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PREFACE

My First Conference is an annual conference for doctoral students of engineering and technology studying at University of Rijeka. It is a joint initiative of Faculty of Engineering, Faculty of Maritime Studies and Faculty of Civil Engineering of the University of Rijeka. Doctoral students from other institutions and graduate students with ambitions in scientific research are also welocome to participate in this annual event.

The goals for the participants of this conference are:

- To provide the feedback for the ongoing student's research; the presented work should not be only the completed research, but also the research that is still not finished
- Improvement of the presentation skills in English at a scientific conference at no cost
- Development of the possibility for the interdisciplinary research projects between doctoral students from different institutions
- Public presentation of the research results required within the doctoral study obligations (this presentation can serve for this purpose if the person in charge of the institution's doctoral study approves it)

The first edition of My First Conference took place at University of Rijeka, Faculty of Engineering in September, 2017. For the first conference, 2 keynote lectures and 29 contributed lectures were presented. The second edition of My First Conference was held at University of Rijeka, Faculty of Maritime Studies in September, 2018. During the conference, 34 papers were presented along with 2 plenary lectures.

This year the conference is held at University of Rijeka, Faculty of Civil Engineering on September 12, 2019. For the third edition 27 abstracts from three participating institutions were submitted, together with a keynote speaker lecture from assistant professor D.Sc. Leo Škec from University of Rijeka, Faculty of Civil Engineering. A laboratory tour of five laboratories at the Faculty of Civil Engineering guided by Vice-dean for scientific and research affairs and international cooperation professor D. Sc. Vanja Travaš is scheduled at the end of the conference.

Finally, the organizers would like to thank to all the authors for participating in the third edition of My First Conference, as well as the organizing institutions and organizing committee members for their contribution in the realization of this year's event.

We hope to see you at the fourth edition of My First Conference in 2020!

Organizing committee of MFC 2019

KEYNOTE LECTURE

assoc.prof.D.sc. Leo Škec
Theoretical, numerical and experimental investigation of fracture resistance in adhesive joints

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Theoretical, numerical and experimental investigation of fracture resistance in adhesive joints

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Abstract

Due to their numerous advantages with respect to the traditional joining techniques (e.g. riveting, bolting, welding), adhesive joints are nowadays widely used in the industry, from automotive and aerospace industry to electronic components industry and civil engineering. One of the most common and dangerous failure modes of structures with adhesive joints is debonding or delamination. In order to design structures that can withstand debonding of adhesive joints it is necessary to determine the fracture resistance of the adhesive used. This is done by using standard tests and relatively simple theoretical background based on beam theories (either Euler-Bernoulli or Timoshenko) and linear-elastic fracture mechanics (LEFM). In general, there are three modes of delamination, namely mode I (transversal opening), mode II (sliding shear) and mode III (scissoring shear). The present work is mainly based on the most important results from the recent MSCA-IF-2015 project, which was author's post-doc fellowship at Brunel University London. The research includes new advances in characterisation of fracture resistance for mode-I debonding, more efficient numerical and analytical modelling of delamination tests and experimental validation of advanced numerical models for rate-dependent delamination. Beside the scientific part, the aspects of submitting project proposals to competitive calls and the experiences of working on foreign institutions will be discussed. Finally, current and future work of the research group working on adhesive joints at the Faculty of Civil Engineering in Rijeka will be presented.

Keywords

adhesive joints, debonding, delamination, fracture resistance, numerical modelling

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Numerical investigation of heat transfer and fluid flow in plain fin-and-tube heat exchanger

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Abstract

The objective of the present numerical study is to investigate the air side thermal-hydraulic characteristics for water-to-air heat exchanger [1,2]. For the purpose of numerical analysis, 3D mathematical model is developed and implemented, using governing equations of fluid flow and heat transfer, and boundary conditions. The fluid is considered incompressible with constant properties and the flow is assumed to be steady-state and laminar. All the computational work is carried out using the finite volume method by means of CFD software ANSYS FLUENT 18.2. The coupling between velocity and pressure is performed with the SIMPLE algorithm and the Power Law scheme is used for the treatment of convection-diffusion terms. Numerical mesh is validated by performing a grid independence study. A comparison of the numerical results with obtained experimental data shows good agreement. Numerical simulations have been performed for Reynolds number in a range $285 \leq Re \leq 690$, with corresponding frontal air velocity ranging from 0.825 to 2 m/s. Inlet air and water temperatures are 288.7 K and 323 K, respectively. Numerically obtained temperature contours and velocity vectors in the mid-plane between two fins and near the fin surface have been presented. Finally, dependence of average air-side Nusselt number on Reynolds number has been analysed.

Keywords

Fin-and-tube heat exchanger, Numerical study, The finite volume method

Acknowledgement: This work has been fully supported by Croatian Science Foundation under the project HEXENER (IP-2016-06-4095)

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Calculation of the longitudinal strength of the ship using the programming language Python 3.7

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ABSTRACT:
Calculation of vertical transversal forces and bending moments is an important step of each ship's project documentation and a part of the structural stability calculation. It is most commonly used to determine the longitudinal strength of the ship, as well as to predict local strength of a ship structure. Although such calculations are already conducted on specialized software prepared by classification societies, the goal of this work was to prepare an in-house open source checking tool for student projects as well as to use it as a teaching tool for presenting the most commonly used mathematical models, such as Newton - Cotes formula known as Simpson's rule, linear and/or quadratic interpolation. Python 3.7 programming language was chosen as programing tool for ease of use and large number of easily accessible documentation. Although there are already numerous Python modules that can successfully address the above mentioned problems, they were not included in software. Instead, all functions are coded within the main program and are solely the work of the author. The program has been checked and calibrated using documentation of several use cases.

Keywords: *longitudinal strength of the ship, Python, Simpson's rule, software*

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Thermoelastic and ultrasonic finite element analysis of an ultrasonic sensor

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Abstract

The contribution involves the development of an ultrasonic sensor for operation in high temperature conditions on the outside of a nuclear reactor pressure vessel. It contains information about the operating conditions of the sensor, design of the sensor and problems encountered when designing an ultrasonic sensor. Methods with which stress analysis and ultrasonic analysis were conducted are further described as well as specifics of the materials used to offset the problems encountered with a classical design of a sensor for lower temperatures in current conditions. Results of the analysis are presented and certain design decisions explained.

Keywords

ultrasonic sensor, *stress analysis*, *ultrasonic analysis*, *high temperature*, *piezoelectric*

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A Parallel Implementation of CBS Finite Element Model for 2D Shallow Water Equations

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Abstract

To speed-up the computational simulation of relatively large domain subject to flood analysis, the technique of parallel computing is necessary. The *parallel programming paradigm* is implemented in the previously developed program code for the numerical integration of 2D shallow water equations. The program code is written in FORTRAN90. The numerical procedure is based on the CBS algorithm. The spatial discretization is performed with CST finite elements and the time discretization is conducted in the usual manner by finite difference. The numerical procedure includes an implicit solver for the determination of the pressure field at each time step. To speed-up the computation, a *conjugate gradient method* is implemented in a parallel framework using OpenMP programming interface. Apart the mention, a significant reduction of arithmetic operations is introduced by skipping the same operation during the computation of terms in the stability matrix **K**. The developed program code is adapted for the SMP architecture which will be used for computations on the supercomputer BURA at the University of Rijeka.

Keywords

Parallel computing, CBS algorithm, Finite Element, Shallow Water Equations, FORTRAN90

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Numerical Modelling of Transport in Inhomogeneous and Anisotropic Porous Media

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Abstract

To study some aspects related to groundwater and surface water interaction, a computer code is developed using FORTRAN90 to simulate the transport processes in inhomogeneous and anisotropic porous media. To reproduce the hydraulic property of a generic subsurface porous media, a program code was previously developed to reconstruct the spatial distribution of relevant hydraulic quantity using same type of data obtained at available boreholes locations. The transport process at the moment includes convection, molecular diffusion, dispersion, retardation and mass degradation/production [1,2]. The domain under consideration is three-dimensional and the saturation of soil should be taken into account to simulate the transition from dominant molecular diffusion to convection. It should be pointed out that the developed program code, at the moment, do not include the solution of *Richards equation* to model the movement of water in unsaturated soils. However, the intention to include the description of all the mass in the subsurface is present and the further development of the code will lead in that direction.

Keywords

Transport in porous media, *convection/diffusion/dispersion*, *finite elements*, *FORTRAN90*

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Optimization of a small size shell and tube heat exchanger using response surface methodology

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Abstract

In this paper, optimization of a small size water-water shell and tube heat exchanger has been performed after a series of numerical calculations. Firstly, a mathematical model was defined, consisting of computational domain, conservation equations and boundary conditions. The problem was considered as steady-state, laminar and incompressible. Numerical method was the finite volume method, SIMPLE algorithm was used for pressure-velocity coupling and ANSYS Fluent was used as numerical solver. The numerical procedure was previously validated using experimental data [1]. In order to perform optimization, a number of numerical calculations has been performed for varying values of parameters; 2-4 mm for the tube diameter, 40-60 mm for the shell diameter, and 0,048-0,143 m/s for the shell-side inlet velocity. Specified objective functions were maximum heat flux, minimum mass and combined function of maximum heat flux with minimum mass.

Response Surface Methodology (RSM), an assemblage of statistical and mathematical techniques, has been used for optimization [2]. Analyses using specific combinations of minimum, referent and maximum values of parameters, in order to obtain appropriate values of responses, are the basis of RSM. Of all RSM techniques, the Box-Behnken design requires the least amount of combinations to provide satisfactory optimization results. As a result, objective functions have been represented as 3D surface, from which optimal values of parameters can be visually determined.

Keywords

Shell and tube heat exchanger, Numerical analysis, Optimization, Response surface methodology

Acknowledgement: This work has been fully supported by Croatian Science Foundation under the project HEXENER (IP-2016-06-4095).

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Dynamic Ship Positioning Using the Time-Frequency Distributions and Kalman Filtering

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Abstract

Today, oil drilling is mainly done in deep waters far from the coastal area. In addition, for purpose of easier maintenance and transportation, drilling rigs usually float on water. However, transport vessels cannot be anchored under such conditions, so they need a dynamic positioning technique to keep the stationary position relative to a reference point on the sea surface. Dynamic positioning systems provide the ability to control ship position and direction using a combination of thruster mechanism and propulsion, measurements of essential vessel variables, as well as the surrounding impacts, such as wind speed. The required criteria for performing a given task, as well as the surrounding conditions and expectations of behaviors at different natural phenomena, together have an impact on designing dynamic positioning systems [1]. Accuracy of the observed dynamic positioning system depends on the selected wave filtering method and controller design. In order to reduce the amount of thruster oscillations, it is necessary to filter noisy signal measurements in terms of their reconstruction and subsequent use for the purpose of control. Some advanced filtering techniques utilize the Kalman recursive filter, which provides optimum estimated values from the noisy measurements by minimizing the error variation for linear and nonlinear signals [1]. Another approach to noise removal is based on time-frequency distributions [2,3]. For this purpose, high-resolution, reduced interferences time-frequency distributions should be developed and used. Adaptive, data-driven filtering in the time-frequency domain may be used to enhance accuracy of the positioning systems and mathematical models of the vessel, as well as the characteristics of the waves that appear to be a disturbance when performing a task on water.

Keywords

Dynamic positioning, Time-frequency distribution, Kalman filter

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Multi-parameter optimization tool for the identification of mechanical properties in additively manufactured composites

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In recent years, research on material behavior has been significantly influenced by the widespread developments in additive manufacturing. Due to the precise layer deposition, these production techniques made a step towards in bridging the gap between experimental and computational models, but with the addition of some particular manufacturing effects. Formed by combining thermoplastic polymer layers and layers of reinforcement fibers coated in the same thermoplastic polymer, these stacked composite systems acquire their mechanical characteristics in dependence on fiber, as well as on the matrix printing direction. Moreover, due to the printing pattern, the assumption of ideal matrix-fiber connection [1] shouldn't be maintained without the application of certain corrections. In addition, every layer has a printing starting point which is manifested as a broken fiber bundle. Since it occurs in all AM parts, this kind of manufacturing defect should be considered within tests.

While taking these effect into the consideration [2], novel approaches include advanced data fitting methods based on a combination of finite element method and various optimization algorithms [3], [4], inverse finite element analysis i-FEM [5], or the virtual fields method [6]. These advanced techniques provide an opportunity for the reduction of necessary experiments in order to predict the material behavior for novel composite systems.

Henceforth, an algorithm for the identification of mechanical properties in additively manufactured fiber-reinforced composite systems has been developed. The algorithm is based on classical laminate theory (CLT) [1], and in order to acquire the elasticity, shear moduli, and the Poisson ratio, takes raw experimental data for several layer configurations. The data is analyzed and fitted using a genetic optimization algorithm which returns the set of eight variables corresponding to the mechanical properties of the matrix and matrix-fiber layers.

In the first step the algorithm has been tested and calibrated upon the data provided in [7], then, the test specimens have been designed, produced, and tested according to ASTM D3039. In order to identify the mechanical properties per layer, the acquired data has been analyzed, while the properties per component have been identified via volume fraction acquired through the analysis of a scanned specimens cross-section.

Keywords
experimental determination, composite materials, additive manufacturing, fitting algorithms, constitutive model updating
Acknowledgments: This work has been supported by the University of Rijeka (uniri-tehnic-18-34)

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Short-term photovoltaic power forecasting and optimisation using cloud tracking methods

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Abstract

In recent times, solar PV power plants have been increasingly used due to their high solar energy potential and low impact on the environment. Although the PV power plants are highly preferred as a power source, PV power plants have their own disadvantages such as the unstable nature of the PV power output. Considerable integration of PV power generators into the power grid threatens power system secure operation due to unpredictable power fluctuations following cloud cover variations. Short-term forecast information on the expected power production can assist existing forecasting techniques and enable efficient integration of renewable energy sources through efficient energy trading, power system control and management of energy storage units. This paper presents an approach to predict local PV power output based on short-term solar forecasting by the use of ground-based camera and analyzes the benefits of such forecast to the power system operation.

In the proposed research analytics of the commonly used forecasting methods with the added precision of the short-term forecasting is made. Cost-effectiveness is calculated with different types of optimization techniques whose outcome is different forecasting accuracy range. An overview of the benefits for the transmission system operator has been made. This overview considers the ways in which short-term forecasting can improve the efficiency of power management in an electric grid.

Keywords

short-term forecast, cloud tracking, renewable energy, solar energy, variable generation, PV integration, power system control

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APPLICATION OF THE MICROSIMULATION TRAFFIC MODEL IN ASSESSING CONGESTION OF THE CONTAINER TERMINAL "BRAJDICA" ACCESS ROAD NETWORK

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Abstract

Adequate permeability of individual terminal zones is of highest importance for the functioning of the entire system because of the importance of container turnover in the world - emphasis placed on the zones of container terminals [1]. The terminal zone in which the core object represents a road network, by which the heavy-duty vehicles (HDV) delivery/dispatch containers (cargo) on/from terminal is still the most important zone for port terminals located in the territory of the developing countries [2]. The mentioned zone is also the foundation of the container terminal "Brajdica". Container terminal "Brajdica" is highly important for the entire container turnover of the North Adriatic transport area and because of that is the main object of this research. The constant increase in the turnover of the container terminal "Brajdica" is correlated with the load of the access road network, i.e. with the increasing degree of congestion, assuming that the shares of transport modes involved in the delivery / dispatch of containers are not changed. The aim of this paper is to use the micro-simulation traffic model and the PTV Vissim computer program to carry out simulations of several scenarios to assess whether the throughput rate of the access road traffic network is sufficient with respect to the existing as well as to possible future traffic loads that are assumed to be constantly increasing in compliance with the achieved annual rate of container terminal turnout growth.

Keywords

container terminal "Brajdica", microsimulation traffic model, state road D-404, traffic congestion

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Hysteretic damping model in timber beams

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Abstract

Vibrations of timber floors in residential buildings and timber bridges under vehicle and pedestrian loading are a subject of research for the new version of the European norms for the design of timber structures. One of the topics that is least understood is the principle of damping in timber beams which are one of the main structural elements in timber floors and bridges.
Overall damping ξ in beams can be described as a sum of material (internal) damping ξ_{int} and structural damping ξ_{str} [1]. Structural damping ξ_{str} depends on connections in the structural system (floors, bridges) and its values can only be found using numerical computation in a finite element software.
On the other hand, material damping ξ_{int} depends on the material properties, internal friction and the level of stress. There are various models which are used for modelling internal damping but here the emphasis is on hysteretic damping model [2]. The basics of its use in modelling damping comes from the result that energy dissipation per cycle of vibration is a consequence of internal friction known as material hysteresis. The dissipated energy is independent of frequency and using the hysteretic damping factor the SDOF equation for vibrations can be solved.

Keywords

vibrations, *material damping*, *structural damping*, *hysteretic damping model*, *material hysteresis*

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Climate adaptive architecture

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Abstract

Due to present climate change [1] and consequent increase in awareness of the need to reduce energy consumption for heating and cooling of buildings, which has been increasing in recent years due to rising air temperature [2], the question arises as to whether there is a more environmentally and energy efficient way of construction and use of buildings.
In response to this issue in recent years in the world, the area of bioclimatic architecture is being explored again. Bioclimatic architecture is an area of architecture that began to develop in the early 1970s [3, 4] as a result of growing social ecological awareness in the wake of the oil crisis in 1973 when ideas on reducing oil dependence and improved use of energy emerged.
This paper presents an overview of bioclimatic strategies which use the natural principles for achieving thermal comfort in the building, taking into account local climate conditions.
This review will be important for further research within the PhD program, which aims to determine the success of adaptation of local vernacular architecture to microclimatic conditions as well as its bioclimatic strategies.

Keywords

Bioclimatic architecture, climate adaptability, vernacular buildings, bioclimatic strategies, climate change

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Comparison of valid European standards for vertical vibration control on footbridges

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Abstract

The problem of vibrations on pedestrian bridges is a topic that has been intensively explored over the past 20 years. Although an incredibly large amount of research has emerged on the topic [1], the problem of vibrations is very poorly represented in European standards. Annex B to Eurocode EN 1995-2:2013: Design of timber structures [2] gives expressions to determine the vertical acceleration of the timber bridges with simply supported beams or truss systems, depending on the natural frequency of the bridge, the number of pedestrians crossing the bridge and the way they move across the bridge (walking or running). UK National Annex to Eurocode EN 1991-2:2003: Actions on structures [3] gives models of pedestrian loads, using which is possible to calculate the vertical acceleration of the bridge, also depending on its natural frequency, the number of pedestrians and the way they move across the bridge. In this paper, the calculations of maximum vertical acceleration on two fictional pedestrian bridges will be made according to these two different European standards. The results of the calculations will be presented and compared.

Keywords

footbridge, *vibration serviceability*, *vertical vibration, acceleration control*

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High Efficiency Domestic Hot Water System Powered by Solar Energy

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Abstract

The aim of this paper is to examine the effect of solar collectors' area, domestic hot water (DHW) storage volume and DHW consumption on the work performance of DHW system powered by solar energy. All of the considered systems incorporate flat plate solar collectors with biaxial solar tracking, DHW storage tank, circulation pump and system controller. The values of studied parameters for different cases were generated with the orthogonal array design of experiments whereupon the simulations of different DHW systems were performed in TRNSYS software. Simulation results were used for response surface optimization [1] with the aim to maximize solar gains during winter but maintain water temperatures in system below 95 °C during summer. The three-variable regression function which describes the effect of storage tank volume, DHW consumption and solar collectors' area on the maximum useful solar energy gain to energy provided by auxiliary heater ratio is obtained. Results of the optimization are optimal storage tank volume, DHW consumption and solar collectors' area with respect to the maximum useful solar energy gain to energy provided by auxiliary heater ratio.

Keywords

Solar power, DHW, Dynamic Simulation

Acknowledgement: This work has been fully supported by Croatian Science Foundation under the project HEXENER (IP-2016-06-4095).

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ON METHODOLOGY FOR GNSS POSITIONING PERFORMANCE ASSESSMENT FOUNDED ON EXPERIMENTAL OBSERVATIONS

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Abstract

Global Navigation Satellite System (GNSS)-based applications rely on quality of position, velocity and timing, accomplished through measurement and processing of satellite signals propagation characteristics in a process commonly known as satellite navigation. GNSS positioning performance is in foundation of GNSS-based applications' quality of service, thus a need for a common and independent approach. Here we discuss the generalised methodology established on statistical analysis and founded on experimental observations. The methodology allows for systematic and objective characterisation of GNSS positioning performance in positioning environment of interest and regardless of requirements of targeted GNSS application. Sources of high-quality experimental data were discussed. The methodology was demonstrated through its refinement for characterisation of multipath-related GNSS positioning performance degradation, thus contributing to understanding the sea-wave multipath contribution to GNSS positioning error.

Keywords

GNSS, Positioning performance assessment, Methodology, Experimental data

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Different Analysis Procedures In EEG Data Signal Processing

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Abstract

In the electroencephalography (EEG) data signal processing [1], commonly used methods utilize time and frequency domain analysis. Analysis in time domain gives an amplitude value of the signal in each time moment. As opposed to that, analysis in frequency domain indicates which frequencies are present in the signal. Furthermore, lack of frequency-information in the time domain analysis and lack of time-information in frequency domain analysis in nonstationary signals where frequency content varies with time leads to a usage of joint time-frequency representation (TFR) [2]. Such representation, which is localized in both time and frequency, is obtained using a distribution whose domain is the two-dimensional (t, f) space called time-frequency distribution (TFD). Apart of the most commonly used TFD - Wigner-Ville distribution (WVD), in this paper EEG signal is presented and compared with several different TFDs. Additionally, some differences between different types of analyses, such as empirical mode decomposition, wavelet etc., are explained.

Keywords

Time domain, frequency domain, time-frequency domain

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Shear locking phenomenon in plate finite elements

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Abstract

Shear locking is a widely known phenomenon in finite element analysis which occurs when first order finite elements with linear interpolations are used in solving problems where deformations due to bending are dominant, like in slender structures/structural elements. In such cases, first order finite elements exhibit large shear stiffness due to the inability to capture real kinematics of the problem.
It has been found that linked interpolation in beam finite elements based on Timoshenko's assumptions eliminate shear locking problem completely and that it is capable of returning exact results. In the light of that, such concept has been applied to Mindlin plate and shell elements as well. However, that didn't exactly lead to elimination of shear locking problem in those types of elements so different improvements were made in order to minimize shear locking, some of which proved to be quite effective.
A few three node plate finite elements, with an emphasis on those based on linked interpolation, will be presented and tested on a set of standard thin and thick plate problems in order to determine the influence of the locking effect.

Keywords

shear locking, *linked interpolation*, *Mindlin plate theory*, *plate finite element*, *finite element method*

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Using Convolutional Neural Network in Urinary Bladder Cancer Diagnostics

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Abstract

Nowadays, ever-growing trend of utilizing artificial intelligence (AI) algorithms in medical diagnostics can be noticed. One of the challenges in urinary bladder cancer diagnosis is a classification of tumor images without the need of biopsy and pathohistological analysis. The commonly used AI algorithm for classification of medical images is convolutional neural network (CNN). In this paper, utilization of CNN for classification of urinary bladder tissue images is shown. With the aim for determining CNN configuration that achieves the highest classification performance, several CNN configurations are presented. Aforementioned CNNs are trained and tested using 1997 images of bladder cancer and 986 images of non-cancer tissue. If CNN designed with two convolutional and two pooling layers is used, accuracies up to 98% are achieved. CNN configuration with three convolutional and three pooling layers achieves accuracies up to 99%. Similar accuracies are achieved if configuration with four convolutional and four pooling layers is utilized. Accuracies up to 95% are achieved if configuration with five convolutional and pooling layers is utilized.

Keywords

Artificial intelligence, *Convolutional neural network*, *Tumor tissue images*, *Urinary bladder cancer*

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Spalling wear analysis of a stainless steel gear

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Abstract

The wear process where flakes of metal brake off a larger body is referred to as metal spalling. Spalling typically occurs in gears and bearings [1]. A better insight into the spalling process itself, the phenomena that cause the initiation of the process as well as all the effects on mechanical properties is necessary to prolong the service life of such elements.
This paper deals with spalling of geared shaft teeth [2], part of a larger shipyard crane drivetrain. Wear analysis is performed as a combination of experimental and numerical research.
Visual inspection is used to identify wear locations and wear propagation paths around the gear. A sample is cut out of the shaft and analysed by optical emission spectrometer with a glow discharge source in order to determine the chemical composition of the material. Tensile strength tests are performed on standard test specimens machined from the shaft. Hardness test are also performed. Optical and scanning electron microscopy was used to inspect damaged teeth surfaces to reveal possible flaws and the fine microstructure of the material. A 3D finite element (FE) gear shaft model is used for numerical stress analysis.
All experimental testing results point to a case of gear teeth spalling most probably caused by excessive contact stresses between teeth pairs. FE analysis confirmed this assumption, especially when mismatch of the gears is simulated.

Keywords

Spalling, *wear*, *gear*, *stainless steel*

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Usage of photogrammetry technique for pavement surface macrotexture determination

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Abstract

Pavement surface macrotexture has a significant influence on driving safety as it ensures sufficient level of friction between pavement surface and vehicle tires, especially at high speeds and under wet surface conditions [1]. Macrotexture results from asphalt mixture properties, where aggregate gradation and type, bitumen and air voids amount are the most important and it is usually represented by several performance indicators, such as texture depth or profile depth of investigated pavement surface. There are various methods for determining these indicators, for example volumetric measurements of texture depth or laser measurements of profile depth, which are standardized and traditionally used in pavement performance assesment by road agencies [2]. Besides the mentioned, some other methods can be used for pavement macrotexture determination, for example photogrammetry of pavement surface texture [3]. By using digital cameras with sufficient resolution it is possible to capture pavement macrotexture, and by using an adequate analysis tool for the captured images it is possible to obtain macrotexture indicators.

An overview of pavement macrotexture properties and determination methods is given in this paper. Some of the advantages of using digital image processing for pavement macrotexture characterization are pointed out. The results of a preliminary investigation of photogrammetry technique for pavement macrotexture assesment performed at Faculty of Civil Engineering Rijeka are presented and the plans for further research are formulated.

Keywords

pavement macrotexture, traffic safety, mixture properties, digital image analysis, macrotexture indicators

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Digital image correlation in experimental mechanics

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Abstract

Digital image correlation is an optical measurement technique that traces displacement of continuum. It is used mainly in experimental mechanics but also finds its use in R&D departments of numerous industries for its simplicity in comparison with alternatives.

Cameras are used to capture raster graphics where a single pixel represented only by its light intensity (brightness) on a scale from 0 to 255. By knowing the position of the two cameras, one can triangulate the spatial position of the single pixel, i.e. spatial position of a material point. This concept is usually implemented by painting the surface of a mechanical body with a stohastic speckle pattern. Quality of speckle pattern depends on several factors such as camera settings, calibration of cameras, pattern paint reflectiveness and randomness of pattern brightness. Pixel brightness of a speckle pattern can then be interpolated by a surface fit across a square area of image of predetermined size. These areas of image are also called facets.

For a mechanical body to be tracked, one must find the correlation between deformed and undeformed facet (deformation mapping) across two frames. This is done iteratively by maximising the so-called correlation coefficient. Finally, one can determine the displacement field and, consequently, obtain deformation, speed and acceleration of a mechanical body.

Keywords

Digital image correlation, optical measurement, experimental mechanics, deformation mapping

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Automatic dataset extraction from video files

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Abstract

Training a machine learning model for object detection nowadays is a relatively easy task, given that images for constructing a dataset for common objects are available online in large numbers and many machine learning frameworks are available for free and are easy to use. But problem arises when there is no enough data i.e. images for making a dataset for certain, uncommon objects. In that case the only solution is obtaining a dataset of said object by hand; by utilizing web scraper or by manually taking pictures of object. As machine learning models need large amounts of data, gathering dataset by hand is a very long and tedious process. In this paper a solution is proposed in which images of a certain object are automatically extracted from videos, which results in a large number of images of said object even from a short length video file. In the process associated annotations are automatically extracted using the correlation object tracker, which results in a complete dataset on which a machine learning model can be trained on. Additionally, blur detection is applied to disregard blurred images. Testing the generated models showed that gathering datasets from video files is a plausible approach for fast and relatively easy dataset acquisition for training custom object detectors.

Keywords

Object detection, *Object tracking, Machine learning, Auto-annotation*

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Reactive Power Compensation with PV Inverters for Loss Reduction in Distribution Network

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Abstract

Power distribution network is changing constantly. There are more and more power plants, battery storage system and cable share in distribution network. New elements in the network cause problems but they can create opportunities for improvement.

For example, in situation with low load condition and high cable share, capacitive loading is present. This situation usually appears in touristic areas with high load variation. Capacitive loading causes unnecessary losses so the aim is to reduce capacitive loading.

It is possible to reduce capacitive load in network with technology such as SVC, STATCOM, shunt reactor etc. In this article, it is considered another solution. This solution are PV inverters. It is explored whether is it possible to use PV inverters to compensate reactive power in systems in different loading conditions. For a specific distribution system, the applicability of reactive power compensation by PV inverters, considering both loading level increase and PV penetration increase will be investigated.

Keywords

Reactive Power, Compensation, Reactive Power Management, PV Inverter Compensation

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Automated deployment of blockchain nodes for use in mobile robotics

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Abstract

Blockchain technology is gradually entering the world of robotics. It is most useful in systems using peer-to-peer (P2P) communication requiring secure and trusted sharing of data in the absence of third-party trusted endorsement. Its application is particularly desirable for robotic swarm systems. Blockchain based platforms are a natural fit for this role. Such platform can be effectively used by robot nodes reporting their telemetry, location, acquired data and other useful information in a secure, verifiable and traceable way.

One of the problems barring the way is lack of automated blockchain deployment tools. Registration of individual robots and deployment of blockchain nodes and configurations is a tedious job that requires many steps to be performed for each new node (robot) that joins the network.

In this work a method for rapid deployment of a private permissioned blockchain is introduced and implementation details are described. An example use case application is also presented for robot nodes using blockchain to securely report their location.

Keywords

mobile robots, blockchain, data sharing, computer security

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Guidelines for the general model training standard for operators maneuvering non-conventional vessels-MTSOMN

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Abstract

The number of non-conventional vessels - nv in the maritime traffic of the world is increasing. The minimum training standard for the operator of nv is not provided. Therefore, due to the increase in the number of nv and the non-definition of the minimum standards of training, there are insufficiently educated and trained operators of non-conventional vessels. There is an increase in the number of working hours in nv navigation which leads to an increase: the traffic density, the risk of possible maritime accidents. Training of seafarers on conventional vessels - cv is defined by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). To reduce traffic density, reduce the risk of possible maritime accidents in relation to the existing situation in this paper the Guidelines for the general model training standard for operators maneuvering non-conventional vessels-MTSOMN are determined.

Keywords

non-conventional vessels, standard of training , risk, guidelines

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Zero-emission vessel as a part of North Adriatic marine transport

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Abstract

Stricter global environmental standards and pollution reduction demands require new and innovative efforts to reduce environmental impact created by marine transport. With relatively large increases in fuel prices, newly established environmental restrictions and green approach to shipping, it has become ever more necessary to find and implement new environmentally friendly strategies, technologies and ship designs. Application of green energy storage technologies in marine coastal transportation has the potential to enable true emission-free ship operation, particularly in pollution sensitive locations, such as ports, harbours or highly populated coastal areas. As propulsion and power generation systems are one of the main pollution sources on board a vessel, diversification of ship's electrical energy production systems together with implementation of zero-emission technologies, can allow for better pollution mitigation and reduction of overall environmental impact. Vessels such as ferries, that service short and medium distance transit lines are particularly suited for implementation of such green solutions due to precisely known transport schedules and docking times. This in turn allows for precise knowledge of necessary vessel shore support systems like shore grid availability or power rating capability. Implementation of hybrid and fully electric vessels has already been successfully implemented in Norway but in order to adapt and develop suitable solutions for North Adriatic marine transport, it is necessary to take into consideration relevant local parameters like route planning, transit times, docking schedules and overall ship and shore power requirements.
This paper presents some of the challenges and findings from Interreg METRO project that are relevant for energy assessment and power system development of hybrid and fully electric vessels for environmentally friendly coastal and intercoastal North Adriatic marine transport.

Keywords

North Adriatic, *marine transport, zero-emission, green energy*

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Analysis of the potential impact of the ‘’One Belt One Road” initiative on seaports business

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1 Abstract

The "One Belt One Road" initiative has a potential to transform the existing routes of maritime trade and influence the seaports business. The ‘’One Belt One Road" initiative provides opportunities for seaports business but also initiative has challenges for seaports business. In this paper, the main characteristics of "One Belt One Road" initiative will be identified. The impact, challenges and potential benefits of the "One Belt One Road" initiative on seaports business will be elaborated.

2 Keywords

‘’One Belt One Road’’, maritime trade, seaports business

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