanced Approach for Orchestration of Web Services in Factory Automation Systems

The Service-oriented Architecture (SOA) paradigm makes it possible to build systems from several independent components. Most typically, web services are chosen as the building blocks of such a system. A web service is essentially a passive software entity, which listens for request messages sent to it over the network, possibly reacts to the requests by performing some operations, and finally sends response messages to the request senders. The traditional application domain of web services belongs to the so-called IT domain. While opening new horizons in software development life-cycles, web services have been adopted in various new application domains, including the domain of factory automation (software development for factory automation). Indeed, recent research projects have experimented with controlling production system equipment through web service interfaces. When migrated from pure software to the physical realm involving industrial equipment, web services set additional demands for the application domains. For example, since the domains involve operations with physical effects, roll-back or application recovery procedures become challenging. This research work targets the orchestration of factory automation systems encapsulated as web services and presents various techniques for overcoming the difficulties. Orchestrating web services to accomplish a complicated production task can be difficult due to the transitoriness of both production equipment states and the set of available web services. Nevertheless, the selection of appropriate web services can be facilitated by augmenting each service with semantic information describing its conditions and effects. Web services augmented with such descriptions are termed semantic web services. While Web Ontology Language, OWL, is ideal for describing application domain concepts and property relationships, the OWL-S ontology, which is based on OWL, has been specifically developed for describing web services. Once the semantic service descriptions have been analyzed to find the appropriate web services, the selected services can be invoked using their syntactic WSDL descriptions. In addition to automated web service selection, semantic descriptions allow the composition of web services to achieve production tasks. Service composition involves first analyzing the descriptions to determine the appropriate service invocation process for achieving the desired goal and then executing the process. This dissertation presents an approach in which the production equipment and their states are represented using an ontology, and the model is dynamically used in decision-making. In particular, the devices in the considered production systems provide web service interfaces through which they can be controlled, while semantic web service descriptions formulated in OWL-S make it possible to determine the conditions and effects of invoking the web services. The approach presented in this research work additionally involves a set of specialized web services that co-operate to achieve production goals using the domain web services. One of the services maintains a semantic model of the current system state, while another uses the model to compose the domain web services so that they jointly achieve the desired goals. The semantic model of the system is automatically updated based on event notifications sent by the domain services. Software agents controlling production devices must maintain an up-to-date view of the physical world state in order to efficiently reason and plan their actions. Especially in a factory automation system, the world state undergoes rapid evolution, and the world view must remain synchronized with the changes. This research discusses two approaches to updating the world view based on event notifications sent by web services representing production devices in a manufacturing system. One of the approaches is based on separately specified update rules, and one automatically uses semantic web service descriptions formulated in OWL-S. While all of the examples presented in this research work specifically focus on the factory automation domain, the presented approaches are applicable to all domains involving semantic web services. Semantic Web Service descriptions facilitate the automated discovery and composition of web services. Particularly in the production system domain, the service condition and effect descriptions are essential in selecting the appropriate service or service composition for a given task. OWL-S is one of the most popular semantic web service description languages, and due to its XML syntax, OWL-S can be effortlessly incorporated into service WSDL descriptions. However, developing OWL-S documents for each service instance is laborious. This dissertation presents an approach to automatically generating executable OWL-S descriptions from semantically annotated service WSDL files.
Computing clouds facilitate rapid and effortless resource allocation. Cloud consumers can generally be ignorant of the physical computing resources used or their geographical location, as the resources are abstracted into a commodity that can be dynamically leased from the cloud provider. In particular, Infrastructure-as-a-Service clouds allow clients to dynamically lease virtual machines that behave similarly to physical servers. However, executing an application by directly using computing cloud resources is complicated and typically involves similar steps as installing and executing an application on a physical machine. Moreover, starting numerous application instances on a single virtual machine may result in poor performance. Thus, this dissertation considers the development of a web service that facilitates the use of cloud resources by abstracting them. When the web service is used, an application can be effortlessly started in a computing cloud by invoking simple web service operations. Furthermore, when multiple applications are started, the workload can be automatically distributed between several virtual machines, resulting in higher performance. To conclude, the results presented in this research work demonstrate that semantic web service descriptions can indeed facilitate automatic web service composition and invocation. However, the effort of developing semantic web service descriptions can partly undermine the benefits achieved through their application. Therefore, new tools and methods should be developed to minimize the effort of developing such descriptions.

Characterisation of Novel Corrosion Resistant Stainless Steel/Rubber/Composite Hybrid Structures
Last decade has shown an increasing interest in hybrid materials and structures. With hybrids there is not only potential to create high strength low weight structures, but also to tailor the properties of the final product in a way that is unattainable by any single material alone. Simpler manufacturing process, increased functional integration, improved sound and vibration damping properties, enhanced crack propagation resistance and protection against collapse in a crash are just some examples of possible advantages of hybrid materials. However, before implementation in industrial application, adequate adhesion between the material components of a hybrid must be ensured. Also, from industrial point of view the required manufacturing method should not increase substantially the costs of the product. Although many established adhesion procedures exist, there is still lack of functioning joining methods for certain material combinations. Especially, the adhesive joining of polymeric materials to stainless steel is demanding, as the conventional methods require laborious manufacturing steps. In this study, the possibility to bond stainless steel to fibre reinforced epoxy composite with an ethylene propylene diene terpolymer (EPDM) based rubber is studied. Two different rubber compounds are used to create stainless steel/composite hybrids and a mild steel/rubber/composite structure is used as a reference. Both geometry-dependent peel tests together with environmental testing and geometry-independent single cantilever beam test are used to study the adhesion of the structure's interfaces. Scanning electron microscopy and transmission electron microscopy are used to characterise the nature of the interfaces of the hybrids. In addition, the effect of the rubber on the energy absorption properties of the hybrid structure was of interest. This was studied by non-destructive vibration damping test and by high velocity impact test. In these tests, both sample geometry (rubber thickness) and test parameters were varied to investigate their effect on the hybrid's behaviour. It was found that the studied method to bond stainless steel and epoxy composite by EPDM rubber enables the use of a simple manufacturing process and it furthermore results in well-bonded hybrid structure. The stainless steel/composite bond strength is defined by the cohesive strength of the rubber and
the bond maintains its strength in harsh environments. This enables the evaluation of the stainless steel/composite bond's strength by using the rubber's bulk properties instead of the substrate/rubber interfacial properties, which are difficult to define in a reliable manner. The stainless steel/rubber/composite structure has significantly better vibration damping properties than an all-metal structure. In addition, the rubber improves significantly the damage tolerance of the structure when compared to a corresponding structure which has been conventionally bonded. Thus, the approach of joining stainless steel to fibre reinforced epoxy composite with rubber has potential for industrial applications and the hybrid structure would offer a lighter and better damping solution when compared to all-metallic ones.

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Authors: Sarlin, E.
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sarlin.pdf
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Bibliographical note
Awarding institution: Tampere University of Technology
Source: researchoutputwizard
Source-ID: 1467
Research output: Collection of articles › Doctoral Thesis

Modeling and control of a pneumatic muscle actuator
This thesis presents the theoretical and experimental study of pneumatic servo position control systems based on pneumatic muscle actuators (PMAs). Pneumatic muscle is a novel type of actuator which has been developed to address the control and compliance issues of conventional cylindrical actuators. Compared to industrial pneumatic cylinders, muscle actuators have many ideal properties for robotic applications providing an interesting alternative for many advanced applications. However, the disadvantage is that muscle actuators are highly nonlinear making accurate control a real challenge. Traditionally, servo-pneumatic systems use relatively expensive servo or proportional valve for controlling the mass flow rate of the actuator. This has inspired the research of using on/off valves instead of servo valves providing a low-cost option for servo-pneumatic systems. A pulse width modulation (PWM) technique, where the mass flow is provided in discrete packets of air, enables the use of similar control approaches as with servo valves. Although, the on/off valve based servo-pneumatics has shown its potential, it still lacks of analytical methods for control design and system analysis. In addition, the literature still lacks of studies where the performance characteristics of on/off valve controlled pneumatic systems are clearly compared with servo valve approaches. The focus of this thesis has been on modeling and control of the pneumatic muscle actuator with PWM on/off valves. First, the modeling of pneumatic muscle actuator system controlled by a single on/off valve is presented. The majority of the effort focused on the modeling of muscle nonlinear force characteristics and valve mass flow rate modeling. A novel force model was developed and valve flow model for both simulation and control design were identified and presented. The derived system models (linear and nonlinear), were used for both control design and utilized also in simulation based system analysis. Due to highly nonlinear characteristics and uncertainties of the system, a sliding mode control (SMC) was chosen for a control law. SMC strategy has been proven to be an efficient and robust control strategy for highly nonlinear pneumatic actuator applications. Different variations of sliding mode control, SMC with linear model (SMCL) and nonlinear model (SMCNL) as well as SMC with integral sliding surface (SMCI) were compared with a traditional proportional plus velocity plus acceleration control with feed-forward (PVA+FF) compensation. Also, the effects of PWM frequency on the system performance were studied. Different valve configurations, single 3/2, dual 2/2, and servo valve, for controlling a single muscle actuator system were studied. System models for each case were formulated in a manner to have a direct comparison of the configuration and enabling the use of same sliding mode control design. The analysis of performance included the sinusoidal tracking precision and robustness to parameter variations and external disturbances. In a similar
manner, a comparison of muscle actuators in an opposing pair configuration controlled by four 2/2 valves and servo valve was executed. Finally, a comparison of a position servo realized with pneumatic muscle actuators to the one realized with traditional cylinder was presented. In these cases, servo valve with SMC and SMCI were used to control the systems. The analysis of performance included steady-state error in point-to-point positioning, the RMSE of sinusoidal tracking precision, and robustness to parameter variations.

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Authors: Jouppila, V.
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Source: researchoutputwizard
Source-ID: 609
Research output: Collection of articles › Doctoral Thesis

Retrofitting digital hydraulics – An analytical study
Reason for the slow adaptation of new greener technologies is often the need for large modifications in products or systems. Different kind of regenerative pump-motor transformers might give an optimal solution for the energy efficiency of upcoming hydraulic systems, but the authors’ viewpoint is that it will take decades before the technology is going to be widely adopted. On the other hand especially the industrial hydraulic systems have long lifetimes and the large scale of the system often makes it unprofitable to fully rebuild the system for improved energy efficiency.

In order to improve the existing industrial and mobile hydraulic systems in a shorter time range, retrofittable digital hydraulic valve concepts are presented to replace the old proportional and servo valves. In this paper, the advantages of the three different digital valve system configurations are analysed. Configurations include utilization of a pressurized return line and a common regenerative pressure line attached to valve block through logic valves. The steady-state energy-efficiency of a multi actuator system is compared to a traditional proportional LS-system. As the improvements are highly dependent on the system work cycle and power distribution during the cycle, worst-case and optimal improvements are presented as well as additional calculations based on a work cycle presented in literature. Also the possibility to improve productivity and technical challenges in retrofitting are discussed.

General information
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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Digital hydraulics, Research group: Fluid power automation in mobile machines
Authors: Ketonen, M., Linjama, M., Huhtala, K.
Number of pages: 6
Pages: 163
Publication date: 24 Mar 2014

Host publication information
Title of host publication: Conference proceedings, 9th International Fluid Power Conference Aachen : Modern Fluid Power - Challenges, Responsibilities, Markets, Vol. 1
A Continuum damage model based on Ottosen's four parameter failure criterion for concrete

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Tahaei Yaghoubi, S., Kouhia, R., Hartikainen, J., Kolari, K.
Number of pages: 17
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Publication date: 2014
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Source: researchoutputwizard
Source-ID: 1780
Research output: Scientific - peer-review › Anthology

A Continuum damage model for quasi-brittle materials

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Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Yaghoubi, S. T., Kouhia, R., Hartikainen, J., Kolari, K.
Number of pages: 4
Pages: 160-163
Publication date: 2014

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Place of publication: Stockholm
Publisher: KTH Mechanics
Editors: Eriksson, A., Kulachenko, A., Mihaescu, M., Tibert, G.

Publication series
Name: TRITA-MEK Technical report
Publisher: KTH Mechanics
No.: 24
ISSN (Print): 0348-467X
Activity report of COST Action TU0905 Working Group 2 – Material characterization and material improvement

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Ministry of Education publication type: A3 Part of a book or another research book
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Schneider, J., Karvinen, R., Vandebroek, M., Savineau, G.
Number of pages: 4
Pages: 21-24
Publication date: 2014

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Publisher: CRC Press
Editors: Louter, C., Bos, F., Belis, J., Lebet, J.
ISBN (Print): 978-1-138-00164-0
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http://www.crcnetbase.com/isbn/9781315796475

A hydraulic cylinder model for multibody simulations

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Organisations: Department of Mechanical Engineering and Industrial Systems, Department of Civil Engineering, Life Cycle Effectiveness of the Built Environment (LCE@BE)
Authors: Ylinen, A., Marjamäki, H., Mäkinen, J.
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Scopus rating (2014): SJR 1.799 SNIP 2.525 CiteScore 2.75
Scopus rating (2013): SJR 1.762 SNIP 2.429 CiteScore 3.01
Scopus rating (2012): SJR 1.416 SNIP 2.256 CiteScore 2.19
Scopus rating (2011): SJR 1.496 SNIP 2.661 CiteScore 2.54
Scopus rating (2010): SJR 1.433 SNIP 2.521
Scopus rating (2009): SJR 1.326 SNIP 1.834
Scopus rating (2008): SJR 1.443 SNIP 1.952
Scopus rating (2007): SJR 1.248 SNIP 1.7
Scopus rating (2006): SJR 0.817 SNIP 1.588
A new Generation Sweating Thermal Manikin for the Evaluation of the Thermoregulation Properties of Protective Clothing

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Authors: Varheenmaa, M.
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Research output: Scientific - peer-review › Article

Anisotropic viscodamage-viscoplastic consistency constitutive model with a parabolic cap for rocks with brittle and ductile behavior

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems, Life Cycle Effectiveness of the Built Environment (LCE@BE)
Authors: Saksala, T., Ibrahimbegovic, A.
Number of pages: 14
Pages: 460-473
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: International Journal of Rock Mechanics and Mining Sciences
Volume: 70
ISSN (Print): 1365-1609
Ratings:
Application of Design Review to Probabilistic Risk Assessment in a Large Investment Project

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Virtanen, S., Penttinen, J., Kiiski, M., Jokinen, J.
Number of pages: 12
Pages: 1-12
Publication date: 2014

Host publication information
Title of host publication: Proceedings of the Probabilistic Safety Assessment and Management PSAM12, June 2014, Honolulu, Hawaii
Links:

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-08-06<br/>Publisher name: Pergamon
Source: researchoutputwizard
Source-ID: 1438
Research output: Scientific - peer-review › Article

Applying the digital image corralation method to fretting contact

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Authors: Juoksukangas, J., Lehtovaara, A., Mäntylä, A.
Number of pages: 6
Pages: 1-6

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-12-13
Source: researchoutputwizard
Source-ID: 1754
Research output: Scientific - peer-review › Conference contribution
Atomistic investigation on the structure-property relationship during thermal spray nanoparticle impact

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science
Authors: Goel, S., Faisal, N. H., Ratia, V., Agrawal, A., Stukowski, A.
Number of pages: 12
Pages: 163-174
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: COMPUTATIONAL MATERIALS SCIENCE
ISSN (Print): 0927-0256
Ratings:
Scopus rating (2016): SJR 0.926 SNIP 1.259 CiteScore 2.37
Scopus rating (2015): SJR 0.993 SNIP 1.348 CiteScore 2.3
Scopus rating (2014): SJR 1.129 SNIP 1.677 CiteScore 2.47
Scopus rating (2013): SJR 0.965 SNIP 1.337 CiteScore 2.15
Scopus rating (2012): SJR 1.022 SNIP 1.647 CiteScore 2.14
Scopus rating (2011): SJR 0.996 SNIP 1.46 CiteScore 1.97
Scopus rating (2010): SJR 0.961 SNIP 1.257
Scopus rating (2009): SJR 0.978 SNIP 1.308
Scopus rating (2008): SJR 0.919 SNIP 1.3
Scopus rating (2007): SJR 0.682 SNIP 1.029
Scopus rating (2006): SJR 0.852 SNIP 1.474
Scopus rating (2005): SJR 1.161 SNIP 1.327
Scopus rating (2004): SJR 0.915 SNIP 1.06
Scopus rating (2003): SJR 0.61 SNIP 0.775
Scopus rating (2002): SJR 0.576 SNIP 0.705
Scopus rating (2001): SJR 0.539 SNIP 0.752
Scopus rating (2000): SJR 0.489 SNIP 0.761
Scopus rating (1999): SJR 0.865 SNIP 0.791
Original language: English
DOIs:

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-02
Source: researchoutputwizard
Source-ID: 618
Research output: Scientific › Conference contribution

Champion-työkalut: Fasilitoijan ohjeet. Mestariluokan työkalut hankkeiden valmisteluun ja toteuttamiseen
Clean Components Decrease Unexpected Maintenance Work

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Condition monitoring of hydraulic components and systems
Authors: Rinkinen, J., Elo, L.
Number of pages: 5
Pages: 36-40
Publication date: 2014
Peer-reviewed: Unknown

Publication information
Journal: Maintworld, Maintenance & Asset Management
Volume: 6
Issue number: 2
ISSN (Print): 1798-7024
Original language: English
Links:
http://www.maintworld.com/

Bibliographical note
Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2014-05-30<br/>Publisher name: Omnipress Oy
Source: researchoutputwizard
Source-ID: 1384
Research output: Professional › Article

Concerns over students role as test users in virtual environments

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Tiainen, T., Elliott, A.
Number of pages: 8
Pages: 11-18
Publication date: 2014

Host publication information
Title of host publication: Proceedings of the 18th Academic MindTrek Conference 2014 "Media business, management, content & services" 4-6 November, 2014, Tampere, Finland
Place of publication: New York, NY
Publisher: The Association for Computing Machinery
Editors: Lugmayr, A., Franssila, H., Paavilainen, J.
Delay excited vibrations in grinding wheel rotor system

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Järvenpää, V., Yuan, L.
Number of pages: 8
Pages: 2437-2444
Publication date: 2014

Host publication information
Publisher: International Institute of Acoustics and Vibration (IIAV)
Editors: Crocker, M. J., Pawelczyk, M., Tian, J.

Design reasoning patterns in NPD education design

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Juuti, T., Lehtonen, T., Rättäyä, K., Halonen, N., Vanhatalo, M., Kujansuu, P.
Number of pages: 6
Pages: 682-687
Publication date: 2014

Host publication information
Title of host publication: Proceedings of 16th International Conference on Engineering and Product Design Education, University of Twente, Enschede, The Netherlands 4th-5th September 2014
Publisher: The Design Society
Editors: Bohemia, E., Eger, A., Eggink, W., Kovacevic, A., Parkinson, B., Wits, W.
ISBN (Print): 978-1-904670-56-8

Effect of test parameters on large particle high speed slurry erosion testing

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Number of pages: 7
**Equal coded digital hydraulic valve system - improving tracking control with pulse frequency modulation**

**General information**
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Intelligent Hydraulics and Automation
Authors: Palonitty, M., Linjama, M., Huhtala, K.
Number of pages: 9
Pages: 618-626
Publication date: 2014

**Host publication information**
Title of host publication: The Second International Conference on Dynamics and Vibroacoustics of Machines, September 15-17, 2014, Samara, Russia
ISBN (Print): 978-5-7883-0977-4
Links:
http://confdvm.ssau.ru/

**Bibliographical note**
Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2014-10-31
Source: researchoutputwizard
Source-ID: 1223
Research output: Scientific - peer-review › Conference contribution

**Evaluation of thermal Comfort Properties of Prototypte Uniforms for Rescue Team Workers**

**General information**
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science
Authors: Varheenmaa, M.
Number of pages: 6
Pages: 1-6
Publication date: 2014

Host publication information
Title of host publication: Ambience14&10i3m, Tampere Hall, Tampere, Finland 7-9 September 2014
Editor: Varheenmaa, M.

Publication series
Name: Proceedings of Ambience, Scientific Conference for Smart Textiles
No.: 1
ISSN (Print): 2342-4540

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-09-23
Source: researchoutputwizard
Source-ID: 1704
Research output: Scientific - peer-review › Conference contribution

Experimental Comparisons of Sliding Mode Controlled Pneumatic Muscle and Cylinder Actuators

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Jouppila, V., Gadsden, A. S., Ellman, A.
Number of pages: 10
Publication date: 2014
Peer-reviewed: Yes

Publication information
Volume: 136
Issue number: 4
Article number: 044503
ISSN (Print): 0022-0434
Ratings:
Scopus rating (2016): SJR 0.52 SNIP 0.792 CiteScore 1.29
Scopus rating (2015): SJR 0.626 SNIP 0.89 CiteScore 1.36
Scopus rating (2014): SJR 0.673 SNIP 1.23 CiteScore 1.38
Scopus rating (2013): SJR 0.723 SNIP 1.234 CiteScore 1.4
Scopus rating (2012): SJR 0.579 SNIP 1.043 CiteScore 1.09
Scopus rating (2011): SJR 0.564 SNIP 0.995 CiteScore 0.96
Scopus rating (2010): SJR 0.844 SNIP 1.639
Scopus rating (2009): SJR 0.812 SNIP 1.476
Scopus rating (2008): SJR 0.711 SNIP 1.364
Scopus rating (2007): SJR 0.551 SNIP 1.368
Scopus rating (2006): SJR 0.657 SNIP 1.53
Scopus rating (2005): SJR 0.512 SNIP 1.169
Scopus rating (2004): SJR 0.724 SNIP 1.351
Scopus rating (2003): SJR 0.923 SNIP 1.474
Scopus rating (2002): SJR 1.187 SNIP 1.365
Scopus rating (2001): SJR 1.013 SNIP 1.466
Scopus rating (2000): SJR 0.699 SNIP 1.299
Scopus rating (1999): SJR 0.65 SNIP 1.077
Original language: English
DOIs:
10.1115/1.4026673
Functional failure modes cause-consequence logic suited for mobile robots used at scientific facilities

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Douzi, I. K., Virtanen, S., Bonnal, P., Verma, A.
Number of pages: 9
Pages: 10-18
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Reliability Engineering and System Safety
Volume: 129
ISSN (Print): 0951-8320
Ratings:
Scopus rating (2016): SJR 1.407 SNIP 2.366 CiteScore 3.78
Scopus rating (2015): SJR 1.373 SNIP 2.403 CiteScore 3.93
Scopus rating (2014): SJR 1.467 SNIP 2.714 CiteScore 3.4
Scopus rating (2013): SJR 1.381 SNIP 2.939 CiteScore 3.28
Scopus rating (2012): SJR 1.566 SNIP 3.008 CiteScore 3.55
Scopus rating (2011): SJR 0.825 SNIP 2.945 CiteScore 3.15
Scopus rating (2010): SJR 1.268 SNIP 2.345
Scopus rating (2009): SJR 1.198 SNIP 2.634
Scopus rating (2008): SJR 0.95 SNIP 2.313
Scopus rating (2007): SJR 0.77 SNIP 2.13
Scopus rating (2006): SJR 0.692 SNIP 1.944
Scopus rating (2005): SJR 0.544 SNIP 1.667
Scopus rating (2004): SJR 0.489 SNIP 1.623
Scopus rating (2003): SJR 0.409 SNIP 1.321
Scopus rating (2002): SJR 0.483 SNIP 1.02
Scopus rating (2001): SJR 0.416 SNIP 1.066
Scopus rating (2000): SJR 0.219 SNIP 0.93
Scopus rating (1999): SJR 0.301 SNIP 1.136
Original language: English
DOIs:
10.1016/j.ress.2014.03.012
Links:
http://www.journals.elsevier.com/reliability-engineering-and-system-safety/

Garment fit by Numbers: Statistical Identification of a Garment’s Misfit

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science
Geometry-Aided Inversion of Manipulator Telescopic Link Length from MEMS Accelerometer and Rate Gyro Readings

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Signal Processing, Research group: MMDM, Department of Intelligent Hydraulics and Automation, Research group: Mobile manipulation, Research area: Intelligence in Machines, Signal Processing Research Community (SPRC)
Authors: Vihonen, J., Honkakorpi, J., Mattila, J., Visa, A.
Number of pages: 6
Pages: 181-186
Publication date: 2014
Hydraulikkomponenttien testipäkkistandardi ja mittaustuloksia

General information
State: Published
Ministry of Education publication type: D3 Professional conference proceedings
Organisations: Department of Intelligent Hydraulics and Automation
Authors: Pekkonen, J., Elo, L., Kuosku, M., Rinkinen, J.
Number of pages: 12
Pages: 199-210
Publication date: 2014

Host publication information
Title of host publication: PAMAS 2014 Käyttäjäpäivä, 4.2.2014, Tampereen teknillinen yliopisto, Tampere
Place of publication: Tampere
Publisher: Tampereen teknillinen yliopisto
Editors: Rinkinen, J., Multanen, P., Elo, L., Niiranen, E.
ISBN (Print): 978-952-15-3235-1

Bibliographical note
Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2014-05-30
Source: researchoutputwizard
Source-ID: 1253
Research output: Professional › Conference contribution

Impacts of making design decision sequence explicit on NPD project in forest machinery company

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Halonen, N., Lehtonen, T., Juuti, T.
Number of pages: 10
Pages: 702-711
Publication date: 2014

Host publication information
Title of host publication: Proceedings of 10th NordDesign 2014 Conference, Espoo, August 27-29, Aalto University
Place of publication: Espoo
Publisher: Aalto Design Factory
Editors: Laakso, M., Ekman, K.

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-12-29
Source: researchoutputwizard
Source-ID: 401
Research output: Scientific - peer-review › Conference contribution
Implementing circulating oil lubrication systems based on the IMC-AESOP architecture

General information
State: Published
Ministry of Education publication type: A3 Part of a book or another research book
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Camp, R.; Lobov, A.
Number of pages: 20
Pages: 183-202
Publication date: 2014

Host publication information
Title of host publication: Industrial cloud-based cyber-physical systems. The IMC-AESOP approach
Publisher: Springer
Editors: Colombo, A. W., Bangemann, T., Karnouskos, S., Delsing, J., Stluka, P., Harrison, R., Jammes, F., Martinez Lastra, J. L.
ISBN (Print): 978-3-319-05623-4
ISBN (Electronic): 978-3-319-05624-1
DOIs:
10.1007/978-3-319-05624-1_8

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-06-30
Source: researchoutputwizard
Source-ID: 201
Research output: Scientific - peer-review › Chapter

Improved specimen recovery in tensile split Hopkinson bar

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Isakov, M., Hiermairr, S., Kuokkala, V.
Number of pages: 12
Pages: 1-12
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Philosophical Transactions of the Royal Society A: Mathematical Physical and Engineering Sciences
Issue number: 372
Article number: 20130194
ISSN (Print): 1364-503X
Ratings:
Scopus rating (2016): SJR 0.874 SNIP 1.024 CiteScore 2.26
Scopus rating (2015): SJR 0.78 SNIP 0.985 CiteScore 2.08
Scopus rating (2014): SJR 0.847 SNIP 1.256 CiteScore 2.39
Scopus rating (2013): SJR 1.12 SNIP 1.534 CiteScore 3.12
Scopus rating (2012): SJR 1.068 SNIP 1.387 CiteScore 2.89
Scopus rating (2011): SJR 0.964 SNIP 1.297 CiteScore 2.65
Scopus rating (2010): SJR 1.095 SNIP 1.365
Scopus rating (2009): SJR 1.068 SNIP 1.309
Scopus rating (2008): SJR 0.867 SNIP 1.016
Scopus rating (2007): SJR 0.683 SNIP 0.685
Scopus rating (2006): SJR 0.856 SNIP 0.888
Scopus rating (2005): SJR 0.843 SNIP 0.824
Scopus rating (2004): SJR 0.651 SNIP 0.834
Scopus rating (2003): SJR 0.527 SNIP 0.765
Scopus rating (2002): SJR 0.368 SNIP 0.631
Scopus rating (2001): SJR 0.296 SNIP 0.4
Industrial cloud-based cyber-physical systems, The IMC-AESOP approach

General information
State: Published
Ministry of Education publication type: C2 Edited books
Organisations: Department of Mechanical Engineering and Industrial Systems, Research group: Factory automation systems technology
Number of pages: 245
Publication date: 2014

Publication information
Place of publication: Cham
Publisher: Springer
ISBN (Print): 978-3-319-05623-4
ISBN (Electronic): 978-3-319-05624-1
Original language: English
DOIs:
10.1007/978-3-319-05624-1

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-08-30
Source: researchoutputwizard
Source-ID: 238
Research output: Scientific - peer-review › Anthology

Influence of laser hardening to the sliding wear resistance of the PVD (Al,Ti) N-G and nACo(Registered trademark) coatings

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Surzhenkov, A., Adoberg, E., Antonov, M., Sergejev, F., Mikli, V., Viljus, M., Latokartano, J., Kulu, P.
Number of pages: 4
Pages: 28-31
Publication date: 2014

Host publication information
Title of host publication: 22nd International Baltic Conference on Engineering Materials and Tribology, BALTMATTRIB 2013; Riga Latvia; 14 November 2013 through 15 November 2013
Publisher: Trans Tech Publications Ltd
ISBN (Print): 978-303835043-9

Publication series
Name: Key Engineering Materials
Volume: 604
ISSN (Print): 1013-9826
DOIs:
10.4028/www.scientific.net/KEM.604.28
Influence of the spray gun type on microstructure and properties of HVAF sprayed Fe-based corrosion resistant coatings

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Authors: Milanti, A., Koivuluoto, H., Vuoristo, P.
Number of pages: 6
Pages: 334-339
Publication date: 2014

Host publication information
Title of host publication: International Thermal Spray Conference, ITSC2014, 21-23 May, 2014, Barcelona, Spain
ISBN (Print): 978-3-87155-574-9

Publication series
Name: DVS-Berichte
Volume: 302
ISSN (Print): 1341-3074

Innovatiiviset materiaali- ja rakenneratkaisut hyttystorjunnassa

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science
Authors: Jylhä, K.
Number of pages: 1
Pages: 13-13
Publication date: 2014
Peer-reviewed: Unknown

Publication information
Journal: Tekstiililehti
Issue number: 2
ISSN (Print): 0040-2370
Original language: Finnish
Links:
http://www.tekstiililehti.fi/binary/file/-/id/12/fid/337/

Innovative tool for specifying customer requirements

General information
State: Published
**Issue of using students as test users - some findings in VE testing**

**General information**
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Tiainen, T., Ellman, A.
Number of pages: 8
Pages: 615-622
Publication date: 2014

**Host publication information**
Place of publication: Croatia
Publisher: Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb; The Design Society, Glasgow
Editors: Majanovic, D., Storga, M., Pavkovic, N., Bojcetic, N.
Links:
http://www.designconference.org

**Bibliographical note**
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-09-05
Source: researchoutputwizard
Source-ID: 1625
Research output: Scientific - peer-review › Conference contribution

**Jet pump performance in liquid and gas pumping**

**General information**
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Mikkonen, A., Karvinen, R.
Number of pages: 11
Pages: 1-11
Publication date: 2014

**Host publication information**
Title of host publication: MFIP13, 13th International conference on multiphase flow in industrial plants, Mediterranean Foundation, Sestri Levante (Genova), Italy, 17-19 September 2014
Place of publication: Genova
Publisher: Italian association of industrial plant engineering; University of Genova Polytechnic school; Italian association of chemical engineering
ISBN (Print): 978-88-88198-37-8

**Bibliographical note**
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2015-01-14
Kestäväämpiä teräksiä kulumistutkimuksella

General information
State: Published
Ministry of Education publication type: E1 Popularised article, newspaper article
Organisations: Department of Materials Science
Authors: Ratia, V.
Publication date: 2014
Peer-reviewed: Unknown

Publication information
Journal: TES - Tekniikan edistämissäätiö
Original language: Finnish
Links:
http://www.tekniikanedistamissaatio.fi/rahotettua-tutkimusta

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-31
Source: researchoutputwizard
Source-ID: 1081
Research output: Scientific - peer-review › Conference contribution

Life Cycle Assessment on Personal Protective Equipments

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science
Authors: Fatarella, E., Parisi, L., Varheenmaa, M., Talvenmaa, P., Pavlidou, S.
Number of pages: 8
Pages: 1-8
Publication date: 2014

Host publication information
Title of host publication: Ambience14&10i3, Tampere Hall, Tampere, Finland 7-9 September 2014
Place of publication: Tampere
Publisher: Tampere University of Technology
Editor: Varheenmaa, M.

Publication series
Name: Proceedings of Ambience, Scientific Conference for Smart Textiles
Publisher: Tampere University of Technology
No.: 1
ISSN (Print): 2342-4540

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-09-23
Source: researchoutputwizard
Source-ID: 1360
Research output: Scientific - peer-review › Article

Mapping of stress raising in laser clad components depending on geometry and defects

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Mechanical Engineering and Industrial Systems, Department of Materials Science
Marking of Thermoregulatory Properties of Clothing Materials

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science
Authors: Meinander, H., Pylsy, A.
Number of pages: 4
Pages: 1-4
Publication date: 2014

Host publication information
Title of host publication: Ambience14&10i3m, Tampere Hall, Tampere, Finland 7-9 September 2014
Place of publication: Tampere
Publisher: Tampere University of Technology
Editor: Varheenmaa, M.

Publication series
Name: Proceedings of Ambience, Scientific Conference for Smart Textiles
Publisher: Tampere University of Technology
ISSN (Print): 2342-4540

Bibliographical note
Contribution: organisation=mol,FACT1=1
Source: researchoutputwizard
Source-ID: 1064
Research output: Scientific - peer-review » Conference contribution

Mechatronic design of digital hydraulic micro valve package

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Intelligent Hydraulics and Automation
Authors: Linjama, M., Paloniitty, M., Tiainen, L., Huhtala, K.
Number of pages: 8
Pages: 610-617
Publication date: 2014

Host publication information
Title of host publication: The Second International Conference on Dynamics and Vibroacoustics of Machines, September 15-17, 2014, Samara, Russia
ISBN (Print): 978-5-7883-0977-4
Links:
Metallographic Studies of Electron Beam Welded Copper Lid: Macroscopic Studies and Hardness Measurements of the Cross-Section of XKO49 at 323deg

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science
Authors: Karhula, T.
Number of pages: 54
Publication date: 2014

Publication information
Place of publication: Olkiluoto
Publisher: Posiva
Original language: English

Publication series
Name: Posiva Working Report
Publisher: Posiva
No.: 24
Electronic versions:
Posiva_WR2014_24_Karhula_XKO49_323_macro_hardness
Links:

Bibliographical note
myös MOL 214.<br/>Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-19
Source: researchoutputwizard
Source-ID: 660
Research output: Professional › Commissioned report

Metallographic Studies of Electron Beam Welded Copper Lids: EBSD Studies of the Cross-Section of XKO49 at 323deg

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science
Authors: Karhula, T.
Number of pages: 40
Publication date: 2014

Publication information
Place of publication: Olkiluoto
Publisher: Posiva
Original language: English

Publication series
Name: Posiva Working Report
Publisher: Posiva
No.: 23
Electronic versions:
Posiva_WR2014_23_Karhula_XK049_323_EBSD
Links:

Bibliographical note
Metallographic Studies of Electron Beam Welded Copper Plates: EBSD Studies of the Cross-Sections and Determination of EBSD Reference Curves by EB-Welded Tensile Test Samples

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Materials Science
Authors: Karhula, T.
Number of pages: 241
Publication date: 2014

Publication information
Place of publication: Olkiluoto
Publisher: Posiva
Original language: English

Publication series
Name: Posiva Working Report
Publisher: Posiva
No.: 2013-14
Electronic versions:
Posiva_WR2013_14_Karhula_EBSD
Links:

Bibliographical note
Contribution: organisation=mol,FACT1=1
Portfolio EDEND: 2014-05-27
Source: researchoutputwizard
Source-ID: 662
Research output: Professional › Commissioned report

Microstructural Characteristics and Tribological Behavior of HVOF-Sprayed Novel Fe-Based Alloy Coating

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science
Authors: Milanti, A., Koivuluoto, H., Vuoristo, P., Bolelli, G., Bozza, F., Lusvarghi, L.
Number of pages: 23
Pages: 98-120
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Coatings
Volume: 4
Issue number: 1
ISSN (Print): 2079-6412
Original language: English
DOI:
10.3390/coatings4010098

Bibliographical note
Contribution: organisation=mol,FACT1=1
Portfolio EDEND: 2014-06-26
Publisher name: MDPI
Source: researchoutputwizard
Source-ID: 1085
Research output: Scientific - peer-review › Article
Model-based development in the domain of mobile machines

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Jouppila, V., Kaapu, T., Sjöstedt, C., Ellman, A., Chen, D.
Number of pages: 14
Pages: 759-772
Publication date: 2014

Host publication information
Title of host publication: Digital proceedings of the tenth International Symposium on Tools and Methods of Competitive Engineering - TMCE 2014, May 19-23, Budapest, Hungary
Place of publication: Delft
Publisher: Delft University of Technology
Editors: Horvath, I., Rusak, Z.
ISBN (Print): 978-94-6186-176-4
ISBN (Electronic): 978-94-6186-177-1
Links:
http://tmce.io.tudelft.nl/

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-09-05
Source: researchoutputwizard
Source-ID: 611
Research output: Scientific - peer-review › Conference contribution

Modeling of Age-Dependent Failure Tendency from Incomplete Data
This paper addresses modeling of age-dependent failure rates from incomplete data that includes interval-censored failure ages. Two estimators for cumulative failure rates are presented: a simple non-parametric estimator and a maximum-likelihood method based on the gamma distribution and the non-homogeneous Poisson process. The maximum-likelihood fit of familiar parametric models (e.g., the power law) to the available field data from an aircraft component was far from satisfactory, so a special three-parameter model function had to be worked out. The maximum-likelihood estimate obtained is then used for repeated random generation of different data sets akin to the field data. This way the effect of data set size, censoring rate, and randomness on the non-parametric estimate can be analyzed to get practical appraisals.

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems, Research area: Life-cycle Management, Research group: Käyttövarmuuden suunnittelu ja kunnossapito
Authors: Hagmark, P., Laitinen, J.
Number of pages: 11
Pages: 449-459
Publication date: 2014

Host publication information
Title of host publication: Engineering Asset Management 2011 : Proceedings of the Sixth World Congress on Engineering Asset Management
Place of publication: London
Publisher: Springer-Verlag London Limited
Editors: Lee, J., Ni, J., Sarangapani, J., Mathew, J.
ISBN (Print): 978-1-4471-4993-4

Publication series
Name: Lecture Notes in Mechanical Engineering
ISSN (Print): 2195-4356
DOIs:
10.1007/978-1-4471-4993-4_40
Source: Bibtex
Source-ID: urn:d7b891dd2fe21c5e9c101c432e092e18
Research output: Scientific - peer-review › Conference contribution
Non-Coulomb friction in gross sliding fretting conditions with aluminium bronze against quenched and tempered steel

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Hintikka, J., Lehtovaara, A., Mäntylä, A.
Number of pages: 11
Pages: 151-161
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Tribology International
Volume: 79
ISSN (Print): 0301-679X
Ratings:
Scopus rating (2016): CiteScore 3.16 SJR 1.382 SNIP 2.094
Scopus rating (2015): SJR 1.437 SNIP 2.04 CiteScore 2.61
Scopus rating (2014): SJR 1.545 SNIP 2.5 CiteScore 2.44
Scopus rating (2013): SJR 1.473 SNIP 2.793 CiteScore 2.51
Scopus rating (2012): SJR 1.406 SNIP 2.331 CiteScore 1.96
Scopus rating (2011): SJR 1.247 SNIP 2.209 CiteScore 1.89
Scopus rating (2010): SJR 1.394 SNIP 2.159
Scopus rating (2009): SJR 1.294 SNIP 2.09
Scopus rating (2008): SJR 1.365 SNIP 1.823
Scopus rating (2007): SJR 1.195 SNIP 1.766
Scopus rating (2006): SJR 1.082 SNIP 1.744
Scopus rating (2005): SJR 0.916 SNIP 1.809
Scopus rating (2004): SJR 1.062 SNIP 1.541
Scopus rating (2003): SJR 1.256 SNIP 1.567
Scopus rating (2002): SJR 0.68 SNIP 1.137
Scopus rating (2001): SJR 0.768 SNIP 1.041
Scopus rating (2000): SJR 0.731 SNIP 0.966
Scopus rating (1999): SJR 0.778 SNIP 0.985
Original language: English
Novel Micro-Welding of Silicon and Glass by Ultrashort Pulsed Laser

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Okamoto, Y., Miyamoto, I., Vihinen, J., Okada, A.
Number of pages: 6
Pages: 2792-2797
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Materials Science Forum
Volume: 783-786
ISSN (Print): 0255-5476
Ratings:
Scopus rating (2016): SJR 0.186 SNIP 0.306 CiteScore 0.28
Scopus rating (2015): SNIP 0.337 SJR 0.217 CiteScore 0.29
Scopus rating (2014): SNIP 0.448 SJR 0.269 CiteScore 0.33
Scopus rating (2013): SNIP 0.342 SJR 0.235 CiteScore 0.28
Scopus rating (2012): SNIP 0.467 SJR 0.279 CiteScore 0.34
Scopus rating (2011): SNIP 0.419 SJR 0.247 CiteScore 0.33
Scopus rating (2010): SNIP 0.406 SJR 0.271
Scopus rating (2009): SNIP 0.389 SJR 0.343
Scopus rating (2008): SNIP 0.358 SJR 0.297
Scopus rating (2007): SNIP 0.5 SJR 0.314
Scopus rating (2006): SNIP 0.511 SJR 0.37
Scopus rating (2005): SNIP 0.56 SJR 0.41
Scopus rating (2004): SNIP 0.575 SJR 0.449
Scopus rating (2003): SNIP 0.548 SJR 0.457
Scopus rating (2002): SNIP 0.514 SJR 0.432
Scopus rating (2001): SNIP 0.524 SJR 0.403
Scopus rating (2000): SNIP 0.549 SJR 0.49
Scopus rating (1999): SNIP 0.526 SJR 0.548
Original language: English
DOIs:
10.4028/www.scientific.net/MSF.783-786.2792
Links:
http://www.scientific.net/MSF.783-786.2792

Numerical and experimental study of percussive drilling with a triple-button bit on Kuru granite

General information
On the Structure of Robust Controllers for Infinite-Dimensional Systems

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mathematics
Authors: Hämäläinen, T., Pohjolainen, S.
Number of pages: 4
Pages: 938-941
Publication date: 2014

Host publication information
Place of publication: Groningen, the Netherlands
Publisher: University of Groningen
Production as a key factor for driving competitiveness in manufacturing industry

General information
State: Published
Ministry of Education publication type: C2 Edited books
Organisations: Department of Materials Science
Authors: Varheenmaa, M. (ed.)
Number of pages: 298
Publication date: 2014

Publication information
Place of publication: Tampere
Publisher: Tampereen teknillinen yliopisto
Original language: English

Publication series
Name: Proceedings of Ambience, Scientific Conference for Smart Textiles
Publisher: Tampereen teknillinen yliopisto
No.: 1
ISSN (Print): 2342-4540

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-09-23<br/>Publisher name: Oy Avitime
Source: researchoutputwizard
Source-ID: 793
Research output: Professional › Article

Proceedings of Ambience 14&10i3m, Scientific Conference for Smart and Functional Textiles, Well-Being, Thermal Comfort in Clothing, Design, Thermal Manikins and Modelling, 7-9 September 2014, Tampere, Finland
Product life cycle disposition model

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Halonen, N., Lehtonen, T., Pakkanen, J., Juutila, T., Ellman, A., Riitahuhta, A.
Number of pages: 10
Pages: 831-840
Publication date: 2014

Host publication information
Place of publication: Croatia
Publisher: The Design Society
Editors: Majanovic, D., Storga, M., Pavkovic, N., Bojcetic, N.
Links:
http://www.designconference.org

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-09-05
Source: researchoutputwizard
Source-ID: 400
Research output: Scientific - peer-review › Conference contribution

Properties of WC-FeCrAl coatings manufactured by different high velocity thermal spray processes

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Bolelli, G., Hulka, I., Koivuluoto, H., Lusvarghi, L., Milanti, A., Niemi, K., Vuoristo, P.
Number of pages: 16
Pages: 74-89
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Surface and Coatings Technology
Volume: 247
ISSN (Print): 0257-8972
Ratings:
Scopus rating (2016): CiteScore 2.56 SJR 0.874 SNIP 1.359
Scopus rating (2015): SJR 0.871 SNIP 1.415 CiteScore 2.46
Scopus rating (2014): SJR 0.998 SNIP 1.681 CiteScore 2.44
Scopus rating (2013): SJR 1.057 SNIP 1.859 CiteScore 2.58
Scopus rating (2012): SJR 1.049 SNIP 1.658 CiteScore 2.2
Scopus rating (2011): SJR 1.053 SNIP 1.851 CiteScore 2.38
Scopus rating (2010): SJR 1.155 SNIP 1.66
Scopus rating (2009): SJR 1.449 SNIP 1.526
Scopus rating (2008): SJR 1.479 SNIP 1.564
Scopus rating (2007): SJR 1.165 SNIP 1.509
Scopus rating (2006): SJR 1.276 SNIP 1.709
Scopus rating (2005): SJR 1.252 SNIP 1.666
Scopus rating (2004): SJR 1.269 SNIP 1.498
Scopus rating (2003): SJR 1.276 SNIP 1.516
Scopus rating (2002): SJR 1.208 SNIP 1.183
Scopus rating (2001): SJR 1.115 SNIP 1.181
Scopus rating (2000): SJR 0.981 SNIP 1.03
Scopus rating (1999): SJR 1.062 SNIP 1.167
Original language: English
DOIs: 10.1016/j.surfcoat.2014.03.021

Bibliographical note:
Contribution: organisation=mol,FACT1=1
Portfolio EDEND: 2014-06-26
Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 182
Research output: Scientific - peer-review › Article

Requirements for Manufacturing Operations Management and Control Systems in a Dynamic Environment

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Järvenpää, E., Tokola, H., Salonen, T., Lanz, M., Koho, M., Tuokko, R.
Number of pages: 8
Pages: 1135-1142
Publication date: 2014

Host publication information
Title of host publication: Proceedings of the 24th International Conference on Flexible Automation and Intelligent Manufacturing, FAIM2014, 20th -23rd May, San Antonio, Texas, USA
Place of publication: Lancaster, Pennsylvania
Publisher: DEStech Publications
Editor: Chen, F. F.
ISBN (Print): 978-1-60595-173-7

Bibliographical note
Contribution: organisation=mei,FACT1=1
Portfolio EDEND: 2014-06-30
Publisher name: DEStech Publications
Source: researchoutputwizard
Source-ID: 584
Research output: Scientific - peer-review › Conference contribution

Rolling-sliding wear of nodular cast iron followers against wire ropes

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Authors: Oksanen, V., Valtonen, K., Andesson, P., Vaajoki, A., Laukkanen, A., Holmberg, K., Kuokkala, V.
Number of pages: 6
Pages: 1-6
Simulation Based Methods for Flexible Maintenance Program Development

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems, Department of Industrial Management
Authors: Aaltonen, J., Koskinen, K. T., Vainio, H., Martinsuo, M.
Number of pages: 5
Pages: 446-450
Publication date: 2014

Host publication information
Title of host publication: The 16th Nordic Symposium on Tribology - NORDTRIP 2014, 10th - 13th June, Aarhus, Denmark
Publisher: Danish technological institute
ISBN (Print): 978-87-92765-26-0

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-12-02
Source: researchoutputwizard
Source-ID: 1189
Research output: Scientific » Conference contribution

Sliding mode control of a pneumatic muscle actuator system with a PWM strategy

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Jouppila, V. T., Gadsden, A. S., Bone, G. M., Ellman, A. U., Habibi, S. R.
Number of pages: 13
Pages: 19-31
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: International Journal of Fluid Power
Volume: 15
Issue number: 1
ISSN (Print): 1439-9776
Ratings:
Scopus rating (2016): SJR 0.211 SNIP 0.609 CiteScore 0.91
Scopus rating (2015): SJR 0.282 SNIP 0.758 CiteScore 0.86
Scopus rating (2014): SJR 0.121 SNIP 0.24 CiteScore 0.46
Scopus rating (2013): SJR 0.296 SNIP 0.783 CiteScore 0.9
Scopus rating (2012): SJR 0.228 SNIP 0.946 CiteScore 0.38
Scopus rating (2011): SJR 0.493 SNIP 1.496 CiteScore 0.5
Strain-induced martensitic transformation in EN 1.4318 during successive high and low strain rate loadings

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Materials Science
Authors: Isakov, M., Östman, K., Kuokkala, V.
Number of pages: 4
Pages: 1-3
Publication date: 2014

Host publication information
Title of host publication: Proceedings of the 4th International Conference on Impact Loading of Lightweight Structures (ICILLS 2014), Cape Town, South Africa, January 12-16, 2014
Links:
http://icills2014.org/?page_id=519

Suomalaisten konepajojen tuotannonsuunnittelu on ERP:n ja Excel-taulukoiden varassa

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Järvenpää, E., Lanz, M.
Number of pages: 6
Pages: 19-24
Publication date: 2014
Peer-reviewed: Unknown

Publication information
Journal: Stoori
Issue number: 4
ISSN (Print): 2342-4095
Original language: Finnish

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-06-02<br/>Publisher name: Taylor & Francis
Source: researchoutputwizard
Source-ID: 612
Research output: Scientific › peer-review › Article
Surface Processing of Zirconia Ceramics by Laser

The aim of this study was to investigate phase transformations and glazing of zirconia bulk ceramic as a function of laser processing parameters. Zirconia-based ceramics have good material properties for a variety of applications. The main advantage of zirconia compared to other structural ceramics, like silicon-based ceramics and alumina, is its high fracture toughness (typically over 10MPa√m). This property is largely based on partial stabilization of zirconia, where a portion of the material is in metastable phase, enabling instantaneous phase transformation under mechanical load. This consumes energy otherwise provided to crack propagation. The stable phase of zirconia to exist in room temperature is monoclinic; therefore a rapid cycle of heating and cooling is necessary for achieving metastable tetragonal phase. Pulsed laser processing offers just the right type of thermal cycle for the aforementioned phase transformation to occur. In this study a nanosecond pulsed laser was used for surface processing of zirconia ceramic blocks.

During laser processing high energy can be concentrated into small area, causing sudden local heating, which in turn causes material to melt and vaporize instantly. However, heat dissipation remains small due to the short pulse length, leading to the desirable cycle. Temperatures in the process correlate with several parameters: pulse width, peak energy, repetition rate, pulse overlap, material properties and wavelength. Zirconia is a tough material to process in terms of material removal with laser ablation, since it tends to melt rather than evaporate.

Sustainability and Performance Indicators Landscape

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems, Department of Materials Science, Research group: Ceramic materials, Research group: Research group: Laser, Research area: Manufacturing and Automation, Tampere University of Technology
Authors: Kumpulainen, T., Ismailov, A., Hyvärinen, L., Levänen, E., Vihinen, J.
Number of pages: 10
Pages: 275-284
Publication date: 2014

Host publication information
Title of host publication: Proceedings of the Twenty Eighth International Conference on Surface Modification Technologies
ISBN (Print): 978-81-926196-1-3
Keywords: Laser, Zirconia, Ceramic
Electronic versions:
surface_processing_of_zirconia
Links:

Bibliographical note
ORG=mol,0.5
ORG=mei,0.5
AUX=orc,"Hyvärinen, L."
Research output: Financial - peer-review › Conference contribution

Sustainability and Performance Indicators Landscape

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Lanz, M., Järvenpää, E., Nylund, H., Tuokko, R., Torvinen, S., Georgoulias, K.
Number of pages: 8
Pages: 283-290
Publication date: 2014

Host publication information
Title of host publication: Proceedings of the 24th International Conference on Flexible Automation and Intelligent Manufacturing, FAIM2014, 20th -23rd May, San Antonio, Texas, USA
Place of publication: Lancaster, Pennsylvania
Publisher: DEStech Publications
Editor: Chen, F. F.
ISBN (Print): 978-1-60595-173-7

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-06-30<br/>Publisher name: DEStech Publications
Technical cleanliness of assembled fluid power components

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Intelligent Hydraulics and Automation
Authors: Elo, L., Pekkonen, J., Rinkinen, J.
Number of pages: 8
Pages: 1-8
Publication date: 2014

Host publication information
Title of host publication: 8th FPNI Ph.D Symposium on Fluid Power, FPNI2014, June 11-13, 2014, Lappeenranta, Finland
Publisher: The American Society of Mechanical Engineers ASME
ISBN (Print): 978-0-7918-4582-0
DOIs: 10.1115/FPNI2014-7850

Bibliographical note
Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2014-12-30
Source: researchoutputwizard
Source-ID: 283
Research output: Scientific - peer-review › Conference contribution

Tekstiilien testaus on olennainen osa tekstillidiplomi-insinöörien koulutusta

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Materials Science
Authors: Puolakka, A., Rissanen, M., Varheenmaa, M.
Number of pages: 1
Pages: 14-14
Publication date: 2014
Peer-reviewed: Unknown

Publication information
Journal: Tekstiillilehti
Issue number: 2
ISSN (Print): 0040-2370
Original language: Finnish

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-05-27<br/>Publisher name: Suomen Tekstiilitekniikka liitto r. y.
Source: researchoutputwizard
Source-ID: 1306
Research output: Professional › Article

The effect of test parameters in the impact resistance of a stainless steel/rubber/composite hybrid structure

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Computational Science X (CompX), Engineering materials science and solutions (EMASS)
Authors: Sarlin, E., Lindroos, M., Apostol, M., Kuokkala, V., Vuorinen, J., Lepistö, T., Vippola, M.
Number of pages: 7
Pages: 469-475
Publication date: 2014
The influence of chatter vibration on the cylindrical transverse grinding machine spindle

General information
State: Published
Ministry of Education publication type: B3 Non-refereed article in conference proceedings
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Kalbasi Shirvani, H., Yuan, L., Järvenpää, V.
Number of pages: 8
Pages: 3280-3287
Publication date: 2014

Host publication information
Publisher: International Institute of Acoustics and Vibration (IIAV)
Editors: Crocker, M. J., Pawelczyk, M., Tian, J.

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-05-27<br/>Publisher name: Elsevier
Source: researchoutputwizard
Source-ID: 1466
Research output: Scientific - peer-review › Article
Thermal spray coating processes

General information
State: Published
Ministry of Education publication type: A3 Part of a book or another research book
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Vuoristo, P.
Number of pages: 47
Pages: 229-276
Publication date: 2014

Host publication information
Title of host publication: Comprehensive materials processing, 1st edition Volume 4: Coatings and films
Publisher: Elsevier
Editor: Cameron, D.
ISBN (Print): 978-0-08-096532-1

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-05-27
Source: researchoutputwizard
Source-ID: 1779
Research output: Scientific - peer-review › Chapter

Tribological behavior of HVOF- and HVAF-sprayed composite coatings based on Fe-Alloy + WC-12% Co

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Materials Science, Engineering materials science and solutions (EMASS)
Authors: Bolelli, G., Börner, T., Milanti, A., Lusvarghi, L., Laurila, J., Koivuluoto, H., Niemi, K., Vuoristo, P.
Number of pages: 9
Pages: 104-112
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Surface and Coatings Technology
Volume: 248
ISSN (Print): 0257-8972
Ratings:
Scopus rating (2016): CiteScore 2.56 SJR 0.874 SNIP 1.359
Scopus rating (2015): SJR 0.871 SNIP 1.415 CiteScore 2.46
Scopus rating (2014): SJR 0.998 SNIP 1.681 CiteScore 2.44
Scopus rating (2013): SJR 1.057 SNIP 1.859 CiteScore 2.58
Scopus rating (2012): SJR 1.049 SNIP 1.658 CiteScore 2.2
Scopus rating (2011): SJR 1.053 SNIP 1.851 CiteScore 2.38
Scopus rating (2010): SJR 1.155 SNIP 1.66
Scopus rating (2009): SJR 1.449 SNIP 1.526
Scopus rating (2008): SJR 1.479 SNIP 1.564
Scopus rating (2007): SJR 1.165 SNIP 1.509
Scopus rating (2006): SJR 1.276 SNIP 1.709
Scopus rating (2005): SJR 1.252 SNIP 1.666
Scopus rating (2004): SJR 1.269 SNIP 1.498
Scopus rating (2003): SJR 1.276 SNIP 1.516
Scopus rating (2002): SJR 1.208 SNIP 1.183
Scopus rating (2001): SJR 1.115 SNIP 1.181
Scopus rating (2000): SJR 0.981 SNIP 1.03
Scopus rating (1999): SJR 1.062 SNIP 1.167
User Interpretations of Virtual Prototypes: Physical Place Matters

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Kaapu, T., Tiainen, T., Ellman, A.
Number of pages: 22
Pages: 1-22
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Scandinavian Journal of Information Systems
Volume: 25
Issue number: 2
Article number: 4
ISSN (Print): 0905-0167
Ratings:
Scopus rating (2016): CiteScore 0.74 SJR 0.234 SNIP 0.524
Scopus rating (2015): SJR 0.17 SNIP 0.505 CiteScore 0.52
Scopus rating (2014): SJR 0.152 SNIP 0.237 CiteScore 0.5
Scopus rating (2013): SJR 0.117 SNIP 0.523 CiteScore 0.27
Scopus rating (2012): SJR 0.191 SNIP 1.85 CiteScore 0.38
Original language: English
Links:
http://aisel.aisnet.org/sjis/vol25/iss2/4

Virtual prototypes reveal more development ideas: comparison between customers' evaluation of virtual and physical prototypes

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Tiainen, T., Ellman, A., Kaapu, T.
Number of pages: 11
Pages: 169-180
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Virtual and Physical Prototyping
Volume: 9
Issue number: 3
ISSN (Print): 1745-2759
Ratings:
Water Hydraulics Pushes Into High-Pressure Systems

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Koskinen, K. T., Aaltonen, J.
Number of pages: 4
Pages: 84-89
Publication date: 2014
Peer-reviewed: Unknown

Publication information
Journal: Hydraulics & Pneumatics
Volume: 67
Issue number: 2
Original language: English

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-12-03<br/>Publisher name: Taylor & Francis
Source: researchoutputwizard
Source-ID: 1627
Research output: Scientific - peer-review › Article

Current research in component cleanliness of fluid power

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Condition monitoring of hydraulic components and systems
Authors: Rinkinen, J., Elo, L., Kuosku, M., Pekkonen, J.
Number of pages: 17
Publication date: 2013

Host publication information
Title of host publication: The Tenth International Conference on Condition Monitoring and Machinery Failure Prevention Technologies, CM2013/MFPT2013, 18-20 June 2013, Krakow, Poland
Publisher: Coxmoor Publishing
ISBN (Print): 978-1-901892-37-6
Displacement control of a mobile crane using a digital hydraulic power management system

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Intelligent Hydraulics and Automation, Field robotics for efficient work sites (FIRE)
Authors: Heikkilä, M., Linjama, M.
Number of pages: 10
Pages: 452-461
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Mechatronics
Volume: 23
Issue number: 4
ISSN (Print): 0957-4158
Ratings:
Scopus rating (2016): CiteScore 2.89 SJR 0.871 SNIP 1.715
Scopus rating (2015): SJR 0.962 SNIP 2.056 CiteScore 2.74
Scopus rating (2014): SJR 1.017 SNIP 2.434 CiteScore 2.87
Scopus rating (2013): SJR 0.983 SNIP 2.631 CiteScore 2.91
Scopus rating (2012): SJR 0.764 SNIP 2.531 CiteScore 2.3
Scopus rating (2011): SJR 0.803 SNIP 2.354 CiteScore 2.23
Scopus rating (2010): SJR 0.636 SNIP 1.539
Scopus rating (2009): SJR 0.984 SNIP 1.867
Scopus rating (2008): SJR 0.811 SNIP 1.83
Scopus rating (2007): SJR 0.638 SNIP 1.549
Scopus rating (2006): SJR 0.668 SNIP 1.75
Scopus rating (2005): SJR 0.416 SNIP 1.233
Scopus rating (2004): SJR 0.585 SNIP 1.344
Scopus rating (2003): SJR 0.61 SNIP 1.357
Scopus rating (2002): SJR 0.508 SNIP 1.12
Scopus rating (2001): SJR 0.497 SNIP 1.297
Scopus rating (2000): SJR 0.27 SNIP 0.689
Scopus rating (1999): SJR 0.296 SNIP 0.621
Original language: English
DOIs: 10.1016/j.mechatronics.2013.03.009

Examples of technical cleanliness of fluid power components

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Experimental results in Component Cleanliness of Fluid Power

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Condition monitoring of hydraulic components and systems
Authors: Rinkinen, J., Elo, L., Kuosku, M., Pekkonen, J.
Number of pages: 8
Publication date: 2013

Host publication information
Title of host publication: The 26th International Congress of Condition Monitoring and Diagnostic Engineering Management, COMADEM 2013, 11-13 June, Helsinki
ISBN (Print): 978-952-67981-0-3

Publication series
Name: International Congress of Condition Monitoring and Diagnostic Engineering Management

Bibliographical note
Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2013-07-29<br/>Publisher name: Coxmoor Publishing
Source: researchoutputwizard
Source-ID: 3270
Research output: Scientific - peer-review › Conference contribution

Full-field Strain Monitoring with Digital Image Correlation Method

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Materials Science
Authors: Ojala, P., Dospel, V., Miettinen, J.
Pages: 1-8
Publication date: 2013

Host publication information
Title of host publication: The 26th International Congress of Condition Monitoring and Diagnostic Engineering Management, COMADEM 2013, 11-13 June, Helsinki
ISBN (Print): 978-952-67981-0-3

Bibliographical note
Contribution: organisation=mol,FACT1=1<br/>Portfolio EDEND: 2014-10-30<br/>Source: researchoutputwizard
Hydraulic Energy Recovery in Displacement Controlled Digital Hydraulic System

General information
State: Published
Ministry of Education publication type: A4 Article in a conference publication
Organisations: Department of Intelligent Hydraulics and Automation
Authors: Heikkilä, M., Linjama, M.
Number of pages: 7
Pages: 1-7
Publication date: 2013

Host publication information
Title of host publication: Proceedings of the 13th Scandinavian International Conference on Fluid Power, 3-5 June, Linköping, Sweden
Publisher: Scandinavian International Conference on Fluid Power

Publication series
Name: Scandinavian International Conference on Fluid Power

Bibliographical note
Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2013-06-29<br/>Publisher name: Scandinavian International Conference on Fluid Power
Source: researchoutputwizard
Source-ID: 2259
Research output: Scientific - peer-review › Conference contribution

Kantavuutta maaperään massastabiloinnilla

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Intelligent Hydraulics and Automation
Authors: Seppälä, J., Rinkinen, J.
Number of pages: 3
Pages: 42-44
Publication date: 2013
Peer-reviewed: Unknown

Publication information
Journal: Promaint
Volume: 27
Issue number: 3
ISSN (Print): 1797-2000
Original language: Finnish

Bibliographical note
Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2013-05-29<br/>Publisher name: KP-Media
Source: researchoutputwizard
Source-ID: 3394
Research output: Professional › Article

Katsaus mikropolaariseen kontinuumimaliin

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Engineering Design
Authors: Kouhia, R.
Number of pages: 21
Pages: 70-90
On the solution of non-linear diffusion equation

Publication information
Journal: Rakenteiden mekaniikka
Volume: 46
Issue number: 3
ISSN (Print): 0783-6104
Original language: Finnish
Links:
http://rmseura.tkk.fi/rmlehti/

Bibliographical note
Contribution: organisation=ede,FACT1=1<br/>Portfolio EDEND: 2013-12-29<br/>Publisher name: Rakenteiden Mekaniikan Seura Ry
Source: researchoutputwizard
Source-ID: 2638
Research output: Scientific - peer-review › Article

Puhtaus on puoli hydrauliikkaa

General information
State: Published
Ministry of Education publication type: A1 Journal article-refereed
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Kouhia, R.
Number of pages: 15
Pages: 116-130
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Rakenteiden mekaniikka
Volume: 46
Issue number: 4
ISSN (Print): 0783-6104
Original language: English
Links:

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-09-30<br/>Publisher name: Rakenteiden Mekaniikan Seura Ry
Source: researchoutputwizard
Source-ID: 2639
Research output: Scientific - peer-review › Article

Puhtaus on puoli hydrauliikkaa

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Intelligent Hydraulics and Automation
Authors: Kuosku, M., Rinkinen, J.
Number of pages: 3
Pages: 34-36
Publication date: 2013
Peer-reviewed: Unknown

Publication information
Journal: Promaint
Volume: 27
Issue number: 5
Simulation of residual stresses and deformations in electron beam-welded copper canisters

General information
State: Published
Ministry of Education publication type: D4 Published development or research report or study
Organisations: Department of Mechanical Engineering and Industrial Systems
Authors: Aronen, A., Leikko, J., Taskinen, P., Karvinen, R.
Number of pages: 68
Publication date: 2013

Publication information
Place of publication: Olkiluoto
Publisher: Posiva
Original language: English

Publication series
Name: Posiva Working Report
Publisher: Posiva
No.: 20
Links:

Bibliographical note
Contribution: organisation=mei,FACT1=1<br/>Portfolio EDEND: 2014-12-30
Source: researchoutputwizard
Source-ID: 1940
Research output: Professional › Commissioned report

Täältä pesee - Hydraulikomponenttien pesukoneet ja nesteet kuntoon

General information
State: Published
Ministry of Education publication type: D1 Article in a trade journal
Organisations: Department of Intelligent Hydraulics and Automation, Research group: Condition monitoring of hydraulic components and systems
Authors: Elo, L., Kuosku, M., Rinkinen, J.
Number of pages: 4
Pages: 42-45
Publication date: 2013
Peer-reviewed: Unknown

Publication information
Journal: Promaint
Volume: 27
Issue number: 5
ISSN (Print): 1797-2000
Original language: Finnish

Bibliographical note
Contribution: organisation=iha,FACT1=1<br/>Portfolio EDEND: 2013-10-29<br/>Publisher name: KP-Media Oy
Source: researchoutputwizard
Source-ID: 2107
Research output: Professional › Article