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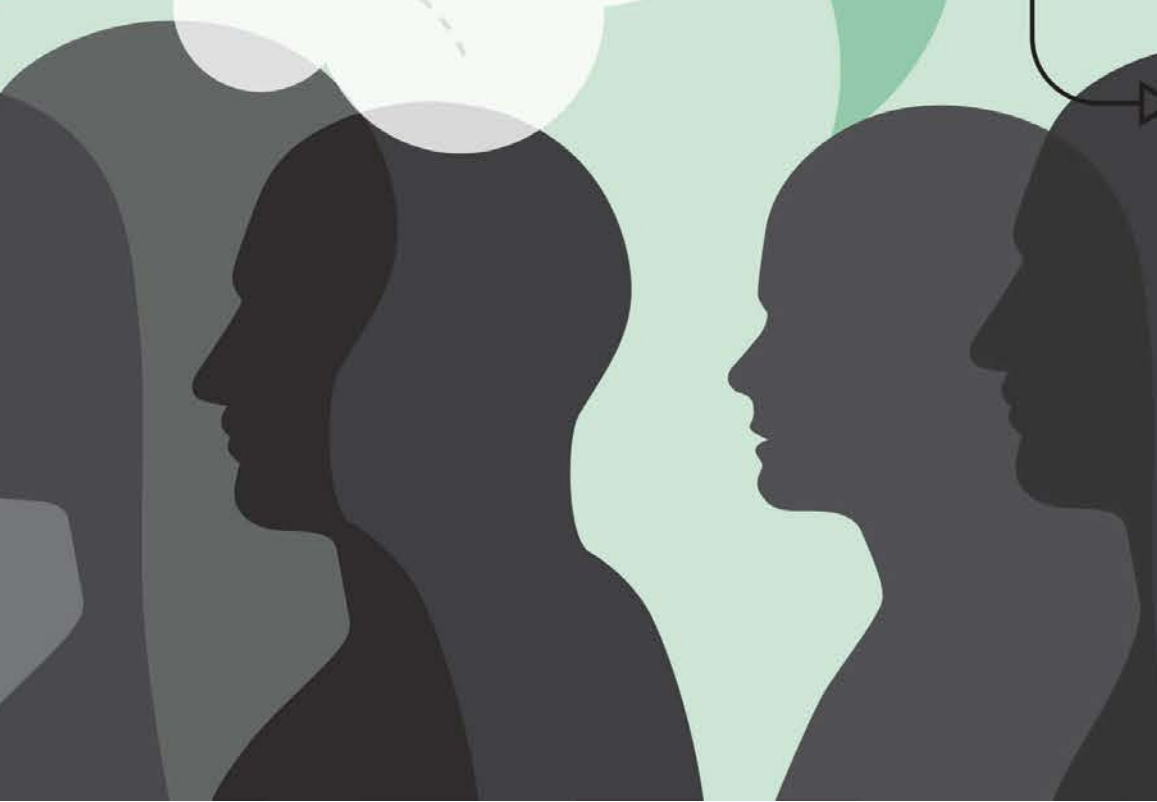

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APPLICATION OF GRASSHOPPER OPTIMIZATION ALGORITHM IN MECHANICAL ENGINEERING

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Summary: In the past fifteen years, a number of methods that solve complex optimization problems in a more efficient manner have appeared. All these methods have emerged as an inspiration to the corresponding phenomena in nature, so they are called biologically inspired methods. In this paper we demonstrate how Grasshopper Optimization Algorithm (GOA for short) can be used for solving certain optimization problems in engineering. In the introduction part, biological fundamentals, as well as method explanation are given. The pseudo code for this algorithm was written using Matlab R2018a software suite. This algorithm can be used for optimization of engineering problems, such as: pressure vessel optimization, beam optimization and cone coupling optimization. At the end of this paper, results and conclusions are presented.

Keywords: optimization, grasshopper algorithm, pressure vessel, beam, cone coupling.

AN IMPROVED LAPLACE TRANSFORM METHOD FOR THE CALCULATION OF THE LIGHTNING CHANNEL RETURN STROKE PARAMETERS

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Summary: The study of lightning return stroke is of great importance for plasma physics as well as for the electrical engineering practice. After the consideration of numerous engineering return stroke models used in the theory, it was decided to apply the generalized lightning traveling current source (GTCS) return stroke model. The procedure starts with the calculation of the channel discharge function from Volterra integral equations of the first kind. This is ill-posed problem and it has been solved in the literature in the closed analytical form. However, this procedure is complex and its numerical use is time-consuming. A new method based on Padé approximation is proposed. The numerical simulations show that this method is faster than previously used methods of the calculations without loosing accuracy. It is concluded that the proposed method has been proved successful and it will be applied and further developed in future research.

Keywords: lightning return stroke, generalized traveling current source model, Laplace transform method, Padé approximation; Meijer G-function.

IMPROVED NUMERICAL MODEL OF THE ARTERIAL WALL APPLIED FOR SIMULATIONS OF STENT DEPLOYMENT WITHIN PATIENT-SPECIFIC CORONARY ARTERIES

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Summary: Atherosclerosis is a disease that causes arterial stenosis and the obstruction of normal blood flow. One of the endovascular treatment procedures in this case is the implantation of a stent to restore the blood flow. This study presented an improved numerical model that is capable of accurately simulating the behavior of human arterial wall in coronary arteries, during the stent deployment process. The new model considered the arterial wall as an incompressible, isotropic and hyper-elastic material. The material coefficients were defined according to experimental values presented in literature. The accuracy of the numerical model was demonstrated through the comparison with follow up data obtained in clinical examination. The small relative and standard deviation error prove that this numerical model can be used to assist clinicians in decision making and treatment planning with reliable predictions of the outcome of the stent deployment procedure.

Keywords: stent expansion, prediction of shape, deformation, hyper-elastic material model, stress-strain relationship, finite element method

DESIGNING A SHIP'S HULL FORM WITH MINIMUM RESISTANCE

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Summary: This paper is a response to the challenge issued by STENA Teknik in February 2019. The goal of this challenge was to achieve more energy efficient and sustainable shipping through hull design optimization. The requirement was to design a ship hull that offers the least resistance through water at design speed and displacement. The length and draught of the hull are limited due to harbor restrictions. In the preliminary design stage, length and ratio of the length and beam were varied, and the resistance was examined through the regression method of Guldhammer & Harvald. After comparing the resistance for different slenderness coefficients, a minimum of ship resistance was observed, and therefore, optimal dimensions were determined. In the next stage, the ship's hull was modeled and resistance calculation was confirmed through several other methods such as Holtrop & Mennen, Hollenbach, and Taylor series.

Keywords: ship hull, energy efficiency, resistance

SMART AUTONOMOUS AGRICULTURAL SYSTEM FOR IMPROVING YIELDS IN GREENHOUSE BASED ON SENSOR AND IoT TECHNOLOGY

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Summary: Agriculture and farm are some of the basic human lives that provide food, grains, and other raw materials needed for life. The subject of research is the observation and control of the microclimate using Internet of Things technology and smart sensor nodes. With increasing environmental pollution such as rivers, lakes, and most of the land that is the basis of agriculture, it is becoming increasingly difficult to grow healthy crops and therefore maintain a good yield. Technology development can play a huge role in protecting agricultural crops and reducing the additional labor required to keep agricultural yields at a level that meets the needs of today's human lives. With a special focus on the now widespread Internet of Things (IoT) technology, it offers a convenient solution for smart agriculture. This paper will introduce a smart greenhouse monitoring and control data logger system as part of a smart farm. The system is based on: a group of built-in sensors, a microcontroller with a peripheral interface (PIC) as a core and a server system and a wireless Internet using the Global System of Mobile Telecommunications (GSM) module with General Packet Radio Service (GPRS) as a communication protocol. It is possible to implement a smart agricultural service, in which the realized smart data logger system could be implemented, which enables automatic control of the greenhouse at the farm.

Keywords: Smart agricultural system, sensor technology, Internet of Things, application, measuring.

RESILIENCE AS A MEASURE FOR RISK ASSESSMENT OF THE WATER SYSTEMS: REVIEW OF EXISTING CONCEPTS

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Summary: Until today, the world has been facing enormous challenges, rebuilding water systems, wastewater plants, and infrastructure in general. Major investment is required to renew and upgrade these aging systems for burgeoning population whose future is profoundly affected by an uncertain and changing climate. Over the last few decades, we have been witnessing many catastrophic disasters like floods, droughts and earthquakes that have considerably exceeded the largest recorded events and caused billions in damage. In order to successfully manage impacts of disasters, it has been essential to assess and quantify resilience of the particular water system. A lot of researchers proposed various definitions of resilience and methods for its quantification. This paper provided an insight of the existing resilience concepts and case studies. Based on the existing literature review, authors proposed the three major issues related to the dynamic resilience which need to be addressed by the future work: assessment of dam safety under an extraordinary disturbance - caused by an earthquake or extreme hydrological event, assessment of hydraulic resilience of a crucial infrastructure within the flood prone area and improvement of the water quality using resilience as a criterion and considering the emerging ecological problems.

Keywords: resilience, risk assessment, water systems, system performance.

ENRICHED ZEOLITES FOR VEGETABLE SEEDLING PRODUCTION

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Summary: A series of experiments was conducted in the experimental greenhouse of the Institute of Vegetable Crops in Smederevska Palanka (Serbia) with a goal to determine the biological nutritional value of the studied substrate mixtures and create the appropriate replacement for Zeoplant soil enhancer. In addition to the peat component (commertial Clasmann-Deilmann KTS 1 substrate or Pirotski peat), the substrate mixtures also contained commertial zeolite based soil enhancer as a control treatment (Zeoplant) and natural zeolites provided from the Igroš tuff deposite near Brus enriched in different ways (treatments). Preliminary experiments showed that the optimal ratio of enriched zeolites in the peat based substrate mixtures is about 25% (volumetric). In the final experiment, natural zeolites were enriched with 4 different organic and mineral fertilizers by diverse methods. Enriched zeolites (EZa, EZb, EZc, Ezd) were mixed in optimal ratio with Pirotski peat and compared with Zeoplant based mixture using Lettuce (Lacttuca sativa L.) as the test species. The data concerning plant height, number of leaves and fresh plant mass were collected. The differences between examined tretmans was minimal, without or with small significance for almost the all traits. The only exception was fresh plant mass and the Zeoplant based mixture which exceded all other mixtures. The trials should be continued. To reach the planed goal, in the future, higher doses of mineral and organic fertilizers should be used for natural zeolites enrichement.

Keywords: substrates, zeolites, natural peat, vegetable, seedlings.

EFFICIENT LARGE-SCALE OPTIMIZATION IN THE CONTAINERIZED ENVIRONMENT

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Summary: Optimization of the transportation pallets, not only from a structural point of view, but also taking into account effectiveness of the production process is a complex multi-objective simulation based optimization problem. To solve it efficiently and effectively one must possess expert knowledge from various fields and appropriate expensive software and hardware. In this regard we present the improvement of already well established WoBinGO framework that enables efficient and frugal simulation based optimization over platforms such as Amazon ECS/EKS, Azure AKS and Kubernetes. The solution consists of dozens of microservices, only three of which are present all the time during optimization, while the rest are scaled using a specially developed application-level auto-scaler. Existing schedulers, whether Kubernetes or commercial, do not take into account the specifics of optimization based on evolutionary algorithms and therefore their performance is not optimal from the point of view of delivery time of results and cost. The proposed auto-scaler takes into account the specifics of the simulation-based optimization. The solution was applied for optimization of the transportation pallets for train as part of the H2020 CloudiFacturing project, and the obtained solution provides the reduction of pallet weight by 12%, material costs by 14% and welding costs by 41%. We have also shown that a cloud infrastructure cost savings up to 48% can be achieved, with almost unchanged delivery time of the optimization results.

Keywords: optimization of the constructions, containerized microservices, cost-efficient autoscaling in the cloud, optimization framework, parallel genetic algorithm.

GENETIC ALGORITHM OPTIMIZATION OF THE ARTIFICIAL NEURAL NETWORK ENSEMBLES

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Summary: The paper represents a novel method for creating and optimizing the ensemble models based on the artificial neural networks. The choice of the set of ANNs that make up the composite ensemble model is performed using genetic algorithms. The genetic algorithm searches for a suitable hyper-parameter combination of the individual ANN models, minimizing the error of the composite ensemble model, and ensuring the diversity of the predictions obtained from the individual ANNs. Such optimized ensemble models have been shown to be significantly more accurate and more general than any individual ANN model, but also more accurate than ensemble models based on bagging and boosting. The optimization process is tremendously time consuming. To reduce the execution time for an order of magnitude, the genetic algorithm search was parallelized on a computing cluster. The scalability of the proposed solution is ensured by using microservices and Kubernetes orchestration. The described solution was verified to model the flow on the inflow Strvna at Vlasina lake in south-east Serbia. The optimized ensemble model shows a significant improvement over the application of individual ANN models.

Keywords: ensemble models, optimization, ANN, genetic algorithms, lake inflows prediction

MULTI-SCALE FINITE ELEMENT SOLUTION FOR CARDIAC MUSCLE CONTRACTION

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Summary: Modeling of intricate and complex biological processes, such as muscle contraction, has proved to be an exceedingly challenging task. There are many conditions and attributes to be considered, such as accuracy, level of approximation, computational complexity or execution time, for the purpose of creating a model powerful enough to give satisfactory results in a reasonable time frame. More realistic models of muscle contraction take into consideration the vast range of aspects that affect muscle function, from 3D sarcomere geometry, calcium activation and the actomyosin cycle, to elasticity of the filaments, etc. Unfortunately, simulations that depend on such models are most often based on stochastic methods and are computationally extremely demanding. Therefore, using such models for muscle behavior prediction as micro-scale models coupled with more complex multiscale (continuum) models is not feasible. Consequently, it is necessary to utilize a micro model that will produce results that are comparable with the ones that complex stochastic models provide, but significantly simplified, hence executable within an acceptable time. This paper focuses on the implementation of micro model based on the models developed by Rice and Campbell into finite element multi-scale model. In each finite element (FE) iteration, the micro model in every integration point receives deformation and activation from macro model. Based on this information, micro model performs transition to the end of the FE time step and provides the macro model with active stress and stiffness, which represent its reaction to the given stimuli and conditions. To make this couplings simulation execution attainable in an acceptable computational time, a parallelization platform, Mexie, was used. The indicated approach reinforced by the parallelization technique has proved to provide prediction of muscle tissue behavior within a reasonable time frame.

Keywords: muscle modelling, multi-scale, finite elements, parallelization

MODELING OF NBTI DEGRADATION IN P-CHANNEL VDMOSFETS

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Summary: This paper gives insight in reliability of p-channel VDMOSFET power transistors subjected to NBT stressing. Effects that lead to degradation of characteristics of these electronic circuits are presented, out of which threshold voltage shift with NBT stressing is further analised. Measurements have been done and experimental results of the threshold voltage degradation of power transistors IRF9520 caused by different types of negative bias temperature stressing are shown. Stressing types, both static and pulsed, and their impact on transistors, especially on threshold voltage shifts have been explained in more details. An elementary equivalent electrical circuit is designed and proposed with the goal to model impact of both types of stressing, and also to calculate and estimate reliability of the circuit under specified stress. All of the elements of the modeling circuit and their dependencies are explained. Example of modeling from the experimental data is given together with the comparison between measured and modeled results. Differences between obtained results are discussed.

Keywords: reliability, VDMOS power transistors, threshold voltage, modeling

PROBABILITY OF HAZARD INITIATION IN INCIDENT SITUATIONS WITH VEHICLES TRANSPORTING DANGEROUS GOODS BY ROAD – CASE STUDY: CITY OF BELGRADE

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Summary: In the paper, 182 incident situations with the intervention of Directorate for Fire and Rescue Units and Civil Protection (Department for Control of Operation of Fire-Rescue Units) on the territory of the city of Belgrade from 2005 to 2015 were analyzed, and a detailed analysis was carried out for road transport and vehicles, commercial vehicles and passenger vehicles using dangerous substances as propulsive energy. For each incident situation in road transport, 69 of them, the basic hazard characteristics of each good were analyzed in order to determine the probability of their occurrence. The analysis of incident situations by classes of dangerous goods was carried out and the presence of Class 2, 3, 8 and 9 substances was determined, with the highest share of Class 3 - flammable gases (59.42%). Decomposition of incident situations was performed according to the type of vehicles, which determined a high share of passenger cars (leakage of dangerous substances from their tanks and installations), with a share of 39.13%. A distribution of all incident situations was formed according to the classification codes present, which served as an input for the event tree to determine the probability of each hazard initiation. The highest probability of initiation of a fire hazard without associated hazards was found to be 0.8695. Other hazards have a much lower probability of occurrence, regardless of whether they have accompanying hazards after the initiation of the primary hazard.

Keywords: probability, hazard, dangerous goods, incident situation, vehicle

EXPERIMENT PLANNING FOR PRELIMINARY ASSESSMENT OF THE MATHEMATICAL MODEL OF AN UNPOWERED AIR GLIDER BOMB

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Summary: This paper aims to present a simple approach of estimating limitations imposed by unpowered air glider bomb design from the practical perspective of the controller implementation, before attempting to perform an initial mathematical model verification. For a given mathematical model, we found optimal constant and time-varying angle-of-attack for achieving maximum flight path length. Controller parameters are chosen, taking into account actuator limitations, wind action, and model uncertainties. Simulation results of the glider flight with off-the-shelf autopilot are given.

Keywords: unpowered glider, experiment planning, model verification

ORCHID SPECIES ANACAMPTIS MORIO AS A POTENTIAL BIOREMEDIATOR OF AS, CD AND PB

Ivana Mikavica[1], Dragana Ranđelović[1], Vladan Đorđević[2], Gordana Gajić[3], Jelena Mutić[4]

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Summary: In this study concentration of toxic elements As, Cd, and Pb was determined in different soil types and belonging orchid species Anacamptis morio vital parts, in order to examine accumulation patterns and provide new insights about potential use of this orchidin bioremediation technology. The soilsdeveloped on limestone, serpentine, and the chert were subjected to the BCR sequential extraction. Samples of orchid root and tuber, as underground parts, and stem, leaves, and inflorescence, as above-ground organs, were also analyzed for content of As, Cd and Pb. During this research, it was observed that metal content in soil is directly proportional to its content in the plant, more specifically in roots, which suggest that A. morio can potentially be used in phytostabilization of contaminated sites.Values for BCF factors showed Cd immobilization in roots regardless of the soil type. Certain level of arsenic was trasfered from root to leaves indicating potential for accumulation of this element into aboveground organs.Assessment of the phytoremediation potential of this orchidor another plant species from diverse environments is important as it provides information about possibility of their future application in environmental remediation programs.

Keywords: toxic metals, orchid, bedrock, bioremediation, BCR fractions

THE INFLUENCE OF LONG-RANGE CORRELATED GROWTH SIGNALSON THE EVOLVING COMPLEX NETWORK STRUCTURES

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Summary: The application of wireless sensor networks (WSN) grows by the day. It is not surprising that methods for the design of energy-efficient and resilient WSN are one of the critical tasks for scientists working in this field. Complex network theory provides methods for studying and designing WSN. Models of complex networks are an efficient tool for uncovering mechanisms that can lead to networks with desired structural and dynamical properties. The main ingredients of a network model are growth and linking rules. The connection between linking rules and emergent topologies of complex networks has been extensively studied. On the other hand, how the properties of growth signal influence the structure of generated networks is still unknown to a large extent. Here we explore how the temporal correlation in growth signals change the structure of the networks with ageing nodes. We find that scale-free networks grown with time-varying signals have different global and local properties compared to ones grown with the constant signal. Signals with long-range correlations change the structure of the networks more than signals similar to white noise. Our results imply that growth signals and their properties need to be considered in the modelling of real complex networks, including WSN.

Keywords: complex networks, complex networks models, time-varying growthsignals

EFFECT OF CORN STRAW PRETREATMENT ON EFFICIENCY OF BIOGAS PRODUCTION PROCESS - COMPUTER SIMULATION

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Summary: Anaerobic digestion is a natural process of organic material degradation by different kinds of microorganisms in the absence of oxygen. This process is used for industrial purpose to manage waste streams or to produce biogas. It gives a major contribution in reduction of harmful effects of organic waste disposal to the environment. The aim of agricultural waste pretreatment in biogas production is to decrease the retention time, improve utilization of raw material and improve the overall productivity and energy efficiency of the production process. In this paper the effects of combined chemical and mechanical pretreatment of corn straw biomass on biogas yield during anaerobic digestion of the feedstock were analyzed. The impact of pretreatment and process parameters in biogas production was analyzed by process simulation using the software SuperPro Designer. Using this tool a decrease of degradation time with an increase in biogas yield was shown.

Keywords: biogas, anaerobic digestion, pretreatment, energy efficiency, SuperPro Designer

SUSTAINABLE MINING TOWARDS ACCOPLISIHNG CIRCULAR ECONOMY PRINCIPLES

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Summary: Today human society is already witnessing rapid depletion of non-renewable ore resources. As the distribution of raw material resources globally is very off-balance, and preassure on environment as the consequence of ore exploatation is not negligible, re-utilization and recycling of industrial side-streams gaining on importance. Finding new potentially anthropogenic resources of material (at first place critical raw materials) are inline with sustainable waste management goals, and in correlation with boundaries given by the circular economy principles. Side-streams from mines can become source for recovery of these materials. The aim of this paper was to analyze position of mining waste in correlation with circular economy principles, as well potential for implementation of them within extraction industry in the Republic of Serbia.

Keywords: mine waste, raw materials, circular economy

TOPSIS MULTI-CRITERIA DECISION MAKING METHOD FOR PELLETIZED FLY ASH PARAMETERS SELECTION

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Summary: The paper presents the potentials of multi-criteria decision making methods application in the field of sustainable solution to waste problems. To demonstrate applicability of multi-criteria decision making methods, the fly ash pellets parameters selection was analyzed. Three selected size fractions of pelletized fly ash, from power plant Nikola Tesla – B, Obrenovac, obtained at different amounts of the binder were used for analysis. Physical-mechanical properties of pellets samples are presented. Firstly, the criteria weighting was performed by the AHP method, and afterwards a decision model using the TOPSIS method was applied. Fly ash pellets were ranked and obtained results implied that the best pellet quality was found for parameters which include the mean diameter of 11.21 mm and 8.36 mm, respectively, and ompressive strength value of 6 MPa.

Keywords: TOPSIS–MCDM, fly ash pellets valuation, cement, strength, concrete

EVALUATION OF FRUIT QUALITY OF TWO AUTOCHTHONOUS APPLE CULTIVARS SUITABLE FOR WIDESPREAD PRODUCTION

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Summary: Autochthonous apple cultivars are mainly grown in extensive orchards. Due to their resistance to pathogens, frost and summer droughts, they should be considered for more intensive organic and integrated production. Since autochthonous cultivars represent valuable source of genetic variability, they contribute to biodiversity and stability of ecosystems. Nevertheless, fruit of autochthonous cultivars is abundant in health-protecting compounds. Thus, the objective of this study was to analyze the fruit quality of two autochthonous apple cultivars, 'Bobovec' and 'Kolačara', in comparison to 'Morrens Jonagored', one of the most commercially important cultivar. The obtained results indicate that examined autochthonous cultivars contained higher amount of soluble solids, total acids and total phenolics. Although 'Bobovec' had the smallest fruit, it exhibited the highest antioxidant capacity and contained the highest concentration of health-beneficial phenolic compounds.

Keywords: 'Bobovec', 'Kolačara', pomological characteristics, chemical properties, bioactive compounds

AUTOMATIC SEGMENTATION OF LUNGS WITH PNEUMONIA IN X-RAY IMAGES OF PATIENTS WITH COVID-19

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Summary: Some of the features for the novel coronavirus (COVID-19) are severe acute respiratory illnesses with respiratory symptoms including pneumonia. Main motiviation for automatic segmentation and classification of patient images suffering from COVID-19 is reduction of false positive rate to avoid further increasing the burden on the healthcare system. Proper and accurate detection ofdisease would help to provide timely and adequate treatment for the patients affected by COVID-19. Main imaging techniques for pneumonia are CT and X-ray, above which artificial intelligence methods could be added to provide automatic discease detection. Traditional method based on thresholding or active contouring are unable to perform segmentation accurately due to small image contrast and tissue bone overlap (ribs are located over the soft tissue in the lungs area).These limitations, can be overcome usingdeep learning methods such as convolutional neural networks. Up to this date, no high accuracy method been developed yet to detect COVID-19 pneumonia, we propose U-net to segment the area of lungs. Dataset consisted of 196 radiological images from 25 patients diagnosed with COVID-19.Available dataset was divided into training, validation and testing subsets, for proper learning of the unique features and testing on the unknown images. Results showed that proposed U-net is able to segment lungs well, achieving the dice coefficient of 90.5%. Futureresearch will be directed towards prediction of patient condition in time in order to prescribe adequate treatment timely and in advance.

Keywords: COVID-19 pneumonia, automatic segmentation, U-net, convolution neural networks

ADJUSTING PH PZC VALUE DURING AND AFTER ADSORBENT PREPARATION

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Summary: Point of zero charge (PZC) is one the most valuable parameter of adsorbent preparation process, in wastewater management. Although, this parameter may be determined measuring the electrokinetic potential (zetta potential) as the function of pH; material engineers oftenrely on pH PZC value which may be easily determined and can give usefuladsorbent properties duringexploitation. Samples from previous study are characterized and their pH PZC values are determined. Provided results are such intriguing since they brought conclusions that those values can be explained by process parameters of the particular sample preparation. Sample marked as Cr_2O_3/Fe_3O_4/EVer have lowest pH PZC value (4.75) and sample marked as $MnFe_2O_4$/EVer highest pH PZC value (7.47). Another study in this paper showed that pH PZC value could be easily increased or decreased by simple base or acid treatment, respectfully. As expected, samples treated with bases or prepared in alkali medium have greater adsorption capacity towards cation species, up to 20 % more than base material in the case $MnFe_2O_4$/EVer.

Keywords: mine waste, raw materials, circular economy

METHOD FOR ACQUISITION AND ANALYSIS OF OPERATING PARAMETERS OF A SUPERCAPACITOR ELECTRIC BUS

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Summary: Reducing the air pollution is one of the main reasons for increased usage of electric buses in city public transport around the world. As a result, reducing the energy consumption of electric buses is becoming increasingly important. One of the most effective ways to reduce energy consumption, and therefore increase vehicle autonomy,is proper driver education.Based on the conducted analysis, it can be seen that the most of researches deal with the estimation of the energy consumption in electric vehicles with the help of mathematical models and simulations, while, on the other side, majority of testing was conducted in laboratory conditions, on chassis dynamometers. This paper presents the method for acquisition and analysisof operating parameters of the electric bus that uses a supercapacitor as anenergy source. This method was used during the testing of electric bus in real operating conditions, and on a test track where different driving cycles were performed. Data acquisition was conducted by using the existing CAN bus data and someadditional sensors.By analysing the collected data, it is possible to determine the impact of different driving styles on the efficiency of the electric bus and, based on that, to define the recommended driving style. Also, the collected data can be used for determination of the energy consumed/recuperatedduring different driving regimes.

Keywords: electric buses, energy efficiency, energy consumption

AN OVERVIEW OF NATIONAL AND INTERNATIONAL STANDARDS FOR EVENT DATA RECORDERS (EDRs) ON MOTOR VEHICLES

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Summary: Point of zero Technological progress in the last two decades have led to the rapid development of various mechatronic systems on the vehicles. On the other hand, a significant increase in the number of vehicles participating in traffic has led to an increase in the number of traffic accidents, with an increasing number of fatalities, but also increasing material damage and high pressure on insurance companies for more accurate analysis of traffic accidents. This has led to the development of devices for recording event data on motor vehicles, in order to obtain real data about the condition of the vehicles in a short period of time before a traffic accident, but also the conditions under which the traffic accident occurred. The development and increasing application of such devices has necessarily led to the implementation of appropriate international regulations, in order to achieve their unification and standardization, aiming to obtain data that can be easily read and analyzed, regardless of vehicle models or devices itself. The paper presents the current situation in terms of national and international regulations. Special importance was given to the very beginnings of the regulations, first national and then official international regulations, shaped into the relevant UN Regulation. Also, a detailed analysis of the data that are the subject of regulations is given, with explanation what kind of data is recorded and in what way. Deadlines for mandatory application of regulations were commented. At the end, guidelines and predictions for the improvement of this area in the future were given, with emphasis on supporting the application of such devices by insurance companies

Keywords: event data recorders, traffic accident, international regulations, insurance companies

EFFECT OF PATIENT SPECIFIC YOUNG'S MODULUS ON MECHANICAL BEHAVIOUR OF CORTICAL FEMORAL BONE – A FINITE ELEMENT STUDY

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Summary: Finite element analysis has been used for decades to analyze the mechanical behaviour of bones. The aim of this study was to the determine mechanical behaviour of cortical femoral bone when patient specific Young's modulus is used. Two cases were analyzed, where the displacement of femoral bone was compared. In both cases, boundary conditions were the same, while different material properties were considered. The first case used Young's modulus obtained from the literature while the second case considered patient specific modulus. In order to use more realistic material properties and improve results of numerical simulation, Young' modulus of cortical femoral bone was determined using computed tomography numbers. The same CT scans were used to create a Finite element model of cortical femoral bone, which was used for numerical simulations. In both cases femoral cortical bone was considered to be homogeneous, linear elastic with isotropic properties.

Keywords: Finite element analysis, femoral bone, young's modulus, patient specific

DIGITAL AGRICULTURE AS A FACTOR OF ENERGY EFFICIENCY AND ENVIRONMENTAL PROTECTION

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Summary: In conditions of enormous pressure on nature's resources on the one hand and the imperative to increase the production of agricultural products, the contemporary social systems can only use smart solutions to rationalize resources and apply new technological solutions in order to achieve efficiency in energy usage and to protect already disturbed natural resources. We examined the benefits and impacts of digital agriculture implementation as factor of energy efficiency and environmental protection. Digitalisation in agriculture refers to tools that digitally collect, store, analyze, and share electronic data and/or information along the agricultural value chain and could improve profitability and employment. Aim of the research paper is to examine the potential of digitalisation in agriculture, in order to achieve increased agricultural productivity, cost efficiency and inclusivity of new technologies. Also, we wanted to point out the environmental benefits through optimized resource usage, as well as adaptation to new needs of sustainable economy. Through the research and analysis of strategies, action plans and ongoing project, we aggregated the examples of good practice as a step to still unanswered questions and gaps in field of factors which contributes to efficient use of energy and environmental protection. Usage of resources and energy with implementation of digital agriculture systems is highly optimized, individualized, smart and anticipatory. Digital agriculture will create systems that are highly productive, anticipatory and adaptable to changes especially as those caused by overuse of energy and natural resources.

Keywords: digital agriculture, innovation, knowledge management, entrepreneurship, sustainable economy

COMPARISON OF STANDARD, SLIM AND ROLL-YOUR-OWN CIGARETTES BY MEASURING LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN MAINSTREAM CIGARETTE SMOKE WITH GAS CHROMATOGRAPHY–MASS SPECTROMETRY

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Summary: Finite Cigarette smoke is made of different substances, polycyclic aromatic hydrocarbons being one of them. PAHs are environmental polutants, and in case of cigarettes, they are created by combustion of tobacco. We measured levels of PAHs in mainstream smoke of three kinds of cigarettes – standard, slim and roll-your-own , for purpose of comparison, all smoked by a person instead of being smoked by a machine, for more realistic results. For quantification of PAHs we used gas chromatography-mass spectometry.

Keywords: Gas chromatography-mass spectrometry, PAHs, cigarette smoke

PREDICTING THE TYPE OF PHYSICAL ACTIVITY FROM TRI-AXIAL SMARTPHONE ACCELEROMETER DATA

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Summary: Development of various statistical learning methods and their implementation in mobile device software enables moment-by-moment study of human social interactions, behavioral patterns, sleep, as well as their physical mobility and gross motor activity. Recently, through the use of supervised Machine Learning, human activity recognition (HAR) has been found numerous applications in biomedical engineering especially in the field of digital phenotyping. Having this in mind, in this research in order to be able to quantify the human movement activity in situ, using data from portable digital devices, we have developed code which uses Random Forest Classifier to predict the type of physical activity from tri-axial smartphone accelerometer data. The code has been written using Python programing language and Anaconda distribution of data-science packages. Raw accelerometer data was collected by using the Beiwe research platform, which is developed by the Onnela Lab at the Harvard T.H. Chan School of Public Health. Tuning has been performed by defining a grid of hyperparameter ranges, using Scikit-Learn's Randomized Search CV method, randomly sampling from the grid and performing K-Fold CV with each combination of tested values. Obtained results will enable development a more robust models for predicting the type of physical activity with more subjects, usage of different hardwares, various test situations, and different environments.

Keywords: Mashine learning, Digital phenotyping, Human activity recognition

MISSING DATA REPRESENTATION BY PERCEPTION THRESHOLDS IN FLOOD FLOW FREQUENCY ASSESSMENT

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Summary: Flood flow frequency analysis (FFA) plays one of the key roles in many fields of hydraulic engineering and water resources management. The output of the FFA are sets of flood quantiles which are the base for the next step of the flood related analyses. The reliability of these results depends of many factors, and the first one is the reliability of the input data - datasets of the annual peak flow. In practice, however, engineers often encounter the problem of incomplete datasets (missing data, data gaps and/or broken records). In this paper, we perform at-site focused analysis, and a complete dataset of annual peak flows from 1931 to 2016 at the hydrologic station Senta of the Tisa river we use as the reference dataset. From this original dataset we remove some data and thus we obtain 15 new series that have gaps of different lengths and locations. Each dataset we further subject to flood frequency assessment using USACE HEC-SSP Bulletin 17C analysis, which introduces the concept of „perception threshold" that can be used for missing data representation. For the data representation in HEC-SSP we use infinity for perception threshold upper bound and different lower bounds for all missing flows in one dataset, so that we create 56 variants of input HEC-SSP datasets. The flood flow quantiles assessed from the datsets with missing data and different perception thresholds we evaluate through percentage error relative to the reference dataset and confidence interval width as uncertainty measure. The results for datasets with one gap up to 23% of the observation period, indicate acceptable flood quantile estimates are obtained even for larger return periods, by setting a lower perception threshold bound at the value of the highest observed flow in the available series of annual maxima.

Keywords: Flood flow frequency analysis, Bulletin 17C, perception thresholds, missing data, HS Senta

APPLICATION OF UAS IN LAND COVER DETECTION AND CLASSIFICATION IN RURAL AREAS

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Summary: Planning, administration, and protection of our environment rely on accurate information on land cover. Gathering detailed information and data on a large scale may take a lot of time, especially if the area of interest is in hard to reach and rural areas. The application of remote sensing techniques can save a lot of time and provide very good data. Most of the remote sensing data come from satellites and planes. To be able to collect and process data on-demand and independently, unmanned aerial vehicles or drones are the most time and cost-effective solutions. This paper examined the possibility of application of commercial and off-the-shelf drones for detailed data collection in rural areas. It also examined the use of this data for fast and high-precision land cover detection and classification. This resulted in a definition of workflow procedures for the application of drones in land cover identification. This workflow connected several procedures and data processing techniques. From data gathering in the field to the information extraction for further application in land use management in GIS software. Another important aspect is the use of machine learning techniques. This minimized the manual work in feature extraction and classification. This improved the quality of the information, accuracy, reduced the possibility of bias interpretation, and reduced the overall time needed for the production of information.

Keywords: UAS, land cover classification, remote sensing, OBIA

SOME ASPECTS ON THE DESIGN APPROACHES FOR BOLTED MOMENT CONNECTIONS IN FRAMES

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Summary: The end-plate bolted connections are widely used in the construction of metal buildings and steel portal frames and play a crucial role in the safety of steel structures. Studies agreed that joint rotational behavior should be considered in frame analysis due to the fact that majority of these joints are semi-rigid. This paper gives a survey on the progress in this topic, based on the studies in the last decade and main design approaches which are analytical, numerical and experimental. There are noted some principal characteristics of each method, along with some advantages and disadvantages. The illustrative example is given to describe the situation when all the mentioned methods are included on the single joint. It is proposed, as a good practice, to propose analytical model in that way to comply with experimental verification and to use numerical model in the form of validation in the last stages of joint design. Finally, it is noted that joint behavior under monotonic or cyclic loading, within the scope of the ductile failure modes of the joint, can be controlled with the design parameters of the end-plate and bolts.

Keywords: survey, end-plate joint, semi-rigid, moment-rotation, design method

REVIEW, SYSTEMATIZATION AND APPLICATION OF THE STANDARDS FOR ASSESSMENT OF STATIC AND FATIGUE STRENGTH OF METAL CRANE STRUCTURES

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Summary: The primary goal of this paper is to present different standards used in the numerical analysis of static and fatigue strength of metal structures. With the progress and improvement of standards, the requirements of employers are also constantly changing. Hence the idea to show difference between standards for the same type of structures by showing the procedure of application of different standards on the example of a crane, the structure of complex geometry. The most commonly used standards for crane analysis are FEM 1.001, BS EN 13001 and Eurocode 3. After analysis and review of standards in the field of crane structures, all types of loads that structure has to withstand in terms of static and fatigue strength are presented in detail. Safety factors were determined according to the prescribed criteria and an overview of permissible stress values is made by using different standards. In that way, it was possible to use the developed methodology to assess the integrity of the crane exposed to different types of loads. The obtained permissible stress values according to the mentioned standards and the calculated stress values obtained by numerical analysis in the finite element method based software Femap with NX Nastran were compared and given in this paper. The information provided in this paper can be used as a basis for a deeper and more detailed study in this area and its practical application.

Keywords: numerical analysis, crane, FEM 1.001, BS EN 13001, Eurocode 3

USING DIFFERENT TYPES OF FINITE ELEMENTS FOR NUMERICAL SIMULATIONS OF BUFFING IMPACT TESTS OF FREIGHT WAGONS

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Summary: The end-plate bolted connections are widely used in the construction of metal buildings and steel portal frames and play a crucial role in the safety of steel structures. Studies agreed that joint rotational behavior should be considered in frame analysis due to the fact that majority of these joints are semi-rigid. This paper gives a survey on the progress in this topic, based on the studies in the last decade and main design approaches which are analytical, numerical and experimental. There are noted some principal characteristics of each method, along with some advantages and disadvantages. The illustrative example is given to describe the situation when all the mentioned methods are included on the single joint. It is proposed, as a good practice, to propose analytical model in that way to comply with experimental verification and to use numerical model in the form of validation in the last stages of joint design. Finally, it is noted that joint behavior under monotonic or cyclic loading, within the scope of the ductile failure modes of the joint, can be controlled with the design parameters of the end-plate and bolts.

Keywords: survey, FEM simulations, buffing impact tests, explicit analysis

BONDING ABILITY OF MAGNESIUM DOPED HYDROXYAPATITE BASED INSERT WITH CLEARFIL DENTAL ADHESIVE

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Summary: Decayed or damaged tooth structure is widely being repaired with the resin based dental composites (RBCs) in the clinical practice. However, relatively high failure rate and short lifespan are common in the case of the larger posterior teeth restorations, caused by the polymerization shrinkage of RBCs. In order to reduce the polymerization shrinkage inorganic dental inserts were introduced. The aim of this study was to fabricate dental inserts based on hydroxyapatite doped with 5 mol. % of magnesium ions (MgHAP) and determine their bonding ability with a restorative material widely used in the clinical practice – Clearfil Universal adhesive. The MgHAP powder and insert were characterized using energy dispersive X-ray (EDX) analysis, X-ray diffraction (XRD) analysis and scanning electron microscopy (FE-SEM). Bonding ability of the inserts with restorative material was measured by shear bond strength (SBS) test, and the type of fracture was determined by the optical microscope. The obtained mean SBS value of the MgHAP inserts was 12.7 MPa, with mostly cohesive type of the fracture present. These inserts present promising dentin substitutes for application in the restorative dentistry.

Keywords: hydroxyapatite, magnesium, dental insert, shear bond strength, restorative dentistry

COMPLEX CORE-SHELL STRUCTURED CARBON FIBERS@Co2MnO4 COMPOSITE AS SUPERCAPACITOR ELECTRODE

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Summary: In this work, a facile single-spinneret co-electrospining method combined with proper thermal treatment is employed to synthesize core-shell carbon fiber@Co_2MnO_4 composite material. Field emission scanning electron microscopy (FE-SEM) micrographs revealed the fibrous structure of composite with average diameter of 187±4 nm with nanocrystals covered on carbon surface. Fourier transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD) analyses of composite material confirmed that nanocrystals are made of cubic Co_2MnO_4 spinel phase. The high specific capacitance of about 235 F g^{-1}, at a sweep rate of 10 mV s^{-1}, is achieved in three-electrode (3E) cell. Moreover, composite electrode exhibited high capacitance in the two-electrode (2E) cell, up to 141 F g^{-1}, at a sweep rate of 10 mV s^{-1}, as well as excellent stability of 90 % after 1000 charge/discharge cycles. The experimental demonstration of the composite electrode performances makes this material very promising in supercapacitors applications.

Keywords: co-electrospinning, carbon, Co_2MnO_4, composite fibers, supercapacitor

DIP-COATING OF THE BIOACTIVE GLASS AND HYDROXYAPATITE ON 3D PRINTED Ti6Al4V SCAFFOLD FOR BONE TISSUE ENGINEERING

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Summary: Coating of the porous 3D-printed metallic implants, for the restoration of critical bone defects in orthopedic and craniofacial surgery, remains a challenge as most of the established surface modification procedures are suitable only for 2D nonporous materials. In this study, a bilayer of synthesized bioactive glass 6P57 and hydroxyapatite (HAP) was deposited on a porous Ti6Al4V scaffold by dip-coating method. The obtained materials were analyzed by thermal microscope and field emission scanning electron microscopy (FESEM). FESEM micrographs reveal that both outer and inner parts of titanium scaffold were uniformly covered with glass with immersed HAP agglomerates. Our results suggest that the dip-coating method applied for the deposition of double-layered bioactive glass and HAP coating is a promising approach to obtain homogenous coatings covering the complete surface of the 3D-printed Ti scaffold.

Keywords: dip-coating, 6P57, HAP, titanium, 3D, coatings

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