# BOOK OF ABSTRACTS

# BOOK OF ABSTRACTS – MY FIRST CONFERENCE 2021

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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 welcome 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.

The third edition of My First Conference took place at University of Rijeka, Faculty of Civil Engineering in September 2019. During the conference, 27 papers were presented along with 1 plenary lectures.

The fourth edition of My First Conference was held at University of Rijeka, Faculty of Engineering in September 2020. For the fourth edition, 33 abstracts were presented together with a keynote speaker lecture.

This year the conference is held at University of Rijeka, Faculty of Maritime Studies on September 23, 2021. For the fifth edition of My First Conference, 30 abstracts were submitted along with 3 plenary and one keynote lecture.

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

We hope to see you at the sixth edition of My First Conference in 2022!

Organizing Committee of MFC 2021

## KEYNOTE LECTURE:

Mariusz Specht, PhD

## PLENARY LECTURES:

Mladen Jardas, PhD

America Califano, PhD

Donato Perfetto, PhD

## CONTRIBUTED LECTURES:

A. Agatić, N. Grubišić, T. Krljan, A. Grbčić

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*Finite element analysis of micropolar continuum: application of the fixed-pole interpolation concept*

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*Implementing neural networks for FE post-processing*

# Activity Based Mobility travel demand model of students population in the City of Rijeka

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Abstract

The Activity-based modeling (ABM) of traffic demand becomes the most prominent tool used in analyzing travel behavior and trip demand. Unlike the aggregate transport models, which are oriented on the macroscopic level, ABM is based on trip patterns for individuals i.e. specific travel groups such as employees, students, tourists, pensioners, etc. The main advantage of the ABM is a detailed temporal and spatial distribution of trip demand. Then, resulting O-D patterns can be further used in the assignment procedures of transport models. This research aims to analyze the main prerequisites for the Activity-based travel demand model for students in the City of Rijeka. A utility function will be set up for different activities and their temporal distribution according to data collection. The results will include a daily schedule mobility plan for the target person group depending on the sequence of discrete choices to perform the activities.

Keywords

*Activity-based models, student population, travel behavior, City of Rijeka, transport demand modeling, traffic assignment*

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# Durability of composite structures and organic hygroscopic objects: strategies for the health monitoring in different fields

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**Abstract**

Structural Health Monitoring (SHM) techniques allow to observe structures (intended as structural components, aircrafts, bridges, buildings etc.), with the aim to identify defects and damages and monitor any growth ensuring safe operation and life. This talk presents the development of SHM strategies and approaches in different fields. First, a procedure that allows monitoring changes in static-parameter distributions (displacements, strains) across polymer composite laminates will be presented; the method is performed with the help of Artificial Neural Networks and compared to experimental data. Then, a simple procedure is implemented in a field different that is the cultural heritage preservation one. This procedure has been developed for managing organic hygroscopic heritage buildings and objects in mixed microclimate conditions, i.e. natural and artificial climate. The strategy is at support of ideas on how to handle the deterioration mechanisms of cultural heritage assets preserved in this mixed microclimate. Finally, main results will be discussed with an eye to the near future possibilities.

**Keywords**

*structural health monitoring, composites, organic hygroscopic objects*

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# The effect of control measures on mobility and traffic safety during COVID-19 pandemic

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## Abstract

Mobility analysis is used to determine how people change travel behavior, and traffic safety analysis focuses on how traffic safety can change from before to after an event. Today, the wide availability of mobile sensors has given us the opportunity to be able to assess changes in human mobility in near real time. The platforms produce aggregated daily mobility metrics and the integration of mobility and safety data related to COVID-19 is expected to provide valuable results. Data collected on the impact of COVID-19 on human mobility using public location data of mobile devices available to many companies such as Google and Apple which is very useful to show the change of human mobility according to a different control policy. With different control policies from local and state government, the outbreak of COVID-19 dramatically changed the behavior in the Republic of Croatia. In this study, we collected timelines of public policies issued by the local and state government. The different levels of control policies during the outbreak of COVID-19 are closely related to safety awareness, driving and travel behavior, and thus an indirect impact on collision frequency. Based on set of data of people involved in traffic accidents and mobility data from mobile devices, the impact of COVID-19 on traffic safety was analyzed. Based on collected set of data of mobility and traffic accidents in the Republic of Croatia from the beginning of the pandemic, this study specifically aims to assess road safety in view of the change in control policies for COVID-19. This paper explores the impact of human mobility and control policies, including declaring emergencies, banning gatherings of certain sizes, closing schools, business restrictions and home stays on the number of people involved in accidents in the Republic of Croatia during the COVID-19 pandemic.

## Keywords

*Traffic, Safety, Mobility, Measures, Pandemic*

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# Supervision and protection of the part of the Adriatic sea under the jurisdiction of the republic of Croatia

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**Abstract**

Never, as today, have states faced so many security challenges, ranging from illegal migration, various types of smuggling, poaching and illegal fishing by ships from other countries, as well as the emergence of maritime terrorism. Therefore, the Republic of Croatia must make additional efforts to deal with these threats. The strategy for the protection of the national interests of the Republic of Croatia in the Adriatic Sea was adopted in order to answer these questions in a timely and effective manner. The aim of this strategy is to increase the efficiency of maritime services, to carry out intensified supervision, protection and, if necessary, to defend the interests of the Republic of Croatia in the Adriatic Sea.

The Croatian Navy, in cooperation with other national services at sea, is responsible for protecting the interests of the Republic of Croatia in the Adriatic Sea. The Coast Guard of the Republic of Croatia, as a unit within the Croatian Navy, is a military organization whose basic job and task is the protection of sovereign rights and the implementation of the jurisdiction of the Republic of Croatia in the economic zone, continental shelf and on the high seas. The Croatian Coast Guard may also act jointly with port authorities, as well as with the maritime police in the implementation of state border surveillance tasks or in the implementation of laws and other regulations in the Croatian coastal sea.

The Croatian Navy, in addition to the Croatian Coast Guard, has a coastal surveillance unit that with its radar stations along the Adriatic coast participates in the protection and control of maritime traffic, but also contributes to creating a real time maritime situation image, so that the Croatian Navy at any time, in coordination with other government services, is able to respond to all the aforementioned challenges at sea..

**Keywords**

*Supervision and protection, Republic of Croatia, Adriatic sea, Croatian Navy, security*

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# Corrosion behaviour of additively manufactured AISI 316L steel

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**Abstract**

Additively manufactured (AM) metal parts are receiving considerable attention in maritime industry as the shipping companies are seeking to implement AM technology in the ship spare part supply chain. However, in order to have confidence in introducing AM steel parts on ships, it is important to understand their behaviour in corrosive marine environment and compare it to the traditionally manufactured metals. In this study accelerated corrosion test and exposure to real marine environment was performed on AM and traditionally manufactured specimens of AISI 316L steel, commonly used in shipbuilding. Exposure to corrosive environment was performed for one month and three months period. Corrosion behaviour was compared based on mass loss and change of mechanical properties, i.e. tensile strength. There is a difference in corrosion behaviour of two types of steel, with AM steel retaining more strength after being exposed to corrosive environment.

**Keywords**

*AISI 316L, corrosion, additively manufactured metal, marine environment*

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# The risk assessment of response to accidental marine pollution from tankers

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**Abstract**

Proper action of operations personnel, according to the intervention plan, enhances offshore oil removal operations. By analysing significant marine accidents in history, we are learning lessons that enable us to successfully remediate oil from the sea in the future. The number of marine accidents has been declining in the last two decades. But these accidents do happen on a daily basis. They result in sea pollution, so the prevention of pollution is of paramount importance. By inserting meteorological and external factor variables into the specialized ADIOS program, the properties of the oil are being graphically presented in realtime. This allows us to develop an intervention plan for a possible marine accident. In this way, creating an intervention plan raises the marine environment protection factor.

**Keywords**

*marine pollution, intervention plan, marine accident*

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# Inaccuracies on calculating heavy fuel oil consumption onboard vessels

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**Abstract**

Common way of measuring heavy fuel oil consumption on board a vessel is to use volumetric fuel flow meters installed at fuel systems inlets for each of the major fuel consumers. At each stage of fuel processing cycle a certain mass fuel losses or deviations and calculation errors occurs that are not counted accurately into fuel consumption figures. The goal of this paper is to identify those fuel mass losses and measuring/calculating errors and to perform their quantitative numerical analysis based on actual data. Fuel mass losses defined as deviations identified during fuel preparation process are evaporation of volatile organic compounds, water drainage, fuel separation and leakages while errors identified are flow meter accuracy and volumetric/mass flow conversion accuracy. By means of using statistical analysis of data obtained from engine log book extracts from three different ships numerical models were generated for each of fuel mass loss point. Measuring errors and volumetric/mass conversion errors are numerically analysed based on actual equipment and models used onboard example vessel. By computational analysis of the obtained models, approximate percentage losses and errors are presented as a fraction of fuel quantity onboard or as a fraction of fuel consumed. Those losses and errors present between 0,001% and 5% of fuel stock or fuel consumption figures for each of identified loss/error point. This paper presents contribution for more accurate heavy fuel oil consumption calculation and consequently accurate declaration of remaining fuel stock onboard. It also presents a base for possible further research on possible influence of fuel grade, fuel water content on accuracy of consumption calculation.

**Keywords**

Ship, Fuel consumption, Heavy fuel oil, Errors, Deviations, Fuel mass loss, Volumetric/mass flow conversion, Remaining onboard stock

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# Photoelastic Observations of Corner-Filleted Flexure Hinges Produced by Digital Light Processing Additive Technology

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## Abstract

Compliant mechanisms, unlike conventional rigid body mechanisms, achieve mobility fully or partially through deformation of compliant members [1]. A study of corner-filleted flexure hinges produced by Digital Light Processing (DLP) additive technology is presented in this paper. In this regard, complex monolithic geometries can be manufactured by additive technologies at lower cost than with conventional production methods. The DLP technology used to manufacture the studied samples can result in anisotropic material properties, which are challenging when modelling deformation behaviour [2]. Standardised tensile and flexural experimental tests were performed to obtain the samples' material properties while considering their anisotropic nature. Furthermore, compression tests on circular disk-shaped samples were performed to determine the material photoelastic constant required for photoelastic measurements [3]. The experimentally obtained material properties were simulated with transversely isotropic material model for a finite-element assessment of the behaviour of the studied corner-filleted flexure hinges. Finally, the photoelastic observations of studied hinges were performed and the results comparatively analysed in contrast to the numerical models.
This work has been supported by Croatian Science Foundation under the project number IP-2019-04-3607 and by University of Rijeka under projects number uniri-tehnic-18-34 and uniri-pr-tehnic-19-21.

## Keywords

*Digital Light Processing (DLP), photoelasticity, flexure hinge, material behaviour modelling*

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# Compatibility equations in Cosserats' continuum theory in rectangular and cylindrical co-ordinate systems

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## Abstract

Governing equations for both the classical (Cauchy's) theory and the micropolar (Cosserats') theory of linear elasticity (equilibrium, kinematic, compatibility, and constitutive equations) are derived for both the rectangular co-ordinate system and for the cylindrical co-ordinate system using transformation of co-ordinates [1,2]. Solid understanding of these equations is essential for any serious analysis of the phenomena present in the micropolar continuum, including the derivation of particular analytical solutions.

In the classical theory, an isotropic elastic material is characterized by Lamé's constants $\lambda$, $\mu$, [1,2] uniquely related to Young's modulus $E$ and Poisson's ratio $n$. When it comes to the micropolar theory, it turns out that there are four new material parameters representing the effects due to micropolar structure of a material [3]. This is so because in the micropolar theory there exist couple stresses in addition to the standard stresses present in the classical theory.

The six independent material parameters of micropolar elasticity are denoted as $\alpha, \beta, \gamma, \lambda, \mu, \nu$, of which $\alpha, \beta, \gamma, \nu$ are the four additional parameters mentioned. The analytical solutions for a couple of representative problems in micropolar elasticity are given by Gauthier, but not always with a sufficient level of detail [3], especially in compatibility equations.

Here, the compatibility equations for the micropolar continuum will be derived in detail in both the rectangular and the cylindrical co-ordinate system. These results are necessary for providing the analytical solutions of some typical problems in elasticity such as pure bending, possibly including anticlastic deformation, and uniaxial torsion.

## Keywords

*Micropolar continuum theory; Compatibility equations; Analytical solutions for micropolar continuum.*

## References

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# Sustainable city logistics

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**Abstract**

The task of city logistics is to develop and implement measures for achievement of effective and ecologically acceptable traffic system. Development of city centre leads to grouping of large numbers of business operators in the city centre, resulting in the increase of the quantity of goods entering the city centre, causing additional traffic congestion, the so called bottlenecks, eventually causing higher levels of noise and emission of exhaust gasses which leads to major dissatisfaction with the quality of life of city population. The analysis of relevant scientific literature and motives (interests) of stakeholders (carriers, economic operators, local population and public administration) led to division of selected criteria into several groups: technical-technological, economic-financial, organizational and social. Possible scenarios for delivery of goods within the city centre have also been proposed: status quo, delivery using a single consolidation centre, delivery using two consolidation centres, delivery by ecologically acceptable vehicles of one consolidation centre and *livability* scenario. A multi-actor multi-criteria analysis (MAMCA), based on optimization and ranking of scenarios in line with the set goal, research problem, defined criteria and interests of stakeholders was used in this lecture. The solution of MAMCA analysis in accordance with the set goal of optimization evaluates the scenario with two consolidation centres as the best one. Additionally, all scenarios were tested on an example of delivery of goods to Rijeka city centre using a simulation tool VISSIM. Testing the scenarios, with limitations in application of the simulation tool and possible selection of evaluation criteria, the scenario of delivery of goods from one consolidation centre is proposed as the best solution. Based on the results of multi-actor multi-criteria analysis and the implemented simulation in the real environment of the city of Rijeka, it is concluded that the existing model of delivery of goods to Rijeka city centre may be improved by construction of a consolidation centre.

**Keywords**

*city logistics, sustainable development, delivery of goods, stakeholders, multi-actor multi-criteria analysis, simulation*

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# Digitalization and Digital Transformation in Maritime Transport

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**Abstract**

Maritime transport is very important for global trade and involves numerous stakeholders and complex business processes. Stakeholders in the maritime transport sector face numerous challenges due to growing demands of service users, complex changes in regulatory frameworks, technological progress, etc. A preliminary review of the available literature has identified a lack of research and scientific papers dealing with digitalization and digital transformation in the maritime transport sector. Digitalization focuses mainly on the business process automation, while digital transformation may be defined as the use of new digital technologies to enable business improvements or to innovate business models. While disruptive digital technologies (such as Big Data, Blockchain or Artificial Intelligence) foster digitalization and digital transformation in the maritime transport sector, the barriers such as insufficient management support or lack of stakeholder collaboration slow down digitalization and digital transformation. Accordingly, stakeholders in the maritime transport sector need to develop appropriate strategies in order to achieve and maintain a competitive position in the market and to operate sustainably, while government and industrial policies have to guide and encourage sustainable and safe practices through digitalization and digital transformation in the maritime transport sector.

**Keywords**

*Digitalization, digital transformation, maritime transport sector*

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# The selection procedure of a ship for inspection

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**Abstract**

This presentation presents a comprehensive review of the port state control inspection. Focus will be on selection of foreign container ships for inspection, historical aspects of the establishment of the regional Memoranda, types and categories of inspection as well as results on flag states, recognized organisation and companies. Final aim is to indicate the importance for harmonize and standardize inspection procedure.

**Keywords**

*Port State Control, inspection, Memorandum, harmonisation, standardization*

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https://www.equasis.org/EquasisWeb/public/HomePage (18.07.2021)

# Deep learning-generated rod finite elements

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## Abstract

Numerous technological innovations that provide clear benefits that society sorely needs require new and advanced materials with their superior properties. The unique mechanical behaviour of these materials is inadequately described by conventional models and therefore poorly understood. Consequently, machine learning approaches appear to be a potential tool for characterizing complex material properties [1]. The stiffness matrix contains information on the mechanical properties of the material whose key component is the strain-displacement matrix. In this research, we utilized deep learning methods to generate a strain-displacement matrix at Gauss points. The intrinsic coordinate system-based isoparametric formulation was employed to derive the element stiffness matrix and equations. The proposed method is utilized to develop quadratic 1D linear elastic and functionally graded rod finite elements with varying Young's modulus. The dataset included nodal coordinates, nodal displacements, and strain of the finite element. Several sets of data including training data, test data, and validation data were employed to obtain the best feasible prediction model. The numerical tests indicated a satisfying model's performance.

## Keywords

*Deep learning, finite element, isoparametric formulation, functionally graded material*

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# Derivation Matrices in Mechanics – Data Approach

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**Abstract**

Great part of mechanics is involved with derivation of some kind, e.g., differential equations. In the long history of mechanics, a lot of mathematical and numerical methods have been developed for their solution. However, today we have an additional component that strongly influences approach to the solution of problems in mechanics. Namely, existence of data allows us to use solution methods that would otherwise be inapplicable. A significant tool towards formalization of the solution process is use of derivation matrices that reduce the derivation operation and solution of differential equations to linear algebra operations [1].

Derivation matrices are formulated by applying numerical methods in matrix notation, like finite difference schemes. Here we are developing a novel formulation based on Lagrange polynomials. The main advantage of the approach is straightforward formulation, clear engineering insight into the process and (almost) arbitrary precision through choice of the interpolation order. Prerequisite for application of derivation matrices is availability of data, recorded displacements or velocities or accelerations.

Let us assume quadratic function interpolation and interpolation of the function value in some point 'j' is represented using the equation

$$p_j(x) = u_l L_l(x) + u_j L_j(x) + u_d L_d(x)$$

where 'u's are unknown function values in discretization points, 'L's are Lagrange interpolation polynomials, and indices 'l' and 'd' represent the left and the right point in the adopted discretization scheme. Value of the derivative in point 'j' is $w_j(x) = u_l L_l(x)$ that gives the equation $p'_j(x)$.

It is clear that we only have to differentiate the Lagrange polynomials, which is straightforward. Special care should be taken at boundary points. In order to preserve a uniform precision, usually an extra point is added at the boundary. The result of this procedure is the derivation matrix of the dimension [n×n], where 'n' is the number of data points. The resulting matrix is singular (of rank 'n-1') until boundary/initial conditions are introduced. However, that does not prevent us to successfully differentiate our unknown function represented with the recorded data points.

Derivation matrix approach is easily applicable to a wide range of engineering problems. This methodology could be extended to dynamic systems with multiple degrees of freedom and adapted when velocities or accelerations are recorded instead of displacements. Additional adjustments are needed when one records a reduced set of parameters (less then one set of data for each degree of freedom). It is also possible to determine the initial conditions and damping at the same time.

Acknowledgment: This work has been supported through project HRZZ 7926 ”Separation of parameter influence in engineering modelling and parameter identification” and project KK.01.1.1.04.0056 ”Structure integrity in energy and transportation”, which is gratefully acknowledged.

**Keywords**

*derivation matrices, partial differential equations, finite difference method, linear algebra*

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# Influence of selective laser melting process parameters on mechanical properties of Ti6Al4V alloy

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## Abstract

The ability to customize the microstructure, surface morphology, and thus the mechanical properties of the widely used Ti6Al4V alloy, provoke great interest in the automotive, biomedical, and military industries, where high topological complexity of the final products with exceptional mechanical properties and minimal mass is often required. The use of selective laser melting (SLM), as one of the rapidly growing additive manufacturing technologies, represents a potential solution to this challenging task. Namely, by controlling the laser power and the scanning speed, the two most significant parameters of the SLM process, it is possible to influence the volume, type and shape of the voids inside material [1]. However, even with similar porosity values, a difference in ductility can be observed. This suggests that the volume, type and shape of voids is not the only dominant mechanism affecting the mechanical behavior of these advanced materials. The different types of the martensitic microstructures created by the heating cycles during the SLM process, as well as the size and orientation of prior β-grain boundaries, also have a detrimental effect on the tensile properties [2]. The aim of this work is to extend previous research findings of the influence of laser power and scanning speed on the microstructure, surface morphology, and behavior of these advanced materials under monotonic and cyclic loading conditions.

This work has been supported by Croatian Science Foundation under the project number IP-2019-04-3607 and by University of Rijeka under project number uniri-tehnic-18-34.

## Keywords

*Ti6Al4V alloy, selective laser melting, process parameters, mechanical properties*

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# On Evolutionary Metaheuristic Optimization Approaches in Data-Driven Signal Processing Techniques

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## Abstract

Data-driven signal processing techniques are used for many practical applications in various fields [1]. Due to their local-adaptive properties, these techniques enable processing noisy signals, regardless of knowledge of the signal models and characteristics [2]. The performance of the data-driven methods depends on the proper selection of algorithm parameters [3,4]. Besides the extensive grid search in the parameter space, the advanced evolutionary metaheuristic optimization techniques, such as particle swarm optimization (PSO)-based algorithms and genetic algorithms (GA) [5], can also be an efficient solution for parameter optimization. This work considers some aspects of their implementation.

## Keywords

*Signal processing, data-driven algorithms, evolutionary metaheuristic optimization, particle swarm optimization, genetic algorithm*

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# Estimating skin parameters from hyperspectral hand images using machine learning

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**Abstract**

In the last several years, it has been shown that it is possible to extract physiological parameters of the observed tissues from hyperspectral images, which can be utilised for non-invasive diagnostics. Commonly used methods to obtain relevant information from hyperspectral images are based on modelling the biological tissue and performing light propagation through the modelled tissue. One such approach is the inverse Monte Carlo (IMC) method, which provides very accurate tissue parameters estimations, but its execution is time consuming and computationally intensive. To overcome this problem, use of machine learning has been extensively researched. Because the average number of measured spectra with correctly estimated parameters in a specific dataset is usually too small to train a neural network, a database of simulated signals on which the models are trained is built. In this study, we investigate and compare two modelling approaches: Random forests and Artificial neural networks. Their performance is evaluated and compared on both the simulated and real datasets.

**Keywords**

*Hyperspectral imaging, Artificial neural network, Random forests, Skin parameters*

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# Deep Learning for Casting Microstructure Inspection: AConvolutional Neural Network Approach

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**Abstract**

In the present research, we used a convolutional neural network (CNN) to determine secondary dendrite arm spacing (SDAS). The goal was to develop a Deep Learning (DL) model capable of predicting SDAS from optical microscopy images with industrially acceptable prediction accuracy. For the training of the CNN model, polished samples from several widely known casting aluminum alloys were used. In order to build a training set having distinct types of microstructures, alloys cast using different casting processes were used: high-pressure die casting, gravity die casting, and ingot casting. Additional alloys were used in various tasks in order to check model performance. We showed that our CNN structure was able to predict SDAS very well, on all different alloy groups. Additionally, it is also shown that using a higher magnification on the microscope, better accuracy could be obtained because more pixels describe the dendrite structure in that case. Consequently, it is shown that our CNN structure can be used for the task of SDAS prediction within the industry because it achieves an acceptable level of predictive accuracy.

**Keywords**

*secondary dendrite arm spacing; convolutional neural network; casting microstructure inspection; deep learning; aluminum alloys*

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# Peptide Activity Prediction Improved by Hellinger Distance

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**Abstract**

Recently, machine learning became a popular choice for the high throughput screening of peptides in order to quickly and efficiently identify potential chemical compounds that possess the desired activity[1]. Most papers use decision trees for this task because of their simplicity and interpretability, but also because it has been shown that high accuracy can be achieved with them. The chemical space of possible compounds is large and its research is mostly based on trial and error methods that require a lot of time-consuming laboratory work, which is why much fewer positive instances are known compared to negative instances. Therefore, datasets can be extremely unbalanced which has a negative impact on the predictive power of decision trees. We seek to solve this problem by using the Hellinger distance (HD) as a splitting criterion when constructing CART decision trees. Previous research has shown that trees built with the HD criterion are more robust and less sensitive to unbalanced datasets[2]. In this paper, we compare the predictive performance of classifiers constructed using HD, Entropy, and Gini index splitting criteria for predicting peptide activity, using multiple datasets that cover nine activities of different levels of imbalances (the most imbalanced dataset having 5701 negative and 77 positive instances). The classifiers we use are the single CART decision tree, random forest, the decision tree ensemble trained with bagging, and the decision tree ensemble trained with boosting.

**Keywords**

*Peptide activity, CART, Decission trees, Hellinger distance, Imbalanced datasets*

**Acknowledgement**

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# Guided wave structural health monitoring in real composite structures

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**Abstract**

Guided wave-base Structural Health Monitoring (SHM) systems have shown great potential in detecting and monitoring damages and defects in real FRP composites allowing the development of new damage tolerant structures together with the reduction of maintenance operations costs and time. This talk presents the latest developments for the FE simulation of a SHM system applied to real isotropic and composite structures under different in-service scenarios, considering the effect of damages, changing temperature and applied loads. Results have been compared to the experiments in order to validate the SHM system and to make it available for possible future industrial implementations.

**Keywords**

*guided wave, structural health monitoring, composites*

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# Measuring of the Weld Toe Radius by Non-destructive Techniques

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**Abstract**

The geometric profile of the weld is the primary factor affecting the stress concentration factor. Extensive research has investigated the influence of weld geometry parameters on the stress concentration factor of the weld and it has been found that the weld toe radius has the greatest influence. Accurate measurement of the geometry of the weld toe radius is essential for the determination of the stress concentration factor. In this paper, three different nondestructive methods, namely Direct Measuring Method, the method of 3D Scanning Weld from GOM Inspect software and Computational Software for processing data from Wolfram Mathematica software have been used to measure the weld toe radius for butt welds. A new approach to measuring weld toe radius using a 3D scanner and computational software is presented. An introduction to a non-contact 3D measurement method based on structured light projection and corresponding measurement software is given. The influence of the operator on the surface measurement results is discussed. A comparison of three methods for measuring weld toe radius has also been presented. The results of the toe radius measurement using the three mentioned methods were analysed and commented.

**Keywords**

*Stress concentration factor, Weld surface geometry, Scanning and measuring, Butt weld geometry*

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# The Benefits of Establishment of the Sea Traffic Management (STM) System in the Adriatic Sea

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## Abstract

In maritime navigation, the Vessel Traffic Service (VTS) represents a sea traffic organisation and surveillance system for the particular sea area. Its most important services are the information support and traffic management with the aim of safety of navigation improvement and the marine environment protection. In pace with the increasing market, and related increase of the maritime transport and traffic in the Adriatic region, the risks of maritime accidents are increasing as well. Although, as per respective standards and official VTS guidelines, the legislative and operational traffic control measures are established, the number of accidents still represents a significant threat to the safety of navigation. In order to cope with this challenge, the Sea Traffic Management system (STM) represents a new means for improvement of the vessels' surveillance and management. The proposed paper elaborates the STM from the organisational, safety and operational point of view, as well as analysing its establishment feasibility in terms of integration with other related services. Further, the advantages of the system and its features are analysed with regards to existing means of surveillance and sea traffic organisation. For the purpose of the research on existing services as well as potential improvement options, the structured interviews and surveys were conducted among VTS operators. The results indicate that the further usage of the STM represents a significant progress towards sea traffic monitoring and VTS services' organisation in the area in terms of integration and mutual communication between all related stakeholders.

## Keywords

Maritime navigation, vessel traffic service, sea traffic management, safety of navigation, marine environment protection

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# Mathematical model of ship speed drop on irregular waves

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**Abstract**

Estimating the speed of a vessel in rough seas is a major challenge for engineers and scientists due to complex interactions and dynamic effects between the sea and the vessel. In this paper, mathemical model for ship speed drop in irregular waves is presented. The calculation is developed for head seas with regards to ITTC-57 wave spectrum and it is based on equilibrium between total resistance of a ship and required thrust. Since the wave height and period is highly stochastic in nature their distribution is modelled as a random process in time domain. Values of still water resistance and added resistance are calculated from external software and imported into original code. Thrust values are considered constant with minor oscillations due to change of wake behind the ship screw. Lastly, differential equations are solved using modified Runge-Kutta 4$^{th}$ order method. Complete mathematical model is proposed in [1]. This model takes into account ventilation effect of a screw behind a ship, wind resistance and ship inertia. It can be improved by taking into account added mass of water moving along with the ship. Model presented in this paper is written solely in Python Spyder.

**Keywords**

*Ship dynamics, seakeeping, mathematical model,*

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# Agent-based modeling and simulation (ABMS) application analysis

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**Abstract**

Agent-based modeling and simulations (ABMS) is a relatively new approach to modeling systems that consist of autonomous, interacting agents. Agent-based modeling provides ways to model individual behavior and the effect of that same behavior more easily on others. Modeling and simulations can be done in several ways, and ABMS is introduced in this paper. Agent-based models are more intuitive and realistic than mathematical or static models and are therefore increasingly used in practice. Agent-based models and multi-agent systems (MAS) are used to simulate very different types of complex systems, from supply chain simulation, socio-economic systems, epidemic prediction to traffic control and many others. Some argue that ABMS is a third way of engaging with science and could reinforce traditional deductive and inductive reasoning as methods of discovery. This paper discusses specific aspects of this approach to modeling and simulation from different perspectives and describes typical elements of an agent-based simulation model, key advantages and disadvantages, and relevant research. Furthermore, agent-based modeling of traffic has been analyzed in more detail, as well as for the design of the future European air traffic management system, using the research work within the Cassiopeia project as an example. Furthermore, a social distance model was developed using the heat map visualization method to facilitate the detection of contacts between objects.

**Keywords**

*agent-based modeling, agent-based simulation, traffic simulation, social distance model*

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# The application of remote sensing for monitoring the morphological changes of Ploče beach in Rijeka

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## Abstract

Unmanned aerial vehicles (UAVs) have been used for coastal research in Croatia since 2012. SfM-MVS photogrammetry is mostly used for analysis of changes on beaches, which increasingly requires high resolution and precision of three-dimensional point clouds resulting from photogrammetric technique [1]. In this paper, this technology was used to study coastal processes on Ploče beach in Rijeka. The beach was surveyed 19 times with a drone in 2020 and 2021, and two 3D scans of the beach area were performed to determine the accuracy of the point clouds. The defined point cloud precision for the emerged beach is better than ± 5 cm. The point cloud representing the submerged beach was compared to the multibeam echo sounder data, and the results showed significantly greater discrepancies than for the emerged beach. The accuracy of the submerged point cloud data was increased by depth correction using the light refractive index, but more accurate corrections are one of the ultimate goals of this research. The CloudCompare software has also proven to be a useful tool for identifying and describing beach surface changes. Successive beach surveys were compared and digital models of the differences (DoDs) were created as a result. The comparisons showed that the greatest changes on the beach are caused by waves from southern and southeastern directions, and when storm events are accompanied by higher rainfall, runoff from coastal springs enhances the coastal process on the beach body. UAV photogrammetry has proven to be a simple, fast, and cost-effective tool for describing and visualising changes on beaches, considering that the morphological changes under the influence of waves and precipitation are much greater than the accuracy achieved.

## Keywords

*beach erosion, SfM photogrammetry, point cloud, digital elevation model*

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# FRP composites property degradation in marine environment

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**Abstract**

Fibre reinforced polymer composites (FRP) coupons have been exposed to real sea environment in order to assess the influence to the mechanical behaviour of composite materials used in the construction of marine vessels and structures. Real life sea environment conditions were opted for instead of the more common simulated and laboratory versions of seawater in the attempt to obtain more realistic structural modelling environmental input parameters for the design of such structures. Also, exposure was performed over prolonged time span, instead of usual accelerated tests. Epoxy and polyester resins, reinforced with glass fibres in three fibre layout configurations were used to manufacture standardized tensile testing coupons. Vacuum assisted infusion and hand layup processes were used to manufacture the coupons. Mass changes due to seawater absorption, microorganism's growth, changes in tensile strength (standard tensile tests) and surface morphology (using optical and scanning electron microscopy) of the coupons were evaluated after 6- and 12-months long periods of submersion in the sea in the Rijeka bay. All specimens have shown mass increase due to water absorption and growth of attached algae and sea microorganisms. Various levels of reduction in tensile strength, depending on the fibre layout configurations, were observed. Significant changes in the matrix material structure were noticed due to forming of salt crystals and microorganisms feeding on the organic resins, effectively producing "voids" in the matrix material.

**Keywords**

*FRP composites, real marine environment, mechanical properties*

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# Theory and Practice of Port Clustering

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## Abstract

The scope of this scientific article is on the creation and operation of port clusters. Also authors research the aspects necessary for success of competitive seaports and port clusters in theory and demonstrates this using examples from different ports. The topic of port clusters can be considered as part of the theoretical and practical approach to the development of transportation, as well as logistics services. In order to prevent neighboring ports from competing and taking each other's customers, ports can form a so-called cluster. Different European ports, based on four geographical prerequisites are used as examples of successful port clusters.

## Keywords

*clusters, sea port, transportation, logistics*

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# Failure analysis of API 5L X60 steel gas pipe

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**Abstract**

Pipelines used in the oil and gas transport usually contain some sulphur dioxide, which absorbs hydrogen from the pipe wall and accelerates hydrogen damage of steels. Also, the welding process and the type of manufacturing process can facilitate the entry of hydrogen into the steel. In this research, damaged API 5L X60 refinery pipes were studied. Microstructural studies showed that the primary microstructure of the steel consisted of 55% ferrite and 45% pearlite. The microstructure in the welding zone also included Widmanstatten ferrite. The observed cracks in the microstructure were also of step-wise cracking and represent the possibility of hydrogen induced cracking. Pre-etching observations using light microscopy shows MnS impurities in the structure. Also, SEM/EDS analysis revealed that the cracks were formed from the accumulation of MnS impurities and these impurities were preferred sites for nucleation and growth of the cracks. The results of the mechanical testing including hardness, impact and tensile test showed that the steel had a ductile behaviour in all the sections and no hydrogen embrittlement has been probable.

**Keywords**

*API 5L X60, failure analysis, pipeline failure*

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# Finite element analysis of micropolar continuum: application of the fixed-pole interpolation concept

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**Abstract**

In order to realistically describe the behaviour of a heterogeneous material and capture the phenomena that the classical (Cauchy) theory cannot, several alternative theories have been developed, one of which is the micropolar (Cosserat) continuum theory. Unlike the classical theory, where the static interaction between two particles of a body is described only by a force vector, in the micropolar theory there exists an additional moment vector field [1]. Consequently, there is an additional couple-stress tensor and both stress tensors are non-symmetric in general. The existence of a couple-stress tensor causes an additional kinematic field (microrotation), which gives an orientation to each material point and it is completely independent of the skew-symmetric part of the displacement gradient at the observed point (macrorotation). To describe a linear centrosymmetric isotropic micropolar continuum, it is necessary to know six independent material parameters [2]. The theory itself is well known, but reliable experimental methods for determining the material parameters are still not established, which prevents wider application of the theory. Alternatively, the material parameters may be obtained from experiments with the help of numerical analysis in an inversely posed problem. The development of high-quality micropolar finite elements is thus very important and for this reason, we present a detailed linear analysis of the micropolar continuum within the finite-element method using a novel interpolation based on the fixed-pole concept. The concept was first introduced in [3] where authors applied it to the geometrically nonlinear 3D beams which has proven to be particularly useful in dynamics, but so far, no attempts have been made to apply it in linear analysis, where some advantages of the concept can be expected. The new family of micropolar finite elements will be tested through *patch* tests and compared with existing elements [4].

**Keywords**

*Cosserat theory, micropolar continuum, finite element methods, fixed-pole concept*

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# Implementing neural networks for FE post-processing

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**Abstract**

In recent years machine learning has become more popular especially since open source libraires such as TensorFlow have become available. Neural networks have been used in computational mechanics for a long time [1] but were a fringe area. However, with an increase in computational power and availability of easy to implement libraries such as Keras, machine learning is quickly gaining more traction [2,3]. In this paper the possibility of using neural networks to post-process finite element displacements is investigated and proven to be a viable application. This proof of concept was done on 2D membrane finite elements and a reduction in computational time was observed.

**Keywords**

*Deep learning, finite elements, data driven modelling*

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