

NT-2026

**NEW TECHNOLOGIES
DEVELOPMENT
AND APPLICATION** | **NOVE TEHNOLOGIJE
RAZVOJ
I PRIMJENA**

BOOK OF ABSTRACTS KNJIGA SAŽETAKA

Editors: Isak Karabegović, Ahmed Kovačević, Sead Pašić, Sadko Mandžuka



Sarajevo
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25th-27th June 2026
NT-XII, Br-XII

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AKADEMIJA NAUKA I UMJETNOSTI
BOSNE I HERCEGOVINE
DRUŠTVO ZA ROBOTIKU
U BOSNI I HERCEGOVINI
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BOOK OF ABSTRACTS

KNJIGA SAŽETAKA

”NT-2026“

**NEW TECHNOLOGIES - DEVELOPMENT AND
APPLICATION**
NOVE TEHNOLOGIJE - RAZVOJ I PRIMJENA

Sarajevo, Bosnia and Herzegovina, 25th-27th June 2026, NT-XII, Br-XII.
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NEW TECHNOLOGIES - DEVELOPMENT AND APPLICATION „NT-2026“

Word of the organizers

Technological development in the last decade has significantly transformed the way industry, science, and society function. Digital transformation, artificial intelligence, robotics, intelligent manufacturing systems, and sustainable technologies have become key drivers of modern economic and social development. In such an environment, there is an increasing need for stronger cooperation between the scientific community, educational institutions, and industry in order to enable faster knowledge transfer, innovation development, and their practical implementation. The International Conference New Technologies, Development and Applications – NT 2026 continues its mission of bringing together researchers, scientists, engineers, and professionals from various fields with the aim of presenting the latest achievements and exchanging experiences in the area of new technologies and intelligent systems. This year's conference confirms its international character through the large number of authors and institutions from different countries, as well as through the significant expansion of research topics and interdisciplinary approaches. The papers presented within the conference cover a broad spectrum of contemporary research in robotics, mechatronics, automation, intelligent manufacturing, digital technologies, artificial intelligence, cybersecurity, transport systems, energy, sustainable development, economics, and education. Special attention is devoted to the application of intelligent and autonomous systems, digital twins, Industry 4.0 and Industry 5.0 concepts, renewable energy sources, smart infrastructure solutions, and sustainable development models. The value of this conference lies in the fact that it enables the meeting of academia and industrial practice in one place, where scientific discussions and the exchange of ideas create the foundation for new research, projects, and technological innovations. Contemporary challenges require an interdisciplinary approach and continuous cooperation between different technical, natural, and social sciences, and NT conference successfully develops and strengthens such a platform year after year.

The NT-2026 Book of Abstracts provides an overview of current research directions and technological solutions with the potential to significantly improve industrial processes, digital transformation, and sustainable social development. It is particularly encouraging that a large number of papers include practical applications of new technologies and concrete solutions oriented toward the modern needs of industry and society. We would like to express our sincere gratitude to all authors, reviewers, members of the scientific and organizing committees, as well as partner institutions and companies that supported the organization of the NT-2026 conference. We are confident that the presented papers, scientific discussions, and established collaborations will contribute to the further development of new technologies and strengthening of international scientific and professional cooperation.

Sarajevo, June, 2026

**Chairman of the Organizing Committee
Prof. Dr. Isak Karabegović**

NOVE TEHNOLOGIJE - RAZVOJ I PRIMJENA „NT-2026“

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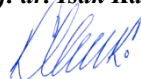
Tehnološki razvoj u posljednjoj deceniji značajno je promijenio način funkcioniranja industrije, nauke i društva. Digitalna transformacija, umjetna inteligencija, robotika, inteligentni proizvodni sistemi i održive tehnologije postaju ključni pokretači savremenog ekonomskog i društvenog razvoja. U takvom okruženju javlja se potreba za snažnijim povezivanjem naučnoistraživačke zajednice, obrazovnih institucija i industrijskog sektora kako bi se omogućio brži prijenos znanja, razvoj inovacija i njihova praktična primjena. Međunarodna konferencija New Technologies, Development and Applications – NT 2026 nastavlja svoju misiju okupljanja istraživača, naučnika, inženjera i stručnjaka iz različitih oblasti s ciljem predstavljanja najnovijih dostignuća i razmjene iskustava u području novih tehnologija i inteligentnih sistema. Ovogodišnja konferencija potvrđuje svoj međunarodni karakter kroz veliki broj autora i institucija iz različitih zemalja, kao i kroz značajno proširenje istraživačkih tema i interdisciplinarnih pristupa. Radovi predstavljeni u okviru konferencije obuhvataju širok spektar savremenih istraživanja iz oblasti robotike, mehatronike, automatizacije, inteligentne proizvodnje, digitalnih tehnologija, umjetne inteligencije, cyber sigurnosti, transportnih sistema, energetike, održivog razvoja, ekonomije i obrazovanja. Posebna pažnja posvećena je primjeni inteligentnih i autonomnih sistema, digitalnih blizanaca, Industry 4.0 i Industry 5.0 koncepata, obnovljivih izvora energije, pametnih infrastrukturnih rješenja i održivih modela razvoja. Vrijednost ove konferencije ogleda se u činjenici da omogućava susret akademske zajednice i industrijske prakse na jednom mjestu, gdje se kroz naučnu diskusiju i razmjenu ideja stvaraju temelji za nova istraživanja, projekte i tehnološke inovacije.

Savremeni izazovi zahtijevaju interdisciplinarni pristup i kontinuiranu saradnju između različitih tehničkih, prirodnih i društvenih oblasti, a upravo takvu platformu NT konferencija uspješno razvija i unapređuje iz godine u godinu.

Knjiga sažetaka NT-2026 pruža pregled aktuelnih istraživačkih pravaca i tehnoloških rješenja koja imaju potencijal značajno unaprijediti industrijske procese, digitalnu transformaciju i održivi razvoj društva. Posebno ohrabruje činjenica da veliki broj radova uključuje praktične primjene novih tehnologija i konkretna rješenja usmjerena prema savremenim potrebama industrije i društva. Zahvaljujemo svim autorima, recenzentima, članovima naučnog i organizacionog odbora, kao i partnerskim institucijama i kompanijama koje su podržale organizaciju konferencije NT-2026. Uvjereni smo da će prezentirani radovi, naučne diskusije i ostvarene saradnje doprinijeti daljem razvoju novih tehnologija i jačanju međunarodne naučne i stručne saradnje.

Sarajevo, juni 2026. godine

**Predsjednik Organizacionog Odbora
Prof. dr. Isak Karabegović**



PREFACE

Modern industrial and social systems are undergoing intensive transformation driven by the rapid development of digital technologies, artificial intelligence, robotics, and intelligent manufacturing processes. Global markets are becoming increasingly dynamic and competitive, while companies and institutions are expected to demonstrate greater flexibility, innovation, and the ability to adapt quickly to technological changes. At the same time, the growing demands for sustainable development, energy efficiency, digital security, and responsible resource management further increase the need for the implementation of advanced technological solutions and interdisciplinary approaches. The industry of the future is no longer based solely on production automation, but on the integration of intelligent systems, cyber-physical technologies, digital twins, autonomous systems, and real-time data analytics. The development of Industry 4.0 and Industry 5.0 concepts opens new opportunities for improving production processes, enhancing product quality, optimizing costs, and creating more sustainable business models. In parallel, modern society faces the need for continuous education and the development of new competencies that will enable the successful implementation of emerging technologies in industry, education, transportation, energy systems, and other fields. The New Technologies, Development and Applications – NT 2026 conference is organized with the aim of creating an international platform for the exchange of scientific achievements, research results, and practical experiences in the field of new technologies and intelligent systems. Special focus is placed on strengthening cooperation between academia, research institutions, and industry through the promotion of innovative solutions and modern technological approaches.

The main objectives of the conference are as follows:

- Strengthening international scientific and professional cooperation in the field of new technologies, intelligent systems, and digital transformation.
- Transfer of advanced technologies, research results, and innovations to industry and the real sector in order to improve competitiveness and sustainable development.
- Promotion of the application of artificial intelligence, robotics, automation, digital twins, and Industry 4.0/5.0 concepts in manufacturing and business processes.
- Encouraging the development of interdisciplinary research and the integration of technical, natural, information, and social sciences.
- Development of new educational approaches and training programs aimed at preparing young professionals for the technologies and occupations of the future.
- Exchange of experiences among researchers, engineers, and industry representatives with the goal of developing innovative and practically applicable solutions.
- Promotion of sustainable technological and energy systems, digital security, and responsible resource management in modern society.
- Raising awareness about the importance of continuous education, lifelong learning, and the development of digital competencies in conditions of accelerated technological progress.

Sarajevo, June, 2026

THE ORGANIZERS



PREDGOVOR

Savremeni industrijski i društveni sistemi prolaze kroz intenzivnu transformaciju uslovljenu ubrzanim razvojem digitalnih tehnologija, umjetne inteligencije, robotike i inteligentnih proizvodnih procesa. Globalna tržišta postaju dinamičnija i konkurentnija, dok se od kompanija i institucija zahtijeva veća fleksibilnost, inovativnost i sposobnost brzog prilagođavanja tehnološkim promjenama. Istovremeno, rastu zahtjevi za održivim razvojem, energetsom efikasnošću, digitalnom sigurnošću i odgovornim upravljanjem resursima, što dodatno povećava potrebu za primjenom savremenih tehnoloških rješenja i interdisciplinarnih pristupa. Industrija budućnosti više nije zasnovana isključivo na automatizaciji proizvodnje, nego na integraciji inteligentnih sistema, cyber-fizičkih tehnologija, digitalnih blizanaca, autonomnih sistema i analize podataka u realnom vremenu. Razvoj koncepta Industry 4.0 i Industry 5.0 otvara nove mogućnosti za unapređenje proizvodnih procesa, povećanje kvaliteta proizvoda, optimizaciju troškova i stvaranje održivijih modela poslovanja. Paralelno s tim, savremeno društvo suočava se s potrebom kontinuiranog obrazovanja i razvoja novih kompetencija koje će omogućiti uspješnu primjenu novih tehnologija u industriji, obrazovanju, transportu, energetici i drugim oblastima. Konferencija New Technologies, Development and Applications – NT 2026 organizovana je s ciljem stvaranja međunarodne platforme za razmjenu naučnih dostignuća, istraživačkih rezultata i praktičnih iskustava iz oblasti novih tehnologija i inteligentnih sistema. Poseban fokus konferencije usmjeren je na povezivanje akademske zajednice, istraživačkih institucija i industrije kroz promociju inovativnih rješenja i savremenih tehnoloških pristupa.

Osnovni ciljevi održavanja konferencije su sljedeći:

- Jačanje međunarodne naučne i stručne saradnje u oblasti novih tehnologija, inteligentnih sistema i digitalne transformacije.
- Transfer savremenih tehnologija, istraživačkih rezultata i inovacija prema industriji i realnom sektoru radi unapređenja konkurentnosti i održivog razvoja.
- Promocija primjene umjetne inteligencije, robotike, automatizacije, digitalnih blizanaca i Industry 4.0/5.0 koncepta u proizvodnim i poslovnim procesima.
- Podsticanje razvoja interdisciplinarnih istraživanja i integracije tehničkih, prirodnih, informacionih i društvenih nauka.
- Razvoj novih obrazovnih pristupa i edukacijskih programa koji će pripremiti mlade stručnjake za tehnologije i zanimanja budućnosti.
- Razmjena iskustava između istraživača, inženjera i predstavnika industrije s ciljem razvoja inovativnih i praktično primjenjivih rješenja.
- Promocija održivih tehnoloških i energetskih sistema, digitalne sigurnosti i odgovornog upravljanja resursima u savremenom društvu.
- Jačanje svijesti o značaju kontinuiranog obrazovanja, cjeloživotnog učenja i razvoja digitalnih kompetencija u uslovima ubrzanog tehnološkog razvoja.

Sarajevo, juni, 2026. godina

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**ACADEMY OF SCIENCES AND ARTS
OF BOSNIA AND HERZEGOVINA**



Matthias Möller

*Associate Professor of Numerical Analysis,
Delft University of Technology
HOLLAND*

Topic: "QUANTUM COMPUTING FOR COMPUTATIONAL SCIENCE AND ENGINEERING: POTENTIAL, CHALLENGES, AND PATHWAYS TO APPLICATIONS"

Biography:

Matthias Möller is an Associate Professor of Numerical Analysis in the Department of Applied Mathematics at Delft University of Technology (TU Delft), where he serves as the Scientific Director of the TU Delft Institute for Computational Science and Engineering (DCSE). His research bridges mathematical modeling, numerical analysis, and high-performance computing, with a focus on numerical methods for differential equations and their efficient implementation on emerging computing architectures. He has a particular interest in quantum algorithms and their applications in computational fluid dynamics and power flow analysis.

Abstract: Quantum computing (QC) is an emerging compute technology that has the potential to radically change the way we will be solving computational problems in the future. The potential power of QC stems from the exploitation of quantum mechanical principles, namely, superposition of states, entanglement and quantum parallelism. With properly designed quantum algorithms that fully exploit these properties it will be possible to solve certain types of computational problems faster or with less compute resources compared to classical counterparts. However, this requires the complete redesign of the solution procedure from scratch rather than a simple "porting" of classical algorithms to quantum computers. In this talk, I will give an overview of potential applications that might benefit from transitioning to quantum computers at least in parts. I will discuss two particular applications in more detail: The first one is computational fluid dynamics which is omnipresent in engineering and many other disciplines such as biomedical applications and numerical weather forecasting. The second application is power flow analysis and optimization which is at the core of planning and operating electric grid.



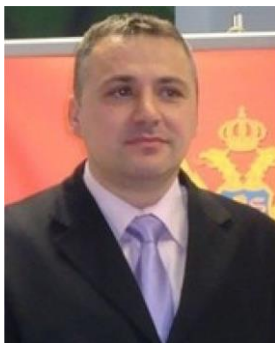
Filiz Ersöz

Ostim Technical University
Ankara
TURKEY

**Topic: "FROM DATA MINING TO DECISION SUPPORT: AI IN
INDUSTRY AND SUSTAINABILITY"**

Biography:

Prof. Dr. Filiz Ersöz is a professor whose research focuses on Artificial Intelligence, Data Mining, Simulation Modeling, and Decision Support Systems, with particular emphasis on sustainable industrial applications. Her scholarly work explores the integration of AI-driven methodologies with simulation and decision support tools to address complex industrial and sustainability challenges. She has published extensively in leading international journals and conferences, contributing to advancements in green supply chain management, carbon performance evaluation, and data-driven optimization. Prof. Ersöz has broad experience in supervising graduate research and leading interdisciplinary projects that bridge theoretical foundations with practical applications. Her current research emphasizes the transformative role of artificial intelligence and simulation modeling in enhancing efficiency, resilience, and sustainability within industrial decision-making processes.



Ramo Šendelj

*University of Donja Gorica
Podgorica
MONTENEGRO*

Topic: "CYBERSECURITY IN HIGHER EDUCATION: NEW HORIZONS OF RISKS AND RESPONSES IN THE ERA OF ARTIFICIAL INTELLIGENCE"

Biography:

Prof. Dr. Ramo Šendelj is a Full Professor and Head of the Cybersecurity Research Group at the University of Donja Gorica (UDG) in Podgorica, Montenegro. His research focuses on cybersecurity, digital resilience, and the application of Artificial Intelligence in information system protection. He has authored and led numerous national and international projects aimed at developing security policies, detecting network traffic anomalies, and strengthening the capacities of higher education institutions in the field of digital security. Prof. Šendelj is the founder of the National Academic CSIRT of Montenegro, through which he actively contributes to developing institutional and technical capacities for responding to cyber incidents in the academic sector. As an expert and researcher, he participates in shaping national cybersecurity strategies and frameworks, promoting collaboration between academia, government, and industry in the field of digital protection.

Abstract: The rapid digital transformation of higher education, accompanied by the increasing use of Artificial Intelligence (AI) in teaching, research, and administrative processes, opens new horizons of risks and threats to the cybersecurity of universities. Academic institutions are becoming particularly vulnerable due to the openness of their networks, data sharing, and complex systems connecting research, teaching, and management infrastructures. At the same time, AI offers new opportunities for enhancing threat detection, predictive analytics, and automated incident response. This lecture will explore key trends in cybersecurity within higher education, analyze the challenges brought by the era of Artificial Intelligence, and present strategic approaches and resilience models that can ensure data protection, system integrity, and trust in the digital environment of universities.



Robert Rijavec

Faculty of Civil and Geodetic Engineering
University of Ljubljana
SLOVENIA

**Topic: "THE ROLE OF NETWORKING IN INTELLIGENT
TRANSPORTATION SYSTEMS AND SERVICES"**

Biography:

Robert Rijavec has nearly 30 years of experience in road planning and design, as well as in the application of geographic information systems in transportation engineering. Over the past two decades, he has focused particularly on Intelligent Transport Systems and Services (ITS) on Slovenian roads and in tunnels. During this time, he has led numerous ITS projects, including the Slovenian national ITS architecture SITSA, the National Traffic Management Centre ITS architecture framework, and the SEE-ITS initiative as part of South-Eastern Europe. He is proud to be both a member and the president of the Slovenian ITS Association, as well as a member of the Slovenian Chamber of Engineers. He currently works in the field of Traffic Engineering at the University of Ljubljana, Faculty of Civil and Geodetic Engineering, where he also serves as the Head of the Traffic Technical Institute.

Abstract: Almost twenty years ago, to connect Slovenia with the pan-European transport network, the Slovenian ITS Association - ITS Slovenia was established. Since then, it has actively contributed to the development and implementation of Intelligent Transport Systems and Services (ITS) in Slovenia and the European Union as the non-profit professional organisation. Today, ITS Slovenia unites sixteen legal entities and over fifty individual members, supported by the Electrotechnical Association of Slovenia as a technical society. As an active member of Network of National ITS Associations - ITS Nationals, it collaborates with similar organizations across Europe. The Ministry of Infrastructure serves as the national authority for ITS, linking ministries, municipalities, and private stakeholders. This paper presents the role and purpose of ITS Slovenia within the national and European ITS community, outlines its key achievements, and looks ahead to future developments. In Europe, the future of ITS will focus on interoperability, harmonised standards, and seamless cross-border data and service integration.

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THE IMPACT OF DIGITAL PHOTOGRAPHY CHARACTERISTICS ON THE PERFORMANCE OF FACIAL RECOGNITION ALGORITHMS

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ABSTRACT:

The paper analyzes the impact of digital photography properties on the performance of face recognition algorithms. The results of the analysis show that the quality of the input image has a direct and measurable impact on the accuracy, stability, and speed of the system. We compared performance of two algorithms - MediaPipe and Haar Cascade - through practical implementation and experimental tests on a set of images of different resolutions, brightness, contrast, blur, and JPEG quality. The results showed that the MediaPipe algorithm achieves significantly higher accuracy and resistance to image degradation, especially in cases of reduced resolution and increased blur. The Haar Cascade expresses greater sensitivity to changes in brightness and contrast, and more often gave false positives in poor lighting conditions. In terms of execution time, the Haar algorithm still has a slight advantage in speed due to its simpler architecture, while MediaPipe offers a more robust model with better overall results and significantly more precise detection of facial boundaries.

Keywords: Face Recognition, MediaPipe Algorithm, Haar Cascade Algorithm, Image Quality

USING LEGO MODELS TO TRAIN PROSPECTIVE AUTOMOTIVE ENGINEERS

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ABSTRACT:

The development of innovative educational tools for preparing prospective automotive engineers is a relevant task in contemporary engineering pedagogy. The use of LEGO Technic and LEGO Mindstorms kits, complemented by components manufactured through 3D printing and computer-aided design software, is presented as a universal platform for mastering fundamental principles of automotive engineering. Combining theoretical knowledge with practical experimentation enables students to design, assemble, and test scaled prototypes of vehicles. A multidisciplinary student team constructed a LEGO-based car model that incorporated subsystems of the drivetrain, steering, suspension, lighting, and electronic control. The model was equipped with an electronic differential, a programmable EV3 microcomputer, and hybrid body elements produced both from LEGO parts and through 3D printing. Experimental investigations included motion tests on different surfaces, determination of the center of gravity, and analysis of the turning radius. In addition, calculated energy losses due to aerodynamic resistance and rolling friction were compared with battery charge consumption. The results demonstrated consistency between analytical calculations and experimental measurements, confirming the educational effectiveness of this approach. The integration of LEGO kits with 3D printing expands the scope of possible experiments and creates opportunities for deeper engagement with engineering disciplines.

Keywords: scaled prototype vehicle, LEGO Technic, automotive engineering education, 3D printing, prototype field trials.

DESIGN OF MULTIPLIERLESS COMPENSATORS FOR CASCADED COMB DECIMATION FILTERS WITH FULL STOPBAND ALIASING REJECTION

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ABSTRACT:

This work describes a multiplierless design of compensators for decimation filters with aliasing rejection in the full stopband, as recently introduced in the literature. First, an introduction to decimation filters and principal applications is given. Next, the comb filter and the novel five cascaded comb decimation filters from the literature are briefly presented. A general approach to the design of multiplierless compensators for all five decimation filters is elaborated. The compensator magnitude response is selected from the literature in the form of the sum of two sinusoidal functions. The amplitudes of the sinusoidal functions are obtained to get an optimum passband deviation using particle swarm optimization (PSO) in MATLAB. The multiplierless design is achieved by presenting the compensator's optimal parameters in SPT (signed power-of-two) form in MATLAB. The general procedure is illustrated using a selected comb-based decimation filter. The comparison of the design of a multiplierless compensated cascaded comb decimation filter with the corresponding optimum Remez design confirmed the advantages of the proposed design, as evidenced by much lower complexity and better aliasing rejection in the full stopband.

Keywords: *Compensator, Decimation, Comb Filter*

DIGITAL TWIN-BASED STRUCTURAL ASSESSMENT OF HEAVY VEHICLE SUSPENSION COMPONENTS

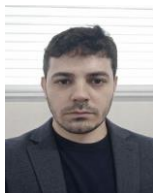
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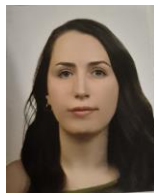
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Caner Baybas



Fevzi Doganer



Hatice Akavioglu



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ABSTRACT:

Buckling-induced collapse is a critical failure mode in heavy-vehicle suspension components, particularly in slender tie rod assemblies subjected to axial compressive loads. Although classical Euler-based formulations provide valuable theoretical insight, their direct applicability to real structural systems remains limited due to geometric imperfections, boundary-condition variability, and system-level compliance. In this study, a comprehensive experimental program was conducted on fifteen tie rod specimens with systematically varied geometries to investigate slenderness-dependent collapse behavior. Quasi-static axial compression tests were performed under pinned–pinned boundary conditions, and the peak collapse loads and corresponding displacements were extracted from the load–displacement responses. The experimental results revealed a pronounced deviation from classical Euler predictions and a strong dependence on geometric parameters. By introducing a slenderness-based collapse mapping and normalized load representation, three distinct stability regimes were identified: high-slenderness (Euler-type), intermediate (Johnson-type), and low-slenderness (inelastic) domains. These regimes reflect different dominant collapse mechanisms and cannot be captured by a single analytical formulation. From a digital twin–compatible viewpoint, the proposed maps and normalized metrics provide a calibration-oriented experimental foundation for future geometry-aware predictive models. Rather than implementing a full digital twin system, this work establishes the essential physical and data-driven building blocks required for regime-aware model updating and rapid stability classification. The presented framework enables more realistic stability assessment and offers a pathway toward adaptive, physics-informed digital twin implementations for heavy-vehicle structural components.

Keywords: Buckling test, tie-rod, digital twin.

SENSORIMOTOR STRATEGY IN CONTROL DESIGN OF REHABILITATION ROBOTICS: A STUDY OF STABILITY AND PERFORMANCE

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Zlata Jelačić

ABSTRACT:

Rehabilitation robotics demands control strategies that ensure stable physical human–robot interaction while accommodating the variability of human motor behavior. Conventional control methods, largely adapted from industrial robotics, often face limitations in balancing stability, compliance, and performance. This paper presents a sensorimotor strategy–based control architecture for rehabilitation robots grounded in principles of human motor control, including hierarchical organization, adaptive impedance regulation, multisensory feedback, and internal modeling. The human–robot system is modeled as a coupled dynamic interaction, and an adaptive impedance controller is developed within a passivity-constrained framework. Stability is rigorously established using passivity theory and Lyapunov analysis, ensuring robustness under time-varying human dynamics and model uncertainty. Simulation and experimental results on a rehabilitation robotic platform demonstrate improved stability–performance trade-offs over fixed-gain impedance control, with smoother interaction, reduced tracking error, and enhanced robustness. These results highlight the value of biologically grounded sensorimotor principles for next-generation rehabilitation robot control design.

Keywords: Rehabilitation robotics; Sensorimotor control; Physical human–robot interaction

COMPARISON OF NONLINEAR CONTROL STRATEGIES FOR THE UR3 COBOT MODELED IN THE SIMSCAPE MULTIBODY ENVIRONMENT

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ABSTRACT:

Since the Industrial Revolution, technologies have evolved at an ever-increasing rate, becoming increasingly useful for improving production efficiency and safety. Cobots have also become part of this ongoing progress. A cobot is a collaborative robot designed to assist humans with dangerous or repetitive tasks. Cobots interact with humans, and therefore, it is necessary to develop efficient control algorithms. With this in mind, this work develops a nonlinear control strategy and compares it with different trajectories. Specifically, these control algorithms are applied to the Universal Robots UR3 multibody model, created using the SIMSCAPE MULTIBODY toolbox. Trajectory generation is developed using the Robotic Toolbox. Using an inverse kinematics algorithm, joint variables are calculated for a specific trajectory. The control strategy used for tracking joint variables combines feedforward (FF) and feedback (FB) controllers. The feedforward controller solves the inverse dynamics problem, while the feedback controller uses two control strategies: the proportional-derivative (PD) and the linear quadratic (LQR) controllers. The main objective is to compare these two different feedback control strategies. To perform this comparison, the mean square error on the end-effector displacement and the six laws of motion with their first derivatives were evaluated.

Keywords: Theoretical and Applied Mechanics, Robot, Cobot, Simscape Multibody, Nonlinear Control, Trajectory tracking, UR3 robot

MULTIBODY ANALYSIS AND CONTROL SYNTHESIS OF AN AUTONOMOUS UNMANNED GROUND VEHICLE USING FEEDFORWARD BRAKING TORQUES AND PROPORTIONAL-DERIVATIVE FEEDBACK CONTROLLERS

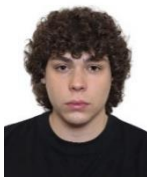
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ABSTRACT:

In recent years, the development of Unmanned Ground Vehicles (UGVs) has been gaining momentum thanks to rapid advances in new control technologies. In this vein, this study analyzed the dynamic behavior of a rover modeled in MATLAB using the SIMSCAPE MULTIBODY toolbox. Specifically, a new control strategy is introduced in this paper. The proposed control policy is based on evaluating braking actions. Preliminarily, the braking torques of each wheel are calculated and compared with those of the plate in horizontal and different inclined plane configurations. Additionally, using cubic interpolation, four equal torques are applied to the four wheels. These feedforward torques start from zero and reach an average value, ensuring the vehicle moves within a specific range of ground inclinations. Due to internal mass imbalances and asymmetries in the multi-body model, various inaccuracies occur during simulation execution. Thus, feedforward control actions alone are not sufficient to move the UGV along a straight path. Therefore, a Proportional Derivative (PD) control strategy is chosen to solve this problem. By doing so, the numerical results from computer simulations accurately track the desired UGV trajectory.

Keywords: *theoretical and applied mechanics, multibody, nonlinear control, mechanics of machines, autonomous unmanned ground vehicles*

DEVELOPMENT OF A PASSIVE SUSPENSION SYSTEM FOR AN AUTONOMOUS TRACKED UNMANNED GROUND VEHICLE USING A MULTIBODY DYNAMICS APPROACH

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ABSTRACT:

In the last two decades, the use of Unmanned Ground Vehicles in civil, industrial, and military applications has grown significantly. In off-road scenarios and severe operating conditions, the suspension system is a critical element. In this context, this work develops a nonconventional suspension for tracked vehicles inspired by passenger-car suspensions. A suspension designed according to this scheme allows greater adjustment and easier maintenance than classic tracked vehicle schemes. In the introductory phase, the different suspension systems are analyzed, and then the design phase proceeds. Specifically, the design phase includes a section dedicated to schematizing the problem as a two-degree-of-freedom system, followed by a section analyzing the software implementation of the system, which leads to the derivation of the characteristic values of the elastic element and the shock absorber. These parameters will then be used in a further system for an analysis focused on both the vertical displacement and the roll of the full vehicle. The last section involves analyzing the designed system by calculating two performance indices, namely road holding and payload comfort.

Keywords: *theoretical and applied mechanics, mechanics of machines, kinematics and dynamics of multibody systems, UGV, suspension systems*

TRAJECTORY GENERATION AND LQR CONTROL OF A THREE-DEGREE-OF-FREEDOM ROBOTIC MANIPULATOR FOR INDUSTRIAL APPLICATIONS

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ABSTRACT:

Industrial automation involves developing efficient algorithms for both trajectory generation and robotic manipulator control. Robotic manipulators can be used for various applications, such as assembly, welding, and painting. This paper presents the modeling, trajectory planning, and control of a three-degree-of-freedom robotic manipulator with a revolute kinematic structure, typically employed for diverse industrial engineering applications. The kinematic model of the robotic arm is derived using the Denavit-Hartenberg formulation, and its dynamic behavior is obtained using the Lagrange equations of the second kind. A Cartesian trajectory of the end effector based on cubic spline interpolation is defined and transformed into joint space via inverse kinematics. Control is achieved using an inverse-dynamics feedforward approach combined with a Linear Quadratic Regulator (LQR) feedback controller. A comparative analysis of open-loop, closed-loop, and combined control strategies shows that the superimposed feedforward-feedback scheme improves tracking accuracy, robustness, and overall system performance.

Keywords: theoretical and applied mechanics, mechanics of machines, industrial automation, trajectory planning, nonlinear control, robotic manipulator

INTEGRATED DOE–LATIN HYPERCUBE APPROACH FOR ROBOTIC CELL-LAYOUT OPTIMIZATION AND SLOSHING REDUCTION

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ABSTRACT:

Sloshing is a physical phenomenon that describes the motion of liquids in partially filled containers subject to external forces. In the context of automated inspection of pharmaceutical vials, this phenomenon can generate air bubbles during handling that are mistakenly identified by viewers as foreign particles, causing the rejection of compliant products and a consequent increase in production costs.

This paper proposes an integrated approach based on Design of Experiments (DOE) and optimization methods using Latin Hypercube Sampling (LHS), supported by a multibody simulation model, to minimize sloshing during robotic handling. The objective is to define the optimal configuration of the cell layout and robot movement parameters, balancing the reduction of oscillations with compliance with cycle time. The results show that the combined DOE–LHS approach allows the identification of configurations that can significantly reduce sloshing while maintaining competitive cycle times, highlighting the effectiveness of the proposed methodology for improving the reliability and efficiency of the robotic pharmaceutical inspection process.

Keywords: *Sloshing, Multibody Simulation, Dynamics, Pharmaceutical Vial Inspection, Robotic Cell Optimization, Design Of Experiments (DOE), Latin Hypercube Sampling (LHS).*

DESIGN OPTIMIZATION OF A MODULAR UGV SUSPENSION SYSTEM USING FULL-FACTORIAL DOE AND MULTIBODY SIMULATION

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ABSTRACT:

The study presents the development and optimization of an unmanned ground vehicle (UGV) designed by the university laboratory of Applied Mechanics and the spin-off MEID4, aiming to produce a modular, reconfigurable platform capable of operating on unstructured terrain. The focus is on the dynamic behavior of the suspension system, a key element in reducing vibrations transmitted to the structure and on-board sensors. To systematically analyze the influence of the main design parameters—stiffness, damping, and arm length—an approach based on Design of Experiments (DOE) in a full factorial configuration was used, integrated with multibody simulations performed in Simscape. The response indicators considered include RMS of vibrations, PSD, and Shock at the 95th percentile. Statistical analysis of the results, conducted using linear models and ANOVA, identified the predominant effect of stiffness and a significant interaction between stiffness and arm length. The identified optimal configuration reduces vibrations and shock peaks without compromising the vehicle's overall stability. The results confirm the effectiveness of the methodological approach adopted and provide a basis for further design evolution of the UGV.

Keywords: UGV, Design of Experiments, Dynamics, Vibration Analysis, Multibody Simulation.

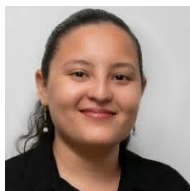
VIBRATION-BASED ANALYSIS FOR PREDICTIVE MAINTENANCE OF HIGH-SPEED ELECTRIC TRAINS (ETR): A SIGNAL PROCESSING CASE STUDY

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ABSTRACT:

The railway market is rapidly expanding and requires increasingly advanced predictive maintenance strategies to ensure safety, reliability, and efficiency. In this context, vibration analysis remains a key tool for monitoring the operating conditions of railway components, enabling early detection of anomalies and prevention of failures. This study applies the method to ETR high-speed trains, focusing on wheels and bogies. The experimental results show characteristic frequencies linked to components such as the motor-generator and abnormal signals consistent with wheel defects, including faceting and chipping. The findings confirm the effectiveness of vibration analysis and suggest its extension to track condition monitoring for improved system reliability.

Keywords: *Predictive maintenance; Vibration-based analysis; Signal processing; Condition monitoring; High-speed electric trains; Railway systems*

**ANALYSIS OF HIERARCHICAL ORGANIZATION, FLEXIBILITY, AND
CONTROL OF THE SENSORIMOTOR SYSTEM BASED ON A DYNAMIC
MODEL OF THE UPPER EXTREMITY**

**ANALIZA HIJERARHIJSKE ORGANIZACIJE, FLEKSIBILNOSTI I KONTROLE
SENZORIMOTORNOG SUSTAVA NA TEMELJU DINAMIČKOG MODELA
GORNJEG EKSTREMITETA**

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Zlata Jelačić

ABSTRACT:

The human sensorimotor system shows exceptional flexibility and robustness in controlling upper-limb movements under changing biomechanical and environmental conditions. This paper analyzes its hierarchical organization using a dynamic musculoskeletal model integrated with optimal control theory to simulate goal-directed reaching. The results indicate that layered control, combining motor planning, inverse dynamics, and adaptive feedback, supports stable performance despite perturbations. Redundancy in the musculoskeletal system enables multiple equivalent movement solutions, enhancing flexibility. Overall, upper-extremity control emerges from interactions between feedforward planning and sensory-driven feedback, offering insights relevant to neurorehabilitation, robotics, and prosthetics.

Keywords: sensorimotor system, hierarchical control, upper extremity.

SAŽETAK:

Ljudski senzomotorni sustav pokazuje iznimnu fleksibilnost i robusnost u upravljanju pokretima gornjih ekstremiteta u promjenjivim biomehaničkim i okolišnim uvjetima. Ovaj rad analizira njegovu hijerarhijsku organizaciju koristeći dinamički mišićno-koštani model integriran s teorijom optimalne kontrole za simulaciju ciljanog dosezanja. Rezultati pokazuju da slojevito upravljanje, koje kombinira motoričko planiranje, inverznu dinamiku i adaptivnu povratnu spregu, omogućuje stabilnu izvedbu unatoč perturbacijama. Redundancija u mišićno-koštanom sustavu omogućava više ekvivalentnih rješenja pokreta, čime se povećava fleksibilnost. Općenito, kontrola gornjeg ekstremiteta proizlazi iz interakcija između feedforward planiranja i senzorički vođene povratne regulacije, nudeći spoznaje relevantne za neurorehabilitaciju, robotiku i protetiku.

Ključne riječi: senzomotorni sustav, hijerarhijska kontrola, gornji ekstremitet.

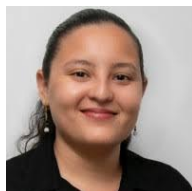
MODEL-BASED DESIGN AND SIMULATION OF TIRE-TERRAIN INTERACTION IN OFF-ROAD AUTONOMOUS VEHICLES

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ABSTRACT:

The development of autonomous vehicles has accelerated significantly in recent years, leading to growing interest in advanced simulation of locomotion systems. A particularly relevant aspect concerns the modelling of contact between the pneumatic and the ground, especially on irregular surfaces. Numerous approaches, both empirical and numerical, have been proposed to describe this phenomenon, including the Magic Formula of Pacejka, the models of the curves μ -s, Hertzian contact models, and the multibody formulation with contact models. In this study the ground-pneumatic has been implemented inside a Simulink Multibody simulation environment through a model of contact force. Two different autonomous vehicles have been analyzed: a rubberised agricultural tractor and a crawler UGV. From a Model-Based Design perspective, in addition to modelling the contact, these components have also been integrated into the models, including energy and actuation elements such as batteries, driver, and motor. This has allowed to characterize both the mechanical aspects, such as the reaction of constraint to the ground, and the electrical aspects, such as the battery discharge dynamics.

Keywords: *Off-Road Autonomous Vehicles, Model-Based Design, Tire-Terrain Interaction, Contact Force Modeling, Vehicle Dynamics Simulation.*

CYBERSECURITY VULNERABILITY ANALYSIS OF SUBSTATION AUTOMATION SYSTEM: MODELING, ATTACK SIMULATION, AND PROTECTIVE STRATEGIES USING MATLAB/SIMULINK

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Merjem Husić

ABSTRACT:

Substation automation systems increasingly rely on high-speed communication among Intelligent Electronic Devices (IEDs), exposing protection functions to cyber manipulation. This paper presents a complete cyber-physical modeling and vulnerability analysis framework implemented in MATLAB/Simulink. A medium-voltage feeder, primary protection relay (IED_A), communication-based backup relay (IED_B), GOOSE-like message structure, and a dedicated Attack Injection module are developed. Four cyberattacks—spoofing, replay, delay, and packet drop—are implemented to evaluate their effect on protection timing and correctness. IED_B is equipped with lightweight validation mechanisms including source authentication, sequence-number anti-replay, timestamp freshness checking, and rate limiting. Simulation results demonstrate that replay and stale delay attacks are fully mitigated, while spoofing and total packet loss remain impactful depending on attacker capability. The proposed modeling framework provides clear insight into cyber-physical interactions in digital substations and supports the development of practical defensive strategies for communication-based protection schemes.

Keywords: IEC 61850, GOOSE, Intelligent Electronic Device (IED), Cybersecurity, MATLAB/Simulink, Substation automation, Backup protection

OVERVIEW OF THE USE OF CAD TOOLS IN COMPANIES IN BOSNIA AND HERZEGOVINA

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Mubina Musić



Adis J. Muminović



Enis Muratović



Nedim Pervan

ABSTRACT:

There are a large number of Computer Aided Design (CAD) design tools available on the market. Design offices are often confused about which CAD tool best suits their needs. This is especially important considering the fact that implementing any of the CAD tools requires a significant investment, so it is very important to choose the right tool for your needs. This paper presents an overview of the current use of CAD tools in companies in Bosnia and Herzegovina. A survey of a large number of users of various tools for 3D CAD modeling and preparation of technical documentation was carried out. 96 users participated in the research. Out of the total number, 45 individual users or company representatives answered the questions anonymously, 32 participants answered on their own behalf, while the remaining number of participants (64) entered the name of the company that uses one of the mentioned programs. In addition, goal of the paper is to investigate current state of the use of (Product Data Management) PDM systems in companies in Bosnia and Herzegovina. The results of the survey showed that a small number of companies in Bosnia and Herzegovina use PDM systems. In this regard, as the next step in the development and implementation of CAD tools in companies in Bosnia and Herzegovina, the implementation of the PDM system is proposed. Third aspect of the research investigated education quality of CAD tools at mechanical engineering faculties in Bosnia and Herzegovina.

Keywords: CAD; Bosnia and Herzegovina, PDM, education

ENERGY-EFFICIENT HYDRAULIC PRESS CONTROL WITH A VARIABLE-SPEED PUMP

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Žiga Janežič



Vito Tič

ABSTRACT:

Variable-speed pump drives controlled by modern frequency converters offer an efficient alternative to conventional hydraulic presses, reducing throttling losses and enabling pressure generation only when needed. This paper presents a compact drive-centric control concept for a small hydraulic press, where a frequency converter executes closed-loop pressure control from a 4 mA to 20 mA sensor and coordinates the press cycle through embedded state-based logic and safety supervision. Experimental commissioning and tuning highlight how practical integration aspects, such as signal conditioning, correct I/O scaling, and robust “pressure reached” detection, strongly influence control quality. With a properly tuned embedded PID, the system achieves smooth pressure tracking at a 50 bar operating point with reduced overshoot and stable behaviour during pressing and holding. The results demonstrate that frequency-converter-centric architectures can provide a flexible and cost-effective route to reliable pressure control in small presses and laboratory/retrofit applications.

Keywords: hydraulic press, variable-speed pump drive, frequency converter, pressure control, PID tuning,, energy efficiency.

ROLE OF ARTIFICIAL INTELLIGENCE AND DIGITAL TWIN TECHNOLOGIES IN THE TRANSITION TO HUMAN-CENTRIC MANUFACTURING

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Gordana Zeba

ABSTRACT:

As manufacturing is the main driver of economic growth, it is essential to focus on its continuous improvement through innovative digital and advanced manufacturing technologies. Industry 4.0 provided strong impetus for the rapid development of technologies aimed at increasing productivity and efficiency in mass-customised production tailored to specific customer requirements. Industry 4.0 primarily focuses on technological improvements, integration, and networking of all resources, while the human factor has been neglected. Industry 5.0 builds on Industry 4.0, with its core principles being resilience, sustainability, and a focus on humans. Given the importance of the transition from Industry 4.0 to Industry 5.0, research was conducted to determine the role and interconnection of technologies, with particular emphasis on artificial intelligence and digital twin technology. The aim is to identify trends in the development of technologies for Industry 5.0, thematic domains, and theoretical foundations using bibliometric methods on data from the Web of Science Core Collection platform for the period 2015–2025. The research results indicate the latest trends in the development of technologies in accordance with the principles of Industry 5.0, such as human digital twins and collaborative robots. The research provides insight into development trends in Industry 4.0 technologies for the transition to human-centric manufacturing within Industry 5.0, enhances understanding of the role of artificial intelligence and digital twins in this context, and offers recommendations for the research community and managers.

Keywords: artificial intelligence, digital twin, industry 4.0, industry 5.0, human-centric manufacturing

ADVANCED ROBOTIC GRIPPERS FOR INDUSTRIAL AUTOMATION: A REVIEW WITH FOCUS ON PALLETIZING APPLICATIONS AND HUMAN-ROBOT PERFORMANCE COMPARISON

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ABSTRACT:

Industrial robots have become indispensable elements of modern manufacturing systems, with robotic grippers playing a central role in enabling flexible and efficient automation. This review paper provides a comprehensive analysis of advanced robotic grippers, with a specific focus on their applications in sorting and palletizing packages. The classification of robotic grippers is presented through mechanical, vacuum, magnetic, and adaptive types, emphasizing their structural differences, operational principles, and suitability for various tasks. Special attention is given to the integration of sensors, artificial intelligence, and machine learning techniques that enable robots to handle packages of different shapes, sizes, and materials in dynamic environments. The study further compares the performance of robotic grippers with manual labor in palletizing processes, highlighting key advantages such as increased throughput, improved safety, reduced operational costs, and higher precision. Real-world industrial examples illustrate how the adoption of robotic grippers has transformed logistics and packaging operations, particularly in sectors such as food, e-commerce, and pharmaceuticals. Challenges related to gripper versatility, system integration, and adaptation to irregular objects are also discussed. The paper concludes by outlining future research directions aimed at developing more intelligent, flexible, and human-friendly robotic grippers technologies. These innovations are expected to further accelerate the transition toward fully automated and resilient production and logistics systems.

Keywords: robotic end-effectors, industrial robots, package sorting, palletizing, automation, adaptive grippers, human-robot comparison

DESIGN AND OPTIMIZATION OF AN ADAPTIVE GRIPPER FOR AUTOMATED RETRIEVAL AND PALLETIZING OF PRODUCTS WITH VARIABLE CHARACTERISTICS

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ABSTRACT:

With the implementation of Industry 4.0 in manufacturing processes and logistics systems, the manipulation of packages with different dimensions, masses, and geometric characteristics presents a significant challenge for automated palletizing within the production process itself. The aim of this paper is the development and optimization of an adaptive gripper intended for collaborative robots, with a focus on reliable retrieval and palletizing of products with variable characteristics. The proposed solution includes a mechanically adjustable gripping mechanism that enables efficient manipulation of boxes with a mass of up to 10 kg, with minimal need for manual adjustment. Within the research, an analysis of technical requirements, the development of a CAD model, the definition of key functionalities, and the optimization of gripper operating parameters were carried out, including gripping force, manipulation stability, and cycle time. Experimental validation showed that the developed gripper significantly increases the success rate of gripping and reduces the risk of package deformation, while integration with a collaborative robot enables safe and flexible application in industrial environments. The results indicate a high potential of adaptive grippers for improving automated palletizing systems and achieving a higher level of efficiency and reliability in operation.

Keywords: design, optimization, adaptive gripper, collaborative robot, palletizing, automation.

SIMULATION OF THE KINEMATICS OF A BIONIC FINGER FOR A HAND EXOSKELETON USING PUSH-ROD LINKAGES

Vitaliy Korendiy¹, Bohdan Markovych¹, Maksym Durniak¹, Ihor Kryvuliak¹

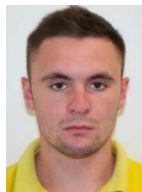
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ABSTRACT:

This paper presents a structural and kinematic study together with simulation results of a biomimetic finger module intended for a robotic hand / hand exoskeleton. The proposed design follows an intrinsic actuation concept and employs rigid push-rod linkages, enabling active flexion and extension without return springs. A structural analysis proves that the mechanism is planar, second-class, and has a single degree of freedom ($W = 1$), meaning that the motion of all phalanges is fully determined by one generalized input coordinate (servo shaft angle). Kinematic relations are derived using closed vector-loop equations and implemented in Wolfram Mathematica for interactive visualization and fingertip trajectory generation. A CAE verification is also conducted in SolidWorks Motion considering real part geometry and joint constraints. The comparison indicates high agreement in the main displacement stroke (approximately 2.5% difference) and confirms a biomimetic fingertip trajectory close to a logarithmic-spiral segment, supporting stable grasping behavior.

Keywords: *bionic finger, hand exoskeleton, 1-DOF linkage, kinematic analysis, Chebyshev formula, vector-loop method, Wolfram Mathematica, SolidWorks Motion, fingertip trajectory.*

APPLICATION OF MACHINE LEARNING METHODS TO A ROBOTIC REHABILITATION GLOVE

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Amila Dedic

ABSTRACT

This paper presents the development of a software solution designed to support the rehabilitation of patients after a stroke, integrating web and mobile applications with machine learning components. The backend service application is implemented using .NET technology and enables communication between the frontend, developed in the Angular environment, and an additional API created using the Python Flask framework, where machine learning models were also developed and trained. The mobile application is built using .NET MAUI technology and allows patients to start and stop rehabilitation exercises.

For the purpose of predicting patient recovery, the Random Forest algorithm was used, and the obtained results indicate the advantages of machine learning methods compared to classical instance-based methods and neural networks. In addition to the software implementation, the paper also presents a robotic pneumatic glove for performing rehabilitation exercises, which is based on an ESP32 microcontroller and solenoid valves for pressure control.

The results show that integrating the software solution with machine learning methods and a rehabilitation device can significantly improve the rehabilitation process, providing doctors and patients with new tools for assessing and monitoring progress.

Keywords: Rehabilitation, stroke, machine learning, Random Forest, pneumatic glove

APPLICATION OF ADDITIVE TECHNOLOGIES IN EXPERIMENTAL VIBRATION TESTING OF TRUSS STRUCTURES

PRIMJENA ADITIVNIH TEHNOLOGIJA U EKSPERIMENTALNOM ISPITIVANJU VIBRACIJA REŠETKASTIH KONSTRUKCIJA

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ABSTRACT:

This paper presents the link between additive manufacturing technologies and experimental methods through the process of vibration testing. The specimens used for testing were manufactured by 3D printing on an Ultimaker 2+ printer. The additional material (filament) used for specimen fabrication was PLA, which is currently one of the most widely used materials in additive manufacturing technologies. This paper presents an experimental analysis that enables verification of the accuracy of numerical models, identification of discrepancies, and evaluation of the influence of real-world factors that are often neglected in theoretical models.

Keywords: Additive Manufacturing, Vibration Testing, Experimental Method, Numerical Analysis

SAŽETAK:

Ovaj rad predstavlja vezu između tehnologija aditivne proizvodnje i eksperimentalnih metoda kroz proces ispitivanja vibracija. Uzorci korišteni za ispitivanje proizvedeni su 3D štampanjem na printeru Ultimaker 2+. Dodatni materijal (filament) korišten za izradu uzoraka bio je PLA, koji je trenutno jedan od najčešće korištenih materijala u tehnologijama aditivne proizvodnje. Rad predstavlja eksperimentalnu analizu koja omogućava provjeru tačnosti numeričkih modela, identifikaciju odstupanja te procjenu uticaja realnih faktora koji su često zanemareni u teorijskim modelima.

Ključne riječi: Aditivna proizvodnja, ispitivanje vibracija, eksperimentalna metoda, numerička analiza

AUTONOMOUS INSPECTION AND REAL-TIME MAINTENANCE USING MOBILE AND COLLABORATIVE ROBOTS

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Ermin
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ABSTRACT:

From year to year, the complexity of production systems increases, and unplanned downtime causes high production costs, which motivates more companies to shift towards a predictive maintenance strategy for their production processes. This paper analyzes the role of mobile autonomous and collaborative robots (cobots) with the aim of improving predictive maintenance through visual monitoring, inspection, and real-time control, thus enabling the detection and management of failures. The paper uses a mixed-methods case study in the manufacturing process of the automotive industry, and the research evaluates the implementation of a robotic system integrated with artificial intelligence that combines autonomous mobile robots (AMR) and collaborative robots (cobots) for monitoring, detecting, and responding to potential equipment failures before they occur. Measurement of relevant quantitative parameters such as Mean Time to Repair (MTTR), Mean Time Between Failures (MTBF), and Return on Investment (ROI) was conducted, while qualitative feedback was collected from system operators. The obtained results show a significant reduction in unexpected machine downtime, with the average daily downtime reduced by approximately 75%, along with improved response time to anomalies and overall process efficiency. In the paper, we further investigated the technical and economic implications, emphasizing the integration of robotic vision systems and artificial intelligence in smart manufacturing environments. The obtained results highlight the transformative potential of robotics in the transition from reactive to predictive maintenance, offering practical recommendations for broader industrial application.

Keywords: predictive maintenance, mobile robots, collaborative robots, visual inspection, real-time monitoring, downtime reduction, Industry 4.0

A HYBRID SOLVER FOR DIGITAL TWINS: COMBINING SYMBOLIC AND NUMERICAL METHODS

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Safet Isić



Izudin Džafić

ABSTRACT:

This paper addresses the critical role of computational models in modern engineering and scientific research, particularly in simulating complex systems. While traditional models are static representations, Digital Twins (DTs) offer a dynamic, two-way connection with the physical world, enabling data-driven decision-making, system monitoring, and optimization. We outline the general architecture of DTs, consisting of physical and virtual worlds connected by a communication layer, highlighting the heavy reliance on an efficient solver for accurate model output. This work proposes a novel solver designed to facilitate the easy translation of expert knowledge into precise mathematical models as well utilize the power of symbolic differentiation techniques. Traditional numerical solvers often rely only on numerical differentiation methods, which can introduce errors and computational problems, particularly in complex systems. Our proposed method combines symbolic differentiation with numerical techniques to enhance accuracy and efficiency in solving mathematical problems.

Keywords: *digital twin, symbolic differentiation, complex systems, nonlinear systems, dynamic systems*

INTEGRATED MODEL OF INDUSTRY 4.0 AND INDUSTRY 5.0 – CASE STUDIES

INTEGRISANI MODEL INDUSTRIJE 4.0/5.0 – PRIMERI PRIMENE

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ABSTRACT:

Evolution to Industry 5.0 are: Emphasizes human-machine synergy: AI augments rather than replaces workers, with collaborative robotics (cobots) and ergonomic designs; Introduces agentic AI and Industrial Copilots: Generative AI interfaces coordinate autonomous AI agents (Siemens-developed and third-party) for tasks in design, planning, engineering, operations, and maintenance - shifting from assisted automation to orchestrated autonomy; Integrates Industrial Metaverse (via NVIDIA Omniverse) for immersive, real-time simulations and multi-user collaboration, and Focuses on sustainability and resilience: AI-optimized resource use, circular economy tools, and adaptive systems for decarbonization and disruption resistance. Siemens' model views Industry 5.0 as a seamless extension of Industry 4.0 - not a replacement - delivering resilient, sustainable, and personalized production where humans, AI, and machines co-create value. This approach positions Siemens as a leader in transitioning industries toward adaptive, ethical, and profitable digital futures.

Keywords: Industry 4.0, Industry 5.0, Integration, Case study.

REZIME:

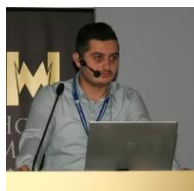
Evolucija ka Industriji 5.0 je: Naglašava sinergiju čoveka i mašine: Veštačka inteligencija proširuje, a ne zamenjuje radnike, kolaborativnom robotikom (kobotima) i ergonomskim dizajnom; Uvodi agentsku veštačku inteligenciju i industrijske kopilote: Generativni interfejsi veštačke inteligencije koordiniraju autonomne agente veštačke inteligencije (razvijene od strane Simensa i treće strane) za zadatke u dizajnu, planiranju, inženjeringu, operacijama i održavanju - prelazeći sa potpomognute automatizacije na orkestriranu autonomiju; Integriše Industrijski metaverzum (preko NVIDIA Omniverse-a) za impresivne simulacije u realnom vremenu i saradnju više korisnika, i fokusira se na održivost i otpornost: korišćenje resursa optimizovano veštačkom inteligencijom, alati cirkularne ekonomije i adaptivni sistemi za dekarbonizaciju i otpornost na poremećaje. Simensov model posmatra Industriju 5.0 kao besprekorno proširenje Industrije 4.0 - ne kao zamenu - pružajući otpornu, održivu i personalizovanu proizvodnju gde ljudi, veštačka inteligencija i mašine zajedno stvaraju vrednost. Ovaj pristup pozicionira Simens kao lidera u tranziciji industrija ka adaptivnoj, etičkoj i profitabilnoj digitalnoj budućnosti.

Ključne riječi: Industrija 4.0, Industrija 5.0, Integracija, Primena.

DEVELOPMENT OF A TOOL FOR ASSESSING THE LEVEL OF INDUSTRY 4.0 AND LEAN MANUFACTURING IMPLEMENTATION

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Bošnjak Igor



Stojkić Željko



Šaravanja Luka

ABSTRACT:

Industry 4.0 and Lean Manufacturing are increasingly important paradigms in modern manufacturing, yet companies often face significant challenges in their effective implementation. This article presents the development of an assessment tool for evaluating the level of Lean Manufacturing and Industry 4.0 implementation in manufacturing companies. Lean focuses on eliminating waste, improving process flow, and increasing customer value through continuous improvement, while Industry 4.0 introduces digital technologies such as IoT, automation, and data-driven systems to transform production. The proposed tool is based on validated constructs and measurement frameworks derived from previous research, enabling a structured analysis of key Lean and Industry 4.0 dimensions. Using questionnaire-based data collection and statistically supported indicators, the model provides an objective overview of a company's current maturity in both domains. This approach helps organisations identify implementation strengths and gaps and better understand how Lean practices can align with digital transformation efforts to support enhanced operational performance.

Keywords: Lean Manufacturing; Industry 4.0; implementation level; maturity assessment; manufacturing systems; measurement framework.

OPEN-SOURCE CLOSED-LOOP STEPPER MOTOR CONTROLLER FOR DIY ROBOTIC ARM APPLICATIONS

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L. Banjanović-Mehmedović



I. Karabegović

ABSTRACT:

This paper presents an open-source closed-loop stepper motor controller designed for “Do It Yourself” (DIY) robotic arm applications, addressing the growing demand for low-cost, modular, and precise robotic solutions accessible to educators, and researchers. The system integrates a TMC2209 stepper motor driver with a TLE5012B magnetic encoder and STM32F103 microcontroller to achieve precise position control through advanced PID feedback control with anti-windup and derivative filtering. The controller features CAN bus communication for multi-axis coordination and comprehensive firmware customization for DIY robotic systems. Experimental evaluation demonstrates positioning accuracy of $\pm 2.0^\circ$, repeatability of $\pm 0.5^\circ$, and emergency stop response time of $< 50\text{ms}$, making it suitable for integration into open-source 3D-printed robotic arms. This work highlights the potential for accessible, high-performance robotic controllers to enhance hands-on learning, prototyping, and research in robotics.

Keywords: *stepper motor control, closed-loop feedback, DIY robotics, PID control, open-source hardware, robotic arm control.*

AI-ENHANCED SKILLOA FOR LLM-DRIVEN VISUAL PROGRAMMING IN AUTONOMOUS MANUFACTURING: OBJECT RECOGNITION AND SPATIAL REASONING CHALLENGES

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L. Ollinger

ABSTRACT:

Modern manufacturing systems require unprecedented flexibility, yet traditional PLC programming remains a bottleneck in achieving autonomous manufacturing control. While skill-based orchestration frameworks like SkillOA enable dynamic composition of manufacturing capabilities, they face critical challenges in automatic skill generation, particularly regarding object recognition and spatial reasoning. This paper presents a novel approach integrating Large Language Models with semantic knowledge frameworks and enhanced object detection to automatically generate manufacturing skills from natural language descriptions. Our system extends SkillOA by introducing an AI-powered Skill Definition Module that creates semantically-annotated atomic skills conforming to the CSS model. Validation demonstrates both capabilities and critical limitations: while achieving 78% reduction in skill definition time, the system reveals fundamental challenges in object localization and spatial reasoning. Generated skills successfully integrate with the SkillOA knowledge base but expose critical gaps in coordinate mapping essential for reliable manufacturing operations.

Keywords: Large Language Models, Skill-based Manufacturing, Object Recognition, Visual Programming, Industry 4.0

DESIGN AND IMPLEMENTATION OF A MECANUM-WHEEL AGV WITH GENETIC ALGORITHM-BASED ROUTING OPTIMIZATION

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Žiga
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Janez
Gotlih



Miran
Brezočnik

ABSTRACT:

This paper presents the development and implementation of an Automated Guided Vehicle (AGV) system based on a mecanum-wheel platform, focusing on navigation, localization, and route optimization in a structured warehouse environment. The AGV was developed using the ROS2 framework, with all core components – including sensor integration, motor control, and SLAM – implemented and thoroughly tested in simulation before deployment on a physical robotic platform. System-level evaluation confirms consistent performance between simulated and real-world operation. In parallel, a Genetic Algorithm (GA) framework was developed to address warehouse routing, modelled as a Travelling Salesman Problem (TSP). The warehouse layout is represented as a graph with pick-up locations as terminal nodes, and the shortest paths between them are efficiently computed using Breadth-First Search (BFS). A key contribution is a vectorized population initialization strategy based on maximizing Hamming distance, which ensures high genetic diversity with fewer chromosomes. Additionally, the GA dynamically shifts from exploration to exploitation during evolution, improving convergence and mitigating premature stagnation. Results show that the proposed approach achieves comparable or improved routing performance with lower computational cost, making it suitable for real-time AGV applications and future integration into the ROS2 ecosystem.

Keywords: Automated guided vehicles (AGV), Omnidirectional drive, Robot operating system 2 (ROS2), Internal logistics, Genetic algorithms.

REAL-TIME VISION INSPECTION FOR OPERATOR-ASSISTED ASSEMBLY STATIONS

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Ben Šnajder



Vito Tič

ABSTRACT:

Manual assembly remains essential in many flexible production settings, yet it is inherently prone to human error especially when small, visually similar parts must be placed correctly. This paper presents a practical approach to upgrading a pick-by-light workstation with real-time machine-vision verification, enabling automatic confirmation of critical manual insertion steps before the process continues.

The proposed solution combines a compact vision setup with industrial control logic and deterministic data exchange over an industrial Ethernet network. A simple request response handshake synchronizes station sequencing with image acquisition and evaluation, while a state-based workflow enforces immediate rework when an error is detected.

The method is validated on a learning-factory assembly cell using representative small components, demonstrating reliable detection of missing or mispositioned parts within the cycle time of the station. Beyond the specific case study, the presented architecture and integration strategy are transferable to a broad class of human-in-the-loop assembly stations where low-cost error-proofing, traceability, and rapid retrofit are required. Limitations related to part pose variability and visual occlusions are discussed, together with directions for improving robustness through more advanced perception methods.

Keywords: machine vision, industry 4.0, PROFINET, PLC; TwinCAT Vision, TIA Portal, error-proofing, pick-by-light, training factory.

MATHEMATICAL FRAMEWORK FOR EVALUATING AMR INVESTMENT IN WAREHOUSE MATERIAL HANDLING

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ABSTRACT:

In this study, a mathematical model is developed to calculate the payback period of integrating autonomous mobile robots (AMRs) in warehouses and interlogistics operations for the transportation of materials and goods. The focus is on the model's structure, formulation, and internal logic. It systematizes quantitative factors that affect the payback period, such as increased throughput, higher speed, elimination of time-consuming search time, and continuous operation without unproductive time. These factors are expressed through annual cash flows, discounted and cumulative net flow. The model includes dynamic parameters, such as annual changes in labor costs, energy prices, and maintenance rates, enabling its application in different industrial environments and risk levels. It mathematically formalizes the gains associated with productivity, ensuring consistency across different warehouse and production systems. The model is developed so that the hourly labor cost explains the model output to R^2 at around 99%, offering an analytical and repeatable tool for decision makers. It provides a unique basis for assessing the feasibility of AMR investments.

Keywords: autonomous mobile robots (AMR), warehouse automation, payback period analysis, cost–benefit modeling, Industry 4.0.

SCENARIO-BASED PAYBACK PERIOD ANALYSIS OF AMR INVESTMENT: COMPARATIVE STUDY OF EU AND WESTERN BALKAN COUNTRIES

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Muhamed Sinanović

ABSTRACT:

Modern warehouses are increasingly implementing autonomous mobile robots (AMR) for material handling and internal transport. This research conducts a comparative study with scenario-based analysis of AMR investment payback period for European Union (EU) and Western Balkan (WB) countries. The optimistic, expected, and pessimistic estimates are analyzed through scenario-based analysis. A comparative study is performed, analyzing the influence of the country's development on the payback period and the desirability of companies to invest. Through this study, the payback period for different operating regimes was analyzed. In the quantitative model used, the hourly labour cost explains the model output to R^2 at around 99%. The EU's average payback period is shown to be 6 times shorter than the average of WB countries. The research showed that the most influential factors on the payback period are hourly labour cost and the number of operating shifts in the warehouse. Accordingly, the payback period is shorter for more developed countries, making this investment more desirable to companies from these countries, allowing them to develop even faster with the implementation of new technologies.

Keywords: autonomous mobile robots (AMR), payback period, scenario analysis, EU and Western Balkan comparison.

MULTI-OUTPUT DRIFT DETECTION AND MODEL ADAPTATION IN SEMICONDUCTOR MANUFACTURING

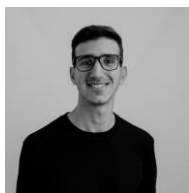
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Amina Mević



Mohamed Ghoneim



Senka Krivić

ABSTRACT:

Drift in data-generating processes is common in real-world systems and poses a significant challenge for maintaining reliable machine learning models. In semiconductor manufacturing, drift may arise from equipment replacement, component wear, periodic maintenance, or modifications to process recipes. Such changes can induce input drift, output drift, or concept drift, all of which can degrade predictive performance, particularly in multi-output regression tasks characteristic of virtual metrology.

This paper presents a comprehensive analysis of drift phenomena in a multi-output semiconductor manufacturing dataset collected over a five-year period. We examine data distribution changes across multiple process variables and outputs using statistical tests and machine learning-based drift detection techniques suitable for multi-dimensional settings. This study identifies: (i) the minimal training window required to maintain acceptable predictive accuracy, (ii) the maximum prediction horizon before model degradation due to drift becomes significant, (iii) characteristic drift frequencies over time, and (iv) practical retraining intervals required to sustain model performance. The results provide actionable insights for deploying robust multi-output predictive models in semiconductor manufacturing environments.

Keywords: data drift, multi-output regression, semiconductor manufacturing, virtual metrology, anomaly detection.

A HOLISTIC APPROACH TO HEALTHCARE IMPROVEMENT: INTEGRATING PROCESS MODELLING, INFORMATION SYSTEMS AND ADVANCED IMAGING

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ABSTRACT:

Modern healthcare organisations face increasing demands for efficiency, quality, and patient-centred care. This research offers a comprehensive approach to healthcare improvement that combines process modelling, medical information systems (MIS), and advanced imaging technologies. The study investigates the combined effects of these components to achieve substantial improvements in healthcare delivery. A conceptual framework is developed to integrate process modelling methods (such as IDEF0), various MIS categories, and advanced imaging techniques. The framework aligns process optimisation with data management and visualisation tools to improve clinical decision-making and workflow efficiency. Potential benefits include streamlined workflows, fewer errors, enhanced patient safety, and better communication. By adopting a holistic approach, healthcare organisations can optimise resource use, improve patient outcomes, and create a more efficient, patient-focused healthcare environment. This research advocates a comprehensive, integrated strategy for healthcare improvement to address the complex challenges of modern healthcare delivery.

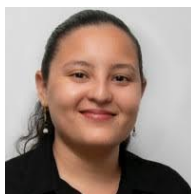
Keywords: Holistic healthcare, process modelling, medical information systems, advanced imaging, integrated approach, healthcare improvement.

ESTIMATION OF SLOSHING ANGLE USING SIGNAL PROCESSING TECHNIQUES AND A LINEAR REGRESSION MODEL

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ABSTRACT:

Sloshing describes the motion of a liquid inside a partially filled container subjected to external excitation. Previous studies differ mainly in application fields and fluid characteristics. This work investigates the estimation of the liquid sloshing angle using a robotic system. Three trajectory profiles are considered, defined by predefined motion laws: cubic, optimized, and trapezoidal.

Digital image processing is used to segment the liquid surface and estimate angular oscillations. Experiments are conducted under controlled lighting conditions. A linear regression model is adopted for angle estimation. Experimental results are compared with numerical predictions based on a simple pendulum model. The results show similar dynamic trends in the sloshing angle, with differences in peak oscillation amplitudes.

Spectral analysis reveals additional harmonic components in the experimental data. These results indicate that image-based measurements can support the development of improved robotic motion strategies. Such strategies can contribute to sloshing reduction under different motion profiles.

Keywords: *Sloshing dynamics, camera calibration, image processing, spectral analysis, motion laws.*

ELO-DRIVEN MACHINE LEARNING FOR EUROPEAN FOOTBALL MATCH PREDICTION

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ABSTRACT:

Predicting football match outcomes remains difficult, particularly for draws, which account for roughly a quarter of matches but are often misclassified by conventional models. This study presents an automated framework that integrates dynamic Elo ratings with machine learning to forecast results across Europe's top five leagues. Using 28,456 matches retrieved from API-Sports.io and stored in PostgreSQL, we constructed team-level features capturing recent form, goal differentials, and venue-specific performance. Elo differentials are updated after each match to reflect evolving team strength. To address class imbalance (44% home wins, 30.5% away wins, 25.5% draws), Synthetic Minority Oversampling (SMOTE) and isotonic calibration are applied. A voting ensemble combining LightGBM, XGBoost, and Random Forest achieves a weighted F1-score of 0.62 and ROC-AUC of 0.81, with the draw-specific F1 improving from 0.28 to 0.45 after calibration. The pipeline supports automated daily updates and quarterly retraining to adapt to seasonal changes. Results demonstrate that fusing Elo-based ratings with ensemble learning enhances minority-class prediction in football analytics, though modeling the full complexity of match dynamics remains challenging.

Keywords: Machine learning; Ensemble learning; Elo rating system; Football match prediction; Automated data pipeline.

CHARACTERISTICS OF PULVERIZED CO-FIRING OF BROWN COAL AND BLACK PELLETS

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Kenan Kadic



Anes Kazagic



Nedim Ganibegovic

ABSTRACT:

Positive insights and results obtained through laboratory investigations of the combustion characteristics of mixtures of brown coal and black pellets represent the fundamental basis for introducing black pellets into regular boiler operation, particularly in industrial and energy applications. This provides a clear and concrete contribution to the energy transition through decarbonization, as well as to the economic and industrial development, particularly in terms of energy, environmental, and market sustainability of the industrial and thermal energy sectors in Bosnia and Herzegovina. In this context, along with previously obtained extensive and valuable inputs - which ultimately resulted in the regular use of waste wood biomass in boiler furnaces - necessary technical-technological and particularly important process inputs were obtained for the introduction of this type of renewable and CO₂-neutral fuel, primarily for industrial and energy furnaces. Specifically, under laboratory conditions, investigations were carried out on the basic combustion characteristics of pulverized brown coal and black pellets separately, and then of various mixtures of these component fuels, all under identical temperature and technical-technological conditions related to fuel feeding, the overall air excess coefficient, and the primary measure of staged air supply into the reaction zone through four separate air portions. Under these combustion conditions, results were obtained regarding the emission levels of key pollutants (NO_x and SO₂) and undesirable components (CO₂) in flue gases, as well as the efficiency of primary energy conversion from fuel, evaluated through CO emissions and the combustible content in slag and ash. Additionally, important insights were gained concerning the behavior of the mineral fraction of these fuels in terms of potential fouling of heating surfaces in the furnace and the boiler.

Keywords: coal, black pellets, co-firing, efficiency, emission, ash.

ONE-SLIT DIFFRACTION EXPERIMENT ENHANCED WITH LDR

UNAPRIJEĐENI EKSPERIMENT DIFRAKCIJE NA JEDNOJ PUKOTINI S FOTOOTPORNikom

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Emina Džaferović-Mašić



Mateo Bušić

ABSTRACT:

Diffraction of monochromatic light on one, two or more slits has been one of the most popular, visually understandable and performed experiments from elementary school to undergraduate studies. In this article, we want to present a somewhat different and enhanced one-slit diffraction set-up where we use LDR (light dependent resistor) in order to show how instead of measuring light intensity in dependence of sine of an angle of diffracted light beams, we can measure current intensity as a surrogate for light intensity and produce the same graph. In addition, we provide a detailed mathematical derivation for this set-up as well as calculation of slit width to show an excellent fit and match between the real and experimentally achieved value of slit width.

Keywords: diffraction, LDR, light dependent resistor, one-slit diffraction, interference

SAŽETAK:

Difrakcija monohromatske svjetlosti na jednom, dva ili više proreza jedan je od najpopularnijih, vizualno razumljivih i najizvođenijih eksperimenata od osnovne škole do preddiplomskog studija. U ovom članku želimo predstaviti donekle drugačiji i poboljšanu postavku eksperimenta difrakcije na jednom prorezu gdje koristimo LDR (fotootpornik) kako bismo pokazali kako umjesto mjerenja intenziteta svjetlosti u ovisnosti od sinusa ugla difrakcijskih svjetlosnih snopova, možemo mjeriti intenzitet struje kao zamjenu za intenzitet svjetlosti i proizvesti isti graf. Osim toga, pružamo detaljan matematički izvod za ovu postavku, kao i proračun širine proreza kako bismo pokazali izvrsno pristajanje i podudarnost između stvarne i eksperimentalno postignute vrijednosti širine proreza.

Glavne riječi: difrakcija, LDR, fotootpornik, difrakcija na jednoj pukotini, interferencija

MAGNET-ZEOLITE-DRIVEN ELECTROCOAGULATION OF SYNTHETIC LAUNDRY GRAYWATER

MAGNETOM I ZEOLITOM POTPOMOGNUTA ELEKTROKOAGULACIJA SINTETSKE SIVE VODE IZ PRAONICA RUBLJA

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ABSTRACT:

Laundry wastewater contains high organic loads and turbidity, with seasonal tourism in Dalmatia further increasing its volume. This study investigated the treatment of synthetic laundry greywater using electrocoagulation (EC), evaluating the effects of electrode materials (Zn, Fe, Al), zeolite (Z) and magnetic field (MAG) assistance as process drivers. Electrochemical behaviour of electrode material and treatment efficiency were assessed via pH, temperature, chemical oxygen demand (COD), turbidity, and electrode consumption. Sedimentation behavior, and electrode surface morphology were also examined, while operational costs, including energy, electrodes, and Faraday efficiency, were estimated to assess cost-effectiveness of Z- and MAG-driven-EC for greywater treatment.

Keywords: electrocoagulation, laundry greywater, magnet, zeolite, iron, aluminium, zinc

REZIME:

Otpadne vode iz pranja rublja sadrže visoka organska opterećenja i zamućenje, pri čemu sezonski turizam u Dalmaciji dodatno povećava njihov volumen. U ovom radu ispitana je obrada sintetske sive vode iz pranja rublja primjenom elektrokoagulacije (EK), uz procjenu utjecaja materijala elektroda (Zn, Fe, Al) te potpore zeolita (Z) i magnetskog polja (MAG) kao procesnih poticaja. Elektrokemijsko ponašanje elektrodnih materijala i učinkovitost obrade praćeni su mjerenjem pH-vrijednosti, temperature, kemijske potrošnje kisika (KPK), mutnoće i potrošnje elektroda. Također su ispitani sedimentacijsko ponašanje i morfologija površine elektroda, dok su operativni troškovi, uključujući energiju, elektrode i Faradayevu učinkovitost, procijenjeni radi ocjene isplativosti Z- i MAG-potpomognute elektrokoagulacije u obradi sive vode.

Cljučne riječi: elektrokoagulacija, siva voda iz pranja rublja, magnet, zeolit, željezo, aluminij, cink.

IMPACT OF HIGH-STRENGTH BARS ON SPIRAL COLUMN CAPACITY

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Muhammad
Saad Khan



Muhammad
Yousuf Iqbal



Muhammad
Masood Rafi

ABSTRACT:

This paper presents a reliability-based calibration of strength reduction factors for eccentrically loaded short reinforced concrete columns reinforced with unintended high-strength steel bars. The influence of these bars was examined in spiral columns constructed with varying concrete compressive strengths and reinforcement ratios ranging from 1% to 4%. It was found that the strength reduction factor can vary significantly depending on the load combinations and the level of tensile strain, although it is not affected by the reinforcement ratio. Based on the statistical analysis, revised strength reduction factors for RC spiral columns are proposed, which differ from those prescribed by current design codes.

Keywords: *Spiral columns, strength reduction factor, eccentric loading, tensile strain effects, reinforcement ratio, reliability-based calibration*

GREEN TRANSITION AWARENESS IN TÜRKİYE'S IRON AND STEEL INDUSTRY

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Filiz Ersöz



Neslihan Köse

ABSTRACT:

The transition toward low-carbon production poses a critical challenge for energy-intensive industries, particularly within the framework of the European Green Deal. For Türkiye's iron and steel sector, which is highly integrated into European markets, the success of this transition depends not only on technological and financial capacity but also on sectoral awareness and institutional readiness. This study investigates awareness of green steel production and the European Green Deal among professionals in Türkiye's integrated iron and steel industry, with a specific focus on individual demographic characteristics. Data were collected through a structured questionnaire administered to industry professionals working in integrated iron and steel plants located in Karabük province, Türkiye, with expertise in production, energy, and environmental processes. Awareness levels were measured using Likert-scale items, and differences across demographic variables including gender, employment in energy/environmental fields, workplace share ownership, and work experience were analyzed using non-parametric statistical tests. The results reveal that awareness of both the European Green Deal and green steel production remains at a low to moderate level, indicating significant knowledge gaps, particularly regarding regulatory requirements and sectoral impacts. Among the examined variables, only employment in energy or environmental-related positions shows a statistically significant association with awareness levels, while other demographic factors do not. These findings highlight the critical role of domain-specific expertise and continuous professional training in supporting the green transition of the iron and steel industry.

Keywords: European Green Deal; Green Steel; Industrial Decarbonization; Sectoral Awareness; Iron and Steel Industry

AN IMPROVEMENT OF PENDULUM-TYPE TUNED MASS DAMPER USING ADDITIONAL FORCING

POBOLJŠANJE PODEŠENOG MASENOG PRIGUŠIVAČA TIPRA KLATNA KORIŠTENJEM DODATNE PRINUDNE SILE

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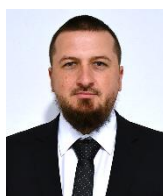
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Safet Isić



Emir Nezirić



Ermin Husak

ABSTRACT:

The Tuned Mass Damper (TMD) is a classical vibration mitigation device that can be implemented in various design configurations. A pendulum-like TMD is particularly suitable for slender structures such as buildings and towers. There are several approaches to improving the performance of a pendulum-like TMD, such as adjusting the pendulum length or incorporating additional external forcing by introducing mechanism that create a counteracting force in addition to the standard inertial damping action. This paper presents an analysis of the effects of additional reactive forcing on vibration control in a two-story building equipped with a pendulum-type TMD. The influence of the additional forcing parameters—amplitude, frequency, and phase—on the damping of vibrations induced by a movable support is analyzed.

Keywords: Pendulum Tuned Mass Damper, Vibration Control, Reactive Forcing, Two-Story Building

SAŽETAK:

Podešeni maseni prigušivač (PMP) je klasični uređaj za smanjenje vibracija koji se može implementirati u različitim konstrukcijskim konfiguracijama. Prigušivač u obliku klatna posebno je pogodan za vitke konstrukcije poput zgrada i tornjeva. Postoji nekoliko pristupa za poboljšanje performansi podešenog masenog prigušivača ovog tipa, poput podešavanja dužine klatna ili uključivanja dodatnog vanjskog pobuđivanja pomoću mehanizma koji proizvodi reaktivnu silu za pojačanje standardnog inercijalnog prigušenja. Ovaj rad prikazuje analizu uticaja dodatnog reaktivnog pobuđivanja na smanjenje vibracija dvospratne zgrade opremljene PMP prigušivačem tipa klatna. Analiziran je uticaj parametara dodatnog pobuđivanja — amplitude, frekvencije i faze — na prigušenje vibracija izazvanih pomičnim osloncem.

Ključne riječi: klatnasti podešeni maseni prigušivač, kontrola vibracija, reaktivna sila, dvospratna zgrada

MATHEMATICAL MODELING AND OPTIMIZATION OF PHOTOVOLTAIC PANEL ORIENTATION WITH SUN-TRACKING SYSTEMS

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Emir Nezirić



Safet Isić



Ermin Husak

ABSTRACT:

Enhancing the efficiency of photovoltaic panels represents a major challenge in the field of renewable energy sources, particularly in the context of optimizing the utilization of solar radiation. This paper investigates the application of solar tracking systems as an effective solution for improving the performance of photovoltaic panels. The focus is placed on theoretical foundations, mathematical modeling, and algorithms, with special emphasis on the Solar Position Algorithm (SPA), which enables precise determination of the Sun's position relative to geographic location, date, and time. By employing this algorithm and mathematical models, various configurations of photovoltaic systems—fixed panels, systems with vertical rotation axes and systems with tilted rotation axes were analyzed to assess their energy efficiency. The results indicate significant advantages of solar tracking systems with tilted rotation axes compared to fixed panels and panels with vertical rotation axes, providing a basis for further research in photovoltaic technologies aimed at increasing the utilization of solar energy.

Keywords: photovoltaic panel, solar tracking, mathematical modeling, SPA algorithm, energy efficiency

SOUND SPEED CALCULATION WITH QUINCKE'S TUBE SET-UP WITHIN DIFFERENT PARAMETRIZATIONS

PRORAČUN BRZINE ZVUKA POMOĆU QUINCKEOVE CIJEVI NA RAZLIČITIM PARAMETRIZACIJAMA

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Imran Husremović

ABSTRACT:

Sound speed has become a quantity that can quite simply be calculated with the rise of technology and digitalization of equipment and procedures. Yet, full digitalization takes away an important part of problem solving skills development in the process itself. In this article we want to present a combination of something old and something new where the aim is to show that old and simple mechanics set-up (Quincke's tube) can be a perfect match with modern equipment (PASCO sensors and DATA STUDIO software), for students to take an active part in setting the right equations, choosing the right values for different parameters instead of simply taking the given values and formulations from the textbook to find sound speed value. In particular, we are performing calculation for sound speed in the air. In dependence of different frequencies, as well as sample rate and range of time for each measurement, we will present the variation in results verified with the theoretical value obtained using the temperature dependent formula for sound speed.

Keywords: sound speed, Quincke's tube, DATA STUDIO, sample rate, PASCO sensors

SAŽETAK:

Brzina zvuka postala je veličina koja se može prilično jednostavno izračunati s razvojem tehnologije i digitalizacijom opreme i postupaka. Međutim, potpuna digitalizacija oduzima važan dio razvoja vještina rješavanja problema u samom procesu. U ovom članku želimo predstaviti kombinaciju nečeg starog i nečeg novog gdje je cilj pokazati da se stara i jednostavna mehanička postavka (Quinckeova cijev) može savršeno uklopiti s modernom opremom (PASCO senzori i DATA STUDIO softver), kako bi studenti aktivno sudjelovali u postavljanju pravih jednažbi, odabiru pravih vrijednosti za različite parametre umjesto jednostavnog uzimanja zadanih vrijednosti i formulacija iz udžbenika kako bi pronašli vrijednost brzine zvuka. Konkretno, izvodimo proračun brzine zvuka u zraku. Ovisno o različitim frekvencijama, kao i brzini uzorkovanja i vremenskom rasponu za svako mjerenje, prikazat ćemo varijacije rezultata provjerene s teorijskom vrijednošću dobivenom korištenjem temperaturno ovisne formule za brzinu zvuka.

Ključne riječi: brzina zvuka, Quinckeova cijev, DATA STUDIO, brzina uzorkovanja, PASCO senzori

FINITE VOLUME ANALYSIS OF THERMAL BEHAVIOUR OF BINGHAM PIPE FLOW

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ABSTRACT:

This work presents a methodology and the results of a numerical analysis of the thermal behaviour of a Bingham fluid. The finite volume method and a solution procedure based on the SIMPLE algorithm are used. The rheological behaviour of the fluid is described by the Bingham plastic. The effects of the Brinkman and Bingham numbers on the thermal behaviour of the fluid are analysed and dis-cussed. The numerical predictions of the average temperature field show very good agreement with the theoretical solution, where the temperature is nearly constant in the plug region and changes in the yielded region. The results show that both Brinkman and Bingham numbers have a significant effect on the thermal behaviour of the fluid. For higher values of the Brinkman and Bingham numbers, viscous dissipation becomes the dominant mechanism in the flow, which lead to an increase of the fluid temperature.

Keywords: Bingham fluid, Bingham number, Brinkman number, heat transfer

COMPARATIVE ANALYSIS OF THE PERFORMANCE OF TOOL MATERIALS WHEN TURNING HARDENED STEEL

KOMPARATIVNA ANALIZA PERFORMANSI ALATA PRI STRUGANJU KALJENOG ČELIKA

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Mirfad Tarić



Pavel Kovač



Borislav Savković



Safet Velić

ABSTRACT:

This paper presents a comparative analysis of the performance of tool inserts made of hard metal (HM) and cubic boron nitride (CBN) during longitudinal turning of a workpiece made of hardened steel X210Cr12, the hardness of which is 62 HRC. The experiments were performed on a machining center with cutting inserts of identical geometry in order to provide conditions for a direct comparative analysis. The main cutting resistance, penetration resistance and roughness of the machined surface were measured. The results show that the forces, as well as the roughness, in all experiments are significantly higher for HM inserts compared to CBN inserts. The roughness of the processed surface largely depends on the applied processing mode. Such findings have significant industrial potential, as they enable the optimization of the hardened steel processing process through the selection of the appropriate tool material.

Keywords: Hard steel, turning, design experiment, surface, cutting forces

SAŽETAK:

Ovaj rad predstavlja uporednu analizu performansi alatnih pločica napravljenih od tvrdog metala (TM) i kubnog borovog nitrida (CBN) tokom uzdužnog struganja radnog predmeta napravljenog od kaljenog čelika X210Cr12, čija je tvrdoća 62 HRC. Eksperimenti su izvedeni na obradnom centru sa reznim pločicama identične geometrije kako bi se obezbedili uslovi za direktnu uporednu analizu. Merenja su glavni otpor rezanju, otpor prodoru i hrapavost obrađene površine. Rezultati pokazuju da su sile, kao i hrapavost, u svim eksperimentima znatno veće za TM pločice u poređenju sa CBN pločicama. Hrapavost obrađene površine u velikoj meri zavisi od primenjenog načina obrade. Ovakvi nalazi imaju značajan industrijski potencijal, jer omogućavaju optimizaciju procesa obrade kaljenog čelika kroz izbor odgovarajućeg materijala alata.

Ključne riječi: ojačani čelik, struganje, dizajn eksperiment, površina, sile rezanja

RESEARCH ON WELDED JOINTS WITH HETEROGENEOUS WELD METAL OF HIGH-STRENGTH STEELS IN THE AVIATION INDUSTRY

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Andriy Voïtovich



Liudmyla Dzyubyk

ABSTRACT:

The use of high-strength steels in the aviation industry is a common practice for reducing the metal consumption of structures while maintaining their strength. Welding such elements still requires the application of special technological techniques to ensure the crack resistance of joints. One of these techniques is based on using multilayer welds with different structural–phase compositions. Such a complex system of weld joint formation requires a thorough study of the material's characteristics through an integrated approach, where individual experimental methods complement one another. In particular, this work employs the well-known method of contact local thermoelectromotive force (CL TEMF) to determine the characteristics of the boundary region and the fusion zone in a welded joint with dissimilar weld passes. Linear dimensions of the individual parts of this zone were established, and the influence of preheating temperature on the microstructure of the welded joint of a high-strength medium-alloy steel of the 30CrMnSi type was investigated. The welds used were two-layer: the root pass was produced with an austenitic structure, while the fill pass had a ferrite–pearlite structure. Transition areas between the separate weld layers were also examined using the CL TEMF method. It is shown that increasing the sample preheating temperature before welding enlarges the fusion zone dimensions, while the average gradient of the CL TEMF change consistently decreases. It was established that solid interlayers of different nature are formed in the fusion zone, and their microhardness may significantly exceed its value in the weld metal. Methods for reducing the thickness of these solid interlayers are proposed.

Keywords: high-strength steels, dissimilar weld, interfacial zone, heat-affected zone (HAZ), two-layer joint, microhardness, contact local thermoelectromotive force (CL TEMF).

AI-ENHANCED MECHATRONIC ACTUATION AND SENSING FOR AUTONOMOUS VEHICLE DYNAMICS

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Titu



Dragos - Florin
Marcu



Bogdan Florea

ABSTRACT:

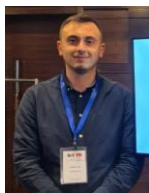
The evolution of autonomous vehicles relies heavily on the precision and responsiveness of mechatronic systems that govern actuation and sensing. This paper explores the application of artificial intelligence (AI) techniques to enhance the performance of mechatronic components responsible for vehicle dynamics, including steering, braking, and suspension control. By integrating machine learning algorithms with advanced sensor fusion, AI-driven mechatronic systems can achieve superior accuracy in environment perception and adaptive actuation under complex and uncertain driving conditions. The proposed framework emphasizes predictive modeling, real-time decision-making, and self-calibration to improve stability, safety, and energy efficiency. Key challenges, such as latency, data integrity, and fail-safe system design, are discussed alongside potential solutions leveraging edge computing and redundancy strategies. The study demonstrates that AI-enhanced mechatronic actuation and sensing represent a critical step toward reliable and scalable autonomous mobility, enabling vehicles to dynamically adapt to diverse operational scenarios with improved robustness and intelligence.

Keywords: autonomous vehicles, mechatronic systems, artificial intelligence, sensor fusion, predictive modeling.

IMPACT OF VEHICLE GEOMETRY ON AERODYNAMICS: COMPARATIVE CFD STUDY OF AHMED AND DRIVAER MODELS

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Ammar Trakić



Mirsad Trobradović



Jasmin Šehović



Dževad Bibić

ABSTRACT:

This study investigates the influence of vehicle geometry complexity on aerodynamic characteristics by comparing the simplified reference Ahmed body with the more realistic DrivAer model. Numerical simulations were performed using the RANS approach with the $k-\omega$ SST turbulence model within the STAR-CCM+ software package, with simulation conditions aligned to available experimental data for validation purposes. Quantitative results demonstrated that both models exhibit good correlation with measurements; however, the Ahmed body showed higher sensitivity to flow separation regimes, whereas the DrivAer model provided a more stable and realistic aerodynamic response. A qualitative analysis of pressure distribution, velocity fields, and wake regions revealed notable differences in flow phenomenology. Pronounced separations and symmetric recirculation zones characterise the Ahmed body, while the DrivAer model generates more heterogeneous patterns with complex vortex structures. The findings confirm that geometric complexity has a significant impact on aerodynamic loads and highlight the importance of realistic reference models in the aerodynamic optimisation of modern vehicle design.

Keywords: Vehicle Aerodynamics, Ahmed Body, DrivAer, CFD, RANS.

ANALYSIS OF WATER MOTION IN A HYDROPOWER PLANT RESERVOIR DURING A FLOOD WAVE EVENT

ANALIZA KRETANJA VODE U AKUMULACIONOM JEZERU HIDROELEKTRANE PRI POJAVI VODENOG VALA

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Mensud Đidelića



Adis Bubalo



Suad Špago



Muris Torlak

ABSTRACT:

Climate changes increasingly cause extreme rainfall and floods that threaten the safety of hydropower and other facilities, people and their property. This paper presents an analysis of variation in water level in a hydroelectric power plant's reservoir in severely intensified hydrologic conditions, during the motion of a flood wave followed by evacuation of water through overflow over the dam and discharge through the turbines. The analysis considers the most important technical characteristics of the hydroelectric power plant, including shape and dimensions of the spillway gates, the reservoir and the surrounding terrain, and the discharge through the turbines. The presented mathematical model includes the measured inflows into the reservoir and their geographical locations, as well as the operating characteristics of the spillway gates. The impact of overflow time and the number of open gates on maintaining the water level in the reservoir within the acceptable limits is presented.

Keywords: hydroelectric power plants, reservoirs, flood wave, overflow, modeling

SAŽETAK:

Klimatske promjene sve češće uzrokuju ekstremne padavine i poplave koje ugrožavaju sigurnost hidroenergetskih i drugih objekata, ljudi i njihove imovine. Ovaj rad prikazuje analizu promjene nivoa vode u akumulaciji hidroelektrane u izrazito pojačanim hidrološkim uslovima, tokom kretanja vodenog vala uz evakuaciju vode preljevanjem na brani i kroz turbine. Analiza uzima u obzir najbitnije tehničke karakteristike hidroelektrane, uključujući oblik i dimenzije preljevnih zatvarača, akumulacije i okolnog terena, te kapacitet turbina. Predstavljeni matematički model uključuje izmjerene dotoke u akumulaciju i njihov geografski položaj, te radne specifičnosti preljevnih zatvarača. Prikazan je uticaj vremena preljevanja i broja otvorenih zatvarača na zadržavanje nivoa vode u akumulaciji unutar prihvatljivih granica.

Cljučne riječi: hidroelektrane, akumulacije, vodeni val, preljevanje, modeliranje

CONSTRUCTIONAL OPTIMIZATION OF FLUE GAS CHANNEL IN A HOT-WATER BOILER BASED ON NUMERICAL FLOW ANALYSIS

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¹Džemal Bijedić, University of Mostar, Faculty of Mechanical Engineering

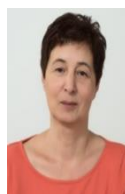
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S. Muharemović



J. Halilović



M. Manjgo

ABSTRACT:

This paper presents a constructional optimization study of the flue gas channel in a hot-water boiler based on numerical flow analysis. The geometry of the flue gas channel represents a key boiler component, since it directly affects flow uniformity, hydraulic losses, and thermal loading of internal surfaces. Several constructional variants were developed by modifying the length and diameter of the heat exchanger pipes within the channel layout. In addition, the influence of different flue gas mass flow rates on velocity distribution and pressure drop was investigated. The CFD results indicate that increased flow rates lead to higher maximum velocities, larger pressure losses, and increased thermal loading of the channel structure. The comparison of investigated variants demonstrates that certain geometric modifications, particularly tube diameter enlargement, improve flow conditions and reduce unfavorable local acceleration zones. The obtained findings provide practical guidelines for the design and development of compact flue gas channels with improved hydraulic performance and balanced operating conditions.

Keywords: *flue gas channel, constructional optimization, hot-water boiler, numerical flow analysis, CFD*

APPLICATION OF FAILURE MODES AND EFFECTS ANALYSIS (FMEA) FOR RELIABILITY IMPROVEMENT OF CENTRIFUGAL PUMP SYSTEMS IN INDUSTRIAL APPLICATIONS

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National University of Science and Technology POLITEHNICA Bucharest, Bucharest, Romania



Cristina-Mihaela Fleacă

ABSTRACT:

Centrifugal pumps are critical components in many industrial systems, and their failure can lead to significant operational, economic, and safety consequences. This paper presents a structured application of Failure Modes and Effects Analysis (FMEA) to identify, evaluate, and prioritize potential failure modes in centrifugal pump systems used in industrial environments. The study focuses on key pump subsystems, including the impeller, shaft, bearings, seals, and casing. Risk Priority Numbers (RPNs) are calculated based on severity, occurrence, and detection criteria adapted to industrial operating conditions. The results highlight the most critical failure modes affecting pump reliability and propose targeted preventive and corrective actions. The research demonstrates how FMEA can support condition-based maintenance strategies and improve decision-making in pump system management.

Keywords: *FMEA, centrifugal pumps, reliability analysis, maintenance engineering, risk assessment.*

MODELING OF THE LASER CUTTING PROCESS USING RSM BASED ON BOX-BEHNKEN DESIGN

MODELIRANJE PROCESA LASERSKOG REZANJA PRIMJENOM RSM NA OSNOVU BOX-BEHNKEN DIZAJNA

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Derzija
Begic-Hajdarevic



Izet
Bijelonja



Kenan
Muhamedagic



Ahmet
Cekic

ABSTRACT:

In this paper, the RSM method was applied to develop a mathematical model for predicting the perpendicularity of the cut during the laser cutting of 2 mm thick aluminum alloy. Controlled process parameters such as laser power, cutting speed and nitrogen assist gas pressure are applied to perform the experiments based on Box-Behnken design. A reduced quadratic regression model was developed with a determination coefficient of $R^2=96.69\%$, that confirms its reliability. Results showed that the laser power has a most significant effect on the perpendicularity of the cut, followed by cutting speed and assist gas pressure.

Keywords: laser cutting, cut perpendicularity, RSM, Box-Behnken, aluminum alloy

REZIME:

U ovom radu, primijenjena je RSM metoda za razvoj matematskog modela za predviđanje okomitosti reza pri laserskom rezanju legure aluminijuma debljine 2 mm. Kontrolisani parametri procesa kao što su snaga lasera, brzina rezanja i pritisak pomoćnog gasa azota su korišteni za izvođenje eksperimenata zasnovanih na Box-Behnken dizajnu. Razvijen je redukovani kvadratni regresioni model sa koeficijentom determinacije $R^2=96,69\%$, što potvrđuje njegovu pouzdanost. Rezultati su pokazali da snaga lasera ima najznačajniji uticaj na okomitost reza, nakon čega slijede brzina rezanja i pritisak pomoćnog gasa.

Ključne riječi: lasersko rezanja, okomitost reza, RSM, Box-Behnken, legura aluminijuma

THEORETICAL PROBLEMS OF MODELING THE TRAPEZEIDIAL THREAD CUTTER WHIRLING PROCESS

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ABSTRACT:

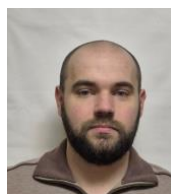
The whirling threading process is quite productive, but it contains a number of bottlenecks that need to be clarified. Among them: the curvilinear deviation of the convolute screw from the standard straightness of the trapezoidal thread profile, as well as the waviness of the obtained thread surface. The problem of the appearance of waviness of the surface, which can presumably be eliminated under such conditions as an increase in the distance between the centre of rotation of the workpiece and the centre of tool holder disk, as well as with an increase in the relative speed of rotation of the spindle and the holder disk and, obviously, with an increase in the number of inserts on the holder disk. The problem of obtaining a curvilinear side profile of the trapezoidal thread, instead of a straight one, which arises as a result of using the angle of inclination of the tool holder disk, which is required to ensure the wear resistance of the tool, can be eliminated or minimized by using the same angle of inclination of the tool holder disk in the manufacture of the screw and nut.

Keywords: threading, screw, whirling ring, thread profile

TECHNOLOGICAL ASSURANCE OF PRODUCT SHAPE FORMATION ON THE BASIS OF COMPLEX TECHNOLOGICAL AND ECONOMIC CRITERION

Oleg Konyukh¹, Taisia Nakonechna¹, Nazarii Kusen¹, Pavlo Brukhal³, Tetiana Lukan², Lolita Pituley²

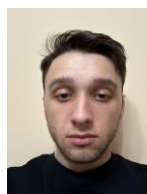
¹Lviv Polytechnic National University, 79013 Lviv, Ukraine
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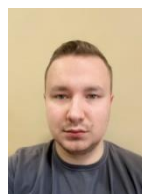
Oleg
Konyukh



Taisia
Nakonechna



Nazarii
Kusen



Pavlo
Brukhal

ABSTRACT:

The continuous increase in technical requirements for critical parts, in the context of a decrease in product development times, requires the development of new methods for modelling production processes to predict the behaviour of components in product shape formation systems. Machining by cutting during product manufacturing is used to ensure regulated quality parameters, despite its significant limitations in accordance with the requirements of Industry 4.0/5.0. Predicting the behaviour of technological system elements and process media to ensure product life cycles during machining by cutting requires thorough research nowadays. The developed method for predicting the behaviour of the technological system for part machining by cutting using the Markov chains technique is presented in this research. The technological assurance of reliability metrics during parts machining is determined by the failure to reach the limit state of the components of the technological system: machine tool-fixture-cutting tool-workpiece, according to the reliability engineering concept. Three interrelated stages of reliability engineering – physics, statistics, and engineering are described in detail for technological operation 005 Horizontal milling during machining of the reduction-gear housing. The advantages and disadvantages of both sequential and integrated implementation of the main stages of reliability engineering and their interrelationships are analysed in this study. A method of product optimisation synthesis during machining of the reduction-gear housing quality by milling has been developed. Further research will be closely related to analysing the modelling results according to the Markov chains technique and theoretical and experimental research for different types of products.

Keywords: reliability engineering, functionally-oriented technology, Industry 4.0/5.0, technological cost, shape formation time, cutting time.

INVESTIGATION OF THE MILLING PERFORMANCE OF DIFFERENT SUPPORT STRUCTURES PRODUCED BY FDM USING HYPER PLA

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Alper Uysal**

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Yavuz S. Gözüml



Mehmet A. Bayrak



Onur Tosun



Y. Furkan Yapan

ABSTRACT:

Fused deposition Modeling (FDM) enables the fabrication of complex geometries and facilitates rapid prototyping. However, the use of support structures is inevitable, and postprocessing is required for their removal. This step significantly influences the overall production time, manufacturing cost, and surface quality. In additive manufacturing, support geometries play a crucial role in determining part quality, as different structural designs can considerably affect both surface finish and machinability. In this study, the milling performance of four newly designed support geometries (gyroid, float, snowflake, and root) produced from Hyper PLA was experimentally evaluated in terms of cutting force, feed force, cutting temperature, and surface roughness. The snowflake support structure exhibited the best overall machining performance, whereas the root design exhibited the poorest results. Compared with the root configuration, the use of the snowflake support reduced the cutting force, feed force, cutting temperature, and surface roughness by 49.9%, 48.5%, 41.4%, and 15.3%, respectively.

Keywords: Support structure, Milling, FDM, Hyper PLA.

ADVANCED DESIGN AND ADDITIVE MANUFACTURING STRATEGIES FOR A SCALED WIND TURBINE MODEL

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Ioana Catalina
Enache



Andrei
Vilcu



Oana Roxana
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Andrei
Iacob

ABSTRACT:

This paper presents the design, structural assessment, and additive manufacturing of a scaled Darrieus-type vertical-axis wind turbine (VAWT) prototype developed for experimental and educational applications. A comparative evaluation between horizontal- and vertical-axis configurations motivates the selection of a compact VAWT geometry suitable for low-speed wind conditions and rapid prototyping. The development process integrates parametric CAD modelling, analytical aerodynamic estimation, structural verification of critical attachment regions, and fused deposition modeling (FDM) fabrication using PLA material. Numerical assessment confirms operation in a low tip-speed ratio regime prioritizing startup torque and structural robustness. The optimized blade fastening system, simplified rotational assembly, and integration of a compact planetary transmission demonstrate the feasibility of additive manufacturing for functional validation of small-scale wind systems. The study supports the use of additive manufacturing as an efficient engineering tool for rapid experimental development in renewable energy research.

Keywords: vertical-axis wind turbine design, wind energy, 3D modelling, structural analysis, additive manufacturing.

PERFORMANCE EVALUATION OF A LABORATORY-SCALE TUBULAR HEAT EXCHANGER FOR AIR PREHEATING APPLICATIONS

PROCJENA PERFORMANSI LABORATORIJSKOG CIJEVNOG IZMJENJIVAČA TOPLOTE ZA PREDGRIJAVANJE ZRAKA

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Mirela Alispahić



H. Hadžiahmetović



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ABSTRACT

In boilers, a significant amount of heat is lost through flue gases, with exhaust temperatures typically between 100 and 150 °C. This otherwise wasted energy can be recovered by installing a tubular heat exchanger. Preheating the inlet air before combustion directly reduces fuel consumption and increases overall boiler efficiency. To evaluate the potential for waste heat recovery in preheating incoming fresh air, a laboratory model of a tube-in-tube heat exchanger with 75/50 mm diameters was constructed. The average fresh air temperature was 20 °C, while the hot air temperature ranged from 115 to 136 °C. Measurements included airflow velocities in both the inner tube and annular space, as well as fresh-air and hot-air temperatures along the tube length. The analysis assessed heat exchanger effectiveness, heat losses to the surroundings, pressure drops on both the hot- and cold-air sides, and the overall heat-transfer coefficient under laboratory conditions.

Keywords: waste heat, tubular heat exchanger, passive air-to-air type, effectiveness

SAŽETAK

U kotlovima se značajna količina toplote gubi kroz dimne plinove čije su izlazne temperature obično između 100 i 150 °C. Ta inače izgubljena energija može se povratiti ugradnjom cijevnog izmjenjivača topline. Predgrijavanje ulaznog zraka prije sagorijevanja direktno smanjuje potrošnju goriva i povećava ukupnu efikasnost kotla. Kako bi se procijenio potencijal za povrat otpadne toplote iskoristiv za predgrijavanje ulaznog svježeg zraka, dizajniran je laboratorijski model izmjenjivača topline tipa cijev u cijevi prečnika 75/50 mm. Prosječna temperatura svježeg zraka na ulazu bila je 20 °C, dok se temperatura vrućeg zraka kretala od 115 do 136 °C. Na izrađenom modelu direktno su mjerene brzine strujanja zraka u unutrašnjoj cijevi i u prstenastom prostoru, kao i temperature svježeg i vrućeg zraka duž izmjenjivača topline. Analizirana je efektivnost izmjenjivača topline, gubici toplote u okolinu, padovi pritisa na strani vrućeg i hladnog zraka, te ukupni koeficijent prijenosa toplote u laboratorijskim uvjetima.

Ključne riječi: otpadna toplota, cijevni izmjenjivač topline, pasivni tip zrak-zrak, efektivnost

RESEARCH ON ENERGY EFFICIENCY OF CONTACT-TYPE HEAT EXCHANGER NOZZLES

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Roman Klimov



Iryna Sokolovska



Olena Hlushchenko



Predrag Dašić

ABSTRACT:

Industrial enterprises and thermal power plants account for the greatest energy consumption in the fuel and energy complex of Ukraine and the world. The use of fuel at these facilities depends on the efficiency of the machines and units that comprise them. Considering the fact that the value of primary energy resources has only grown in recent years, increasing the efficiency by reducing losses in power plants will significantly reduce their consumption. Contact heat exchangers installed at the outlet of combustion products from boilers allow not only the use of thermal energy for heating water, but also to return the condensate of water vapour from combustion products to the production cycle. We performed the operation simulation of the contact economiser installed after the steam boiler in order to determine the thermal and moisture state of the combustion products, the heating temperature, the amount of water, etc. Using the coefficient of specific energy efficiency of the nozzles in the exhaust gas heat exchangers of the heat engineering equipment makes it possible to analyse the operation of the nozzle space from the standpoint of thermal and hydraulic efficiency.

Keywords: temperature, heat exchanger, nozzle, energy, efficiency.

MULTIFACTOR MODELS FOR DETERMINING OPTIMAL DESIGN OF HEAT EXCHANGERS

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Predrag Dašić², Volodymyr Tonkonogyi³**

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Roman Klimov



Oleg Zhulkovskyi



Olha Filimonenko



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ABSTRACT:

Compressed air is one of the most common and versatile energy carriers, widely used in industry, construction, transport, and other sectors. At the same time, improving energy efficiency, reducing losses in pneumatic systems, and implementing modern energy-monitoring methods remain important priorities. When considering both geometric and energy parameters, it should be noted that when using a smaller number of tubes and the length of a single tube, the hydraulic resistance to the movement of the airflow increases significantly. Additionally, when reducing the length of one tube, the total number of tubes increases significantly to achieve their overall length, which affects not only installation cost but also operational performance. The method for determining the optimal design of heaters using the compactness coefficient is presented. The obtained equations allow the determination of the influence of such factors as the number of rows of tubes transversely to the flow and the length of one tube on the volume of the heat exchanger. The developed method makes it possible to analyse the value of the compactness coefficient in a relatively simple analytical form for various combinations of the given factors and to optimise the design of the heater

Keywords: air, tube, factors, heater, energy, pressure.

COMPARISON OF DIMENSIONAL DEVIATIONS IN SPHERES OF DIFFERENT WALL THICKNESSES FORMED BY EXPLOSIVE FORMING

USPOREDBA DIMENZIONALNIH DEVIJACIJA KOD KUGLI RAZLIČITIH DEBLJINA DOBIVENIH OBRADOM EKSPLOZIJOM

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Stipo Buljan



Darko Šunjić

ABSTRACT:

Explosive metal forming is an advanced high-speed forming technology that utilizes the energy of a shock wave to deform a workpiece into the desired shape within a very short time. This method is particularly effective for forming large or geometrically complex components, where conventional processes often face significant limitations. In such applications, 3D scanning plays a key role by enabling detailed analysis of the workpiece geometry. Comparing models before and after deformation provides clear insight into the distribution of dimensional deviations and the overall quality of the forming process. This paper presents the procedure for determining dimensional deviations on a metal sphere made of St12 material with a sheet thickness of 1 mm. In addition to the analysis of this sphere, a comparison was carried out with spheres of the same material but with thicknesses of 1.5 mm and 2 mm, in order to examine how increasing sheet thickness affects the magnitude of the deviations. Based on the obtained results, conclusions were drawn regarding the material behavior during explosive forming and the geometric stability in relation to wall thickness.

Keywords: explosive forming, deformations, deviations, 3D scan

A COMPARISON BETWEEN RAYLEIGH-RITZ AND FINITE ELEMENT MODELS FOR THE STRENGTH ANALYSIS OF REINFORCED CONCRETE WALLS SUBJECTED TO BLAST LOADS

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ABSTRACT:

The numerical modelling of structural response to impulsive dynamic loads is a topic of significant relevance in structural and safety engineering. The analysis of reinforced concrete elements subjected to blast-induced pressure waves requires models that realistically represent the spatial and temporal evolution of the loads. This study compares a modal beam model based on the Euler-Bernoulli theory, developed in MATLAB, with a finite element model implemented in ABAQUS. In the MATLAB model based on the Rayleigh-Ritz, the beam is discretized into a finite number of nodes, and the displacement field is reconstructed as a linear combination of the analytical mode shapes corresponding to a clamped-free boundary condition. External excitation is defined as a pressure wave generated by a fluid-dynamic simulation in ProSAir, representing the explosion of an equivalent TNT charge at a specified distance from the target. The overpressure values are recorded at selected target points, exported as a tabulated dataset, and used as a standard input for both MATLAB and ABAQUS models to ensure consistent loading. The comparison focuses on the peak values of key response quantities, displacements, and bending moment at the clamped end, taking the ABAQUS results as reference. The absolute error between the two predictions is used as an indicator of the modal MATLAB model's ability to reproduce the dynamic response from finite element analysis. The aim is to define a reproducible framework for validating simplified modal models against detailed FEM simulations under realistic CFD-derived pressure loads.

Keywords: Theoretical and Applied Mechanics, Modal analysis, Rayleigh-Ritz Method, Blast loading, MATLAB, ABAQUS, Euler-Bernoulli beam, Dynamic response, Model comparison

DESIGN METHODOLOGY AND CONTROL STRATEGY FOR THE LOCOMOTION OF A TRACKED UNMANNED GROUND VEHICLE

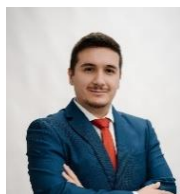
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ABSTRACT:

In the last twenty years, interest in Unmanned Ground Vehicles (UGVs) has grown significantly, driven by their applications in defense, precision agriculture, and infrastructure control. In this context, the main contributions of this work are the definition of a systematic design methodology for mobile robots and the development of dynamic models and control strategies for UGVs. The article begins with an introduction to the world of UGVs and presents the objective the design achieved. The design methodology, virtual model, and electromechanical schematics are then illustrated in detail. The approach demonstrated combines the 3D CAD development phase with multibody modeling and simulation to develop a control algorithm. In particular, a dual PD control system is proposed for tracking the desired trajectory. The results obtained show that this control system is sufficient for monitoring the UGV's trajectory. This work provides an initial methodological basis, and the described approach can be applied to different design concepts characterized by different architectures and extreme operating conditions, corroborated by computer models.

Keywords: Theoretical and Applied Mechanics, Unmanned Ground Vehicles (UGVs), systematic design methodology, SIMSCAPE MULTIBODY, PD control, Vehicle dynamic modeling

MECHANICAL DESIGN OF A NEW COMPOUND PLANETARY GEARBOX MOUNTED ON AN UNMANNED GROUND VEHICLE FOR OFF-ROAD APPLICATIONS

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Guida*

ABSTRACT:

Gearboxes for motion and torque transmission are fundamental to achieving proper vehicle dynamics. This work proposes the development of a new type of compound planetary gearbox featuring an idler between the planetary gear and the crown wheel. The configuration developed stems from the need to create a gearbox that is compact yet capable of withstanding the stresses it is subjected to. The logical path to developing this new design is presented, starting with the classic configuration and highlighting the limitations encountered during the process. The system structure and kinematic relationships are described, with particular attention to the choice of the number of teeth, meshing conditions, and structural strength. The proposed solution is designed for integration into Unmanned Autonomous Vehicles (UGVs) operating in off-road environments, where high reliability, robustness, and high transmitted torque are required. The proposed design is adaptable to a wide range of mechanical systems, making this work a useful reference tool for the design of compact planetary gearboxes.

Keywords: *theoretical and applied mechanics, UGV, powertrain and gearbox design, mechanics of machines, kinematics and dynamics of multibody systems*

OPTIMIZING CONCRETE SCREED FOR STRENGTH, DURABILITY AND WEAR RESISTANCE – MODERN CONCRETE SCREEDS

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ABSTRACT:

This article presents selected results from a comprehensive research program dedicated to optimizing concrete screeds for strength, durability, and wear resistance, with particular emphasis on the development of modern screeds. The research addresses the integration of high-performance cements, mineral additives such as silica fume, and glass fiber reinforcement as key elements of advanced screed technologies. The aim was to determine how optimized mix compositions - considering water-to-cement ratio, cement-to-sand ratio, cement type, and inclusion of admixtures and fibers - affect the mechanical behavior of screeds. An experimental investigation as a part of this research encompassed a number of screed formulations. The mixtures varied in cement type, mineral admixtures, and fiber content. Results showed that screeds with reduced water-to-cement ratios combined with silica fume achieved the highest compressive strength and superior flexural behavior. Fiber reinforcement further improved flexural strength and effectively mitigated microcracking during the drying phase. In contrast, mixes with higher water-to-cement ratios exhibited weaker mechanical behavior, reduced durability, and surface instabilities. By focusing on the role of mineral admixtures and fiber reinforcement, this study highlights the capacity of modern screed systems to substantially enhance long-term durability, wear resistance, and structural integrity in flooring applications. Although part of a broader investigation into screed optimization, the results presented here specifically emphasize the relevance of modern technologies. These findings not only provide practical guidance for engineers but also establish a foundation for ongoing research into advanced screed systems, bridging experimental insights with the demands of modern construction practice.

Keywords: *Modern concrete screeds, Traditional concrete screed, Fiber-reinforced concrete screed, High-performance concrete screed.*

GAGE LINEARITY AND BIAS STUDY OF THE EXPERIMENTAL MEASURING DEVICE COMBINING LINEAR ENCODER WITH FDM TECHNOLOGY

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Branislav Dudić



Biserka Runje



Borislav Savković

ABSTRACT:

Decisions based on measurement results represents one of the key processes in a manufacturing environment. Measurement systems must possess satisfactory metrological characteristics to successfully identify variations in the production process. No measurement system is ideal, which is reflected in the overall variability of the data recorded from the manufacturing process. Measurement System Analysis (MSA) is conducted to determine the level of variability in measurement systems and their contribution to the total process variability, particularly in cases involving the development of an experimental device or the modification of an existing measuring instrument. In this study, an experimental measuring device was developed using additive manufacturing technology, specifically, fused deposition modeling (FDM), to which a linear magnetic encoder was added. The characteristics of this measuring device, such as bias and linearity, were analyzed through an MSA study. In addition, a coordinate measuring machine was used to verify the perpendicularity of the device's measuring probe relative to the worktable. The results of the study do not justify the adopted design solution nor the use of the FDM method for manufacturing the elements of the measuring device.

Keywords: Measurement system analysis, linearity, bias, additive manufacturing, CMM.

DESIGN CONCEPT OF DOUBLE-BASE SOLID-PROPELLANT MOTOR FOR SMALL SOUNDING ROCKETS

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Ajdin Tabić



Faruk Razić



Jasmin Terzić

ABSTRACT:

Small sounding rockets are meant for probing the lower layers of atmosphere. These rockets consist of a solid-propellant motor and a probe carrying electronic sensors, actuators and instruments for measuring atmospheric parameters. This paper investigates and provides design concept of a rocket system that is used for the sounding of the lower layers of the atmosphere. To achieve altitudes up to 2000 m, analysis of the rocket motor, propellant and payload has been completed and presented. On the basis of the ballistic requirements and the selected available propellant charge, the dimensioning of the rocket motor and the assessment of the internal ballistic parameters of the rocket motor were carried out. Preliminary external ballistic analysis, using a 3DOF model for rockets, showed that the given design of the rocket motor will ensure the mission of the sounding rocket. Based on the preliminary design parameters and calculations made by the Research Rocket Society, rocket motor module, payload module and disassembly module have been manufactured and assembled. Static testing of the rocket motor, followed by the flight test of the sounding rocket was planned for the future research.

Keywords: sounding rocket, propellant, nozzle, thrust, material, payload

STATISTICAL MODELLING OF THE INFLUENCE OF CEMENT CLASS ON THE COMPRESSIVE STRENGTH OF CONCRETE

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Farah Mešanović



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Emir Hodžić

ABSTRACT:

Concrete is one of the most widely utilized construction materials, with its performance largely governed by the properties and proportions of its constituents, including aggregates, cement, water, and admixtures. Statistical modelling techniques were employed to assess the impact of cement class on the compressive strength of concrete. A one-way Analysis of Variance (ANOVA) was conducted to determine whether the observed differences in strength among the cement types were statistically significant. To further identify specific group differences, a Tukey HSD post hoc test was employed. Empirical validation methods were incorporated to cross-check the statistical findings, ensuring the reliability and consistency of the results. According to the results, every pair of cement types had significantly varied compressive strengths, indicating that all three types differ from one another statistically. A regression model was created to forecast compressive strength based on cement type after the discrepancies were identified.

Keywords: compressive strength, concrete, cement class, ANOVA, Tukey HSD.

APPLICATION OF FRP BARS IN TIMBER BEAMS

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Merima Salčin



Azra Mahinić Vrce



Fuad Čatović

ABSTRACT:

Wood is an indispensable material in construction, especially in the context of modern building practices and European sustainability policies. As a structural material, its favorable ratio of mechanical properties to self-weight gives it an advantage over other materials in contemporary architecture. The improvement of the mechanical properties of solid wood through developments in the wood industry has led to the application of glued laminated timber. Intensive development of materials in composite systems has resulted in the application of FRP reinforcement in timber structures in order to improve their service performance. An increasing number of studies are focused on the application of FRP reinforcement in timber. One of the possible applications of FRP reinforcement is in the form of rods, which are made of synthetic and natural fibers. This paper presents research on the possibilities of using FRP rods as reinforcement in timber. The advantages of such systems are reflected in more efficient structures, reduced material consumption, and minimal interventions on existing buildings.

Keywords: timber, glulam, beams, FRP reinforcement, strength.

STRESS AND DEFLECTION ANALYSIS OF A WOODEN BEAM FOR A TWO-USER PLAYGROUND SWING

ANALIZA NAPONA I UGIBA DRVENE NOSIVE GREDE NA LJULJAČCI ZA DVIJE OSOBE

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Alma Žiga

ABSTRACT:

This paper presents a structural analysis of the main beam of a two-person playground swing frame. While the European Standard EN 1176-2 describes specific safety requirements and test methods for swings, it does not explicitly provide the detailed calculations necessary for verifying the structural stability of the support components. Using the geometric dimensions adopted in accordance with the standard, this study focuses on the wooden main beam. The static diagram for the beam is presented, and the resulting bending stress and maximum deflection are calculated under specified dynamic loading conditions. These calculated values are then rigorously compared against the prescribed allowable values for the chosen material to confirm the design's safety and compliance.

Keywords: *Playground swing, structural analysis, safety requirements*

SAŽETAK:

Ovaj rad predstavlja strukturnu analizu nosive grede rama dječije ljuljačke za dvije osobe. Iako evropski standard EN 1176-2 propisuje specifične sigurnosne zahtjeve i metode ispitivanja za ljuljačke, on eksplicitno ne navodi detaljne proračune neophodne za provjeru strukturne stabilnosti nosivih komponenti. Koristeći dimenzije elemenata rama, usvojene u skladu sa standardom, ova studija se fokusira na drvenu nosivu gredu. Predstavljen je statički dijagram grede, te su izračunati napon savijanja i maksimalni ugib pod specifičnim uslovima dinamičkog opterećenja. Ove izračunate vrijednosti su zatim rigorozno upoređene sa propisanim dozvoljenim vrijednostima za odabrani materijal kako bi se potvrdila sigurnost i usklađenost dizajna.

Ključne riječi: *Dječija ljuljačka, strukturna analiza, sigurnosni zahtjevi*

INVESTIGATION OF THE STRESS-STRAIN STATE OF A TWO-SUPPORT BEAM TRANSITION OF A MAIN PIPELINE

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Soloviov Oleh¹**

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Andriy Dzyubyk



Volodymyr Grudz



Lyudmyla Dzyubyk



Vitaliy Korendiy

ABSTRACT:

The use of above-ground segments in the construction of main pipelines makes it possible to avoid laying bypass routes, maintain the designed pipeline profile and effectively cross existing obstacles of natural or man-made nature. The length of such segments is relatively small, but the open nature leads to unpredictable changes in operating conditions and requires additional study of the real stress-strain state of the pipeline. In particular, it is necessary to highlight the laying of pipelines in mountainous areas, when various external influences are likely, which are caused by seasonal weather fluctuations in temperature, precipitation, soil erosion, deformation and displacement of soil, changes in the design position of supports, etc. Currently, the use of a beam scheme for laying pipelines is one of the most common design solutions for overcoming relatively small obstacles. Unforeseen vertical movements are possible here, which will change the designed forces in the beam scheme for the above-ground segment of the pipeline. Also, the design of the support elements must take into account probable movements due to the flexibility of individual support elements, construction and structural gaps, structural changes in the geometry of the support elements of the assembly and pipe, installation gaps, etc. Therefore, solving the problems of diagnosing the stress-strain state of above-ground sections, taking into account external influences, is an important and urgent task for the trouble-free operation of main pipelines. In general, the suggested approach shows that the use of mathematical modeling of the spatial position of the beam structure of the above-ground segment transition, in combination with available experimental data on the geometric characteristics of the support elements and the physical and mechanical properties of the soils, allows for a more complete estimation of the strength characteristics of the main pipeline system in the area under consideration.

Keywords: main pipeline, above-ground transition, vertical displacements of supports, intermediate supports of the pipeline, stress state of the pipeline, axis of the pipeline, coefficient of soil bedding, displacement of the pipeline, two-support beam transition.

REGRESSION ANALYSIS OF START MARTENSITIC TRANSFORMATION IN SEMIAUSTENITIC STAINLESS STEEL 17-7PH WITH MODIFIED CHEMICAL COMPOSITION

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Belma Fakić

ABSTRACT:

Precipitation hardening stainless steels have a very wide application in the aviation industry, with great potential for application in the automotive industry. Temperature variation during heat treatment of semiaustenitic 17-7PH steel with modified chemical composition allows obtaining materials with very good mechanical properties with satisfactory microstructural properties. Regression analysis of the influence of the content of individual alloying elements on the properties of 17-7PH steel monitored the influence of the content of chemical elements chromium, nickel and aluminum and their interactions on the values of the temperature of start martensitic transformation, microstructure.

Keywords: semiaustenitic steel, martensite, heat treatment, temperature transformation

THE INFLUENCE OF ENVIRONMENTALLY FRIENDLY LUBRICATING MEDIA ON THE CHANGE IN THE QUALITY OF THE SURFACE LAYER OF A METAL-CUTTING TOOL

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Eshreb Dzhemilov¹, Eldar Vaniev¹**

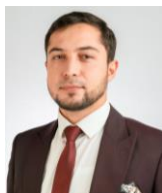
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ABSTRACT:

This article presents the results of a study examining the impact of cutting fluids of varying composition, including those of plant and animal origin, on the hardening of the contact surface of a metal-cutting tool made of HSS-Co high-speed steel with a wear-resistant TiN coating. AISI 321 stainless steel was used as the workpiece material. The tool's durability was increased by running it in an environment with environmentally friendly cutting fluids. The running-in process was carried out at a cutting zone temperature of 200–400°C, measured using a natural thermocouple. An experimental setup designed to provide the required temperature range was also developed, allowing for calibration of the natural thermocouple directly on the lathe. A study of the wear resistance of metal-cutting tools was conducted under conditions recommended for machining stainless steel using the water-miscible 10% cutting lubricant Mobilcut 320 during turning. It was shown that running-in of metal-cutting tools using environmentally friendly cutting lubricants significantly improves their wear resistance.

Keywords: Turning, Lubricating Process Environments, Surface Roughness, Wear-Resistant Coating.

PARAMETERS OF SUPERPLASTIC FORMING OF ALUMINIUM ALLOYS

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Himzo Đukić

ABSTRACT:

Superplastic forming of aluminum alloys makes it possible to produce workpieces with complex shapes, high dimensional accuracy, and high surface quality. This technological process is most widely applied in the aerospace and automotive industries. The design of the technological process of superplastic forming of aluminum alloys involves determining the optimal process parameters. This paper addresses the basic parameters of superplastic forming of aluminum alloys: temperature, strain rate, grain size and shape, and the forming medium. Determining the optimal values of the forming parameters ensures a stable production process and reduced costs.

Keywords: superplastic forming, aluminum alloys, forming parameters, temperature, strain rate

COMPUTER-AIDED DESIGN OF PRODUCTS AND TECHNOLOGIES IN CONCEPTUAL MODELING USING AN INFORMATION MODEL

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ABSTRACT:

The work analyzed the creation of complex architectural structures based on BIM technology. BIM technology covers all stages of a building's life cycle. One of the first stages is the creation of the conceptual model of the building. The formation of a conceptual model of a building is considered in detail. The result is an informational parametric conceptual model for the creation of the complex-shaped building. The proposed model consists of four design levels that sequentially explain the formation of the building. The levels of creating the frame, surface, and solid model are shown sequentially. At the end, the created model is visualized. Each level consists of separate design stages. These stages explain the sequence of creating each of the intermediate model variants. Based on the developed information model, a conceptual model of the oceanarium was created and visualized in Autodesk Revit. Revit is a powerful tool for architects, engineers, and designers that allows them to create 3D models of buildings, perform calculations, analyze data, and generate documentation. Revit supports BIM (Building Information Modeling), the methodology based on the integration of information about an object at all stages of its life cycle. The resulting parametric model of the oceanarium can be modified according to the designer's vision. The result is a fully editable, conceptual bionic model built entirely from built-in shapes, mixtures, voids, and pure Revit logic. The entire structure remains parametric, lightweight, and transparent – ideal for explaining design workflows during the conceptual design stages.

Keywords: Building Information Modeling, conceptual model, information model, surface modeling, solid modeling, visualization.

CONTRIBUTION TO THE PARAMETER IDENTIFICATION OF A CYBERNETIC SYSTEM: DRIVER–TRUCK–ENVIRONMENT

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Aleksandar Đurić



Momir Drakulić



Aleksandar Grkić

ABSTRACT:

The driving of a motor vehicle, in general, and therefore also of a truck, during its movement on the road (in the broader sense of the environment), consists of a cybernetic system: Driver-Truck-Environment (hereinafter referred to as D-T-E). The behavior of that system is important for traffic safety, so it is mandatory to identify its parameters. Therefore, it is necessary to adopt an appropriate research methodology, with the most suitable approach being the one based on vehicle control theory. In this manuscript, an attempt was made to identify some of the parameters that define the D-T-E system. Namely, the behavior of the system during the free driving of the truck in road conditions was determined experimentally. It should be noted that the problem is very complex due to the characteristics of the driver, the dynamic characteristics of the truck and random factors: the micro and macro relief of the road, the influence of the wind, etc. As the characteristics of the driver are related to his personality, taking into account the dynamic characteristics of the truck, it is obvious that the obtained results will have limited significance and they will refer to the FAP 1118 truck.

Keywords: driver, truck, steering system, handling.

PARAMETER REGIONS OF DIFFERENT QUALITATIVE BEHAVIOR OF RATIONAL DIFFERENCE EQUATIONS WITH QUADRATIC TERMS

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Mehuljić

ABSTRACT:

Our research is devoted to a study of qualitative behavior of certain second-order rational difference equation with positive coefficients and initial conditions. By dividing the first quadrant of the parameter plane into disjoint regions, we identify the parameter values that significantly effect the dynamics. We will describe the local approximation of the central manifold of the corresponding equilibrium points. In regions containing nonhyperbolic equilibria, we use center manifold theory to investigate their stability and occurrence of local bifurcations.

Keywords: : Equilibrium Point(s), Center Manifold, Stable and Unstable Manifold, Period-doubling Bifurcation.

ON THE DYNAMICS OF RATIONAL DIFFERENCE EQUATIONS WITH QUADRATIC TERMS OF TYPE (1, 3)

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Vahidin
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Naida
Mujić

ABSTRACT:

Our research is devoted to a study on the local and global behavior of the next equations of type (1,3) (one term in numerator and three terms in denominator)

$$x_{n+1} = \frac{ax_n x_{n-1}}{F(x)}$$

where $a > 0$ and $F(x) = bx_n^2 + cx_n x_{n-1} + d$ is polynomial with positive coefficients b, c, d and with initial conditions (x_{-1}, x_0) from the first quadrant. We will investigate the existence of period-two solutions and their characteristics, as well as the behavior for certain values of the specified parameters.

Keywords: local (global, asymptotic) stability of equilibrium, periodicity, analysis of cyclic behavior, boundedness, period-two solutions.

EXISTENCE AND LOCAL BEHAVIOR OF EQUILIBRIA OF RATIONAL DIFFERENCE EQUATIONS WITH NONLINEAR TERMS

EKSISTENCIJA I LOKALNO PONAŠANJE EKVILIBRIJA RACIONALNIH DIFERENTNIH JEDNAČINA SA NELINEARNIM ČLANOVIMA

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Naida Mujić



Jasmin Bektešević



Amil Pečenковиć

ABSTRACT:

In this paper, we identify the parametric region of existence and describe the local behavior of a first-order rational difference equation containing quadratic terms, under the assumption of nonnegative parameters and arbitrary nonnegative real initial values. Furthermore, we provide a systematic classification of all corresponding local stability scenarios. The complexity of the analytical computations required in this setting has motivated the introduction of a new approach for establishing both the existence and the local stability of every equilibrium point. This type of difference equation naturally appears in various contexts of mathematical modeling, which underscores the relevance and applicability of our results.

Keywords: difference equation, equilibria, asymptotic stability.

SAŽETAK:

U ovom radu određujemo parametarsku oblast egzistencije i opisujemo lokalnu dinamiku racionalne diferentne jednačine prvog reda koja sadrži kvadratne članove, pod pretpostavkom nenegativnih parametara i proizvoljnih nenegativnih početnih uslova. Nadalje, dajemo sistematsku klasifikaciju svih odgovarajućih scenarija lokalne stabilnosti. Složenost analitičkih proračuna potrebnih u ovom okruženju motivisala je uvođenje novog pristupa za dokazivanje egzistencije i lokalne stabilnosti svake tačke ekvilibrija. Ova vrsta diferentne jednačine prirodno se javlja u različitim kontekstima matematičkog modeliranja, što naglašava relevantnost i primjenjivost naših rezultata.

Ključne riječi: diferentna jednačina, ekvilibrijum, asimptotska stabilnost.

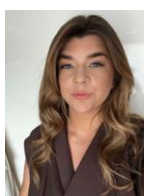
A COMPARATIVE STUDY OF CODE-BASED AND NUMERICAL METHODS FOR STATIC ANALYSIS OF RC FLAT SLABS

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Adna Likić



Sanin Džidić



Smilja Bursać

ABSTRACT:

Reinforced concrete (RC) flat slabs are increasingly used in modern construction due to their architectural flexibility, simple formwork, and efficient load transfer directly from slab to columns. They eliminate the need for beams, providing open-floor spaces that are particularly valuable in commercial and residential buildings. However, this structural simplicity conceals challenges such as punching shear, deflection control, and complex load distribution. This paper presents a comparative analysis of static analysis methods for RC flat slabs. The study examines the performance of a square flat slab system analyzed according to Eurocode 2 (EN 1992-1-1), ACI 318-19, IS 456, and finite element analysis (FEA) using Tower software. Each method is applied to the same geometry and loading conditions and bending moment results are summarized in tabular form. Findings highlight differences in conservatism among codes and demonstrate the ability of FEA to capture realistic structural behavior. The paper contributes to understanding how methodological choices affect the predicted internal forces and, consequently, reinforcement design.

Keywords: flat slabs, concrete, static analysis.

DETERMINANTS OF CONSTRUCTION PROJECT TIME PERFORMANCE: A COMPREHENSIVE SYSTEMATIC REVIEW

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Emad Mamoua



Ahmed El Sayed



Lejla Odobasic Novo

ABSTRACT:

The Construction project duration is shaped by several interacting factors, including labor performance, material management, design changes, cash flow, and weather conditions. This study aims to identify the key elements that influence activity duration during the construction phase. A systematic review of 95 peer-reviewed studies was conducted to examine workforce issues, material supply processes, design modifications, financial stability, and the role of technology. The review shows that labor productivity is the strongest contributor to time variation, with poor supervision and low motivation often leading to delays. Additionally, frequent design changes, weak cash flow control, and unfavorable weather were found to significantly extend project timelines and increase costs. Overall, the findings highlight the complexity of maintaining schedule performance in diverse project environments. Enhanced planning, stronger oversight, and wider adoption of digital tools are essential to reducing delays and improving construction efficiency.

Keywords: construction project success, time performance, labor productivity, material supply chains, design variations, digital construction technologies, project delays.

THE EFFECT OF DIFFERENT GLASS TYPES AS REPLACEMENT FOR SAND ON PROPERTIES OF MORTAR

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M. Ratkusić



M. Čećez



M. Šahinagić-Isović



S. Peco

ABSTRACT:

The increasing demand for natural aggregates and the growing generation of glass waste have accelerated research into sustainable alternatives for cement-based materials. This study investigates the effect of recycled bottle glass as a partial replacement for sand on the fresh and hardened properties of cement mortar. Two types of bottle glass were used, transparent and green, to replace sand at levels of 0%, 10%, 20%, and 30% by weight. Seven mortar mixtures were prepared to examine fresh properties, including workability, air content, and bulk density, while hardened properties were assessed through ultrasonic pulse velocity (UPV), flexural tensile strength, and compressive strength. The results indicate that low replacement levels (10%) of recycled glass can preserve or slightly improve flexural strength. Green glass generally exhibited better flexural and compressive strength retention than transparent glass at higher replacement levels. Although compressive strength decreased with increasing glass content, reductions remained moderate up to 10%. The results confirm that recycled bottle glass, particularly green glass, can be effectively used as a partial sand re-placement in mortar.

Keywords: recycled glass, bottle glass, compressive strength, sustainable materials.

ANALYSIS OF THE EFFECT OF TEMPERATURE VARIATIONS ON THE MECHANICAL CHARACTERISTICS OF ABS MECHATRONIC BRAKING SYSTEM COMPONENTS

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ABSTRACT:

The performance and reliability of mechatronic Anti-lock Braking Systems (ABS) are critically affected by the extreme thermal conditions encountered during real-world operation. These systems are exposed to significant temperature fluctuations, ranging from very high to extremely low values, which can alter the mechanical behavior of their key components. This paper provides an in-depth investigation into the influence of thermal variations on the structural integrity and functional stability of ABS components.

To achieve this, a combined approach is employed: advanced thermomechanical analysis techniques are integrated with rigorous experimental testing. This methodology enables the identification of changes in essential properties such as tensile strength, stiffness, wear resistance, and dimensional stability under cyclic thermal loading. The results demonstrate that repeated exposure to thermal cycles can initiate microcrack formation, accelerate material degradation, and induce variations in braking efficiency.

Furthermore, the study highlights the mechanisms through which thermal stresses interact with mechanical loads, leading to progressive deterioration over time. These findings underscore the necessity of incorporating thermal effect considerations during the design, material selection, and validation phases of ABS development.

Keywords: abs braking systems, thermal stress analysis, mechatronic reliability, material degradation, dimensional stability

INFLUENCE OF GRANITE POWDER AS A PARTIAL REPLACEMENT FOR CEMENT ON THE FRESH AND HARDENED PROPERTIES OF CEMENT COMPOSITES

UTICAJ GRANITNOG PRAHA KAO DJELIMIČNE ZAMJENE ZA CEMENT NA SVOJSTVA SVJEŽIH I OČVRSLIH CEMENTNIH KOMPOZITA

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F. Čatović

ABSTRACT:

The cement industry is one of the largest emitters of carbon dioxide in the construction sector, which is why modern research is increasingly focused on the use of alternative and recycled materials. Granite powder, as a by-product of the natural stone processing industry, occurs in large quantities and most often is discharged as waste. This paper aims to examine the possibility of using granite powder as a partial replacement for cement in cement mortar mixtures, and to analyze its impact on the fresh and hardened properties of the material. The experimental part of the work includes testing the mortar in a fresh and hardened state, namely: workability and setting time, as well as mechanical properties: flexural tensile strength and compression strength. The results obtained are compared with the results of previous research, with the aim of defining the optimal percentage of cement replacement with granite powder.

Keywords: granite powder, cement replacement, sustainable construction, strength.

SAŽETAK:

Cementna industrija je jedan od najvećih emitera ugljičnog dioksida u građevinskom sektoru, zbog čega se moderna istraživanja sve više fokusiraju na upotrebu alternativnih i recikliranih materijala. Granitni prah, kao nusproizvod industrije prerade prirodnog kamena, javlja se u velikim količinama i najčešće se ispušta kao otpad. Cilj ovog rada je ispitati mogućnost korištenja granitnog praha kao djelimične zamjene za cement u mješavinama cementnog maltera, te analizirati njegov uticaj na svojstva materijala u svježem i očvrslom stanju. Eksperimentalni dio rada obuhvata ispitivanje maltera u svježem i očvrslom stanju: konzistencija i vrijeme vezivanja, kao i mehaničke osobine: čvrstoća pri savijanju i čvrstoća pri pritisku. Dobijeni rezultati su upoređeni s rezultatima prethodnih istraživanja, u cilju definisanja optimalnog udjela zamjene cementa granitnim prahom.

Ključne riječi: granitni prah, zamjena za cement, održiva gradnja, čvrstoća.

QUALITATIVE ANALYSIS OF FACTORS INFLUENCING THE SUCCESS OF CONSTRUCTION PROJECTS IN BOSNIA AND HERZEGOVINA

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Emad Mamoua



Ahmed El Sayed



Lejla Odobasic Novo

ABSTRACT:

Construction projects in Bosnia and Herzegovina continue to experience persistent schedule delays, and despite advances in project management practices, the underlying causes of time overruns remain insufficiently understood within the local construction context. This study investigates the primary factors affecting time performance and schedule delays during the construction phase of projects in Bosnia and Herzegovina. A qualitative research approach was adopted, combining a structured review of key international and regional literature indexed in databases such as Scopus and Google Scholar with 15 semi-structured interviews with experienced architects, civil engineers, and project managers. involved in both completed and ongoing construction projects. Data saturation was achieved after the 8 interviews, as no new themes emerged; therefore, 8 interviews were selected for detailed qualitative analysis and direct quotation. The collected data were analyzed using thematic analysis to identify dominant patterns and interrelationships among influencing factors. The findings indicate that inadequate planning and management practices, along with frequent design changes, were the most frequently cited causes of schedule overruns. Work motivation, cash flow, productivity, and climate conditions were identified as the main factors affecting construction duration. Additionally, using modern technology and digital tools and management improved and supported more time duration. The findings indicated that the estimated construction duration is shaped by financial, technical, and managerial factors. Also, the human factors that could minimize the construction delays in the Bosnian construction industry.

Keywords: schedule performance, construction delays, construction project Success, qualitative analysis, duration estimation, Bosnia and Herzegovina

PERIODIC POINTS AND GLOBAL DYNAMICS OF RATIONAL DIFFERENCE EQUATIONS WITH NONLINEAR TERMS

PERIODIČNE TAČKE I GLOBALNA DINAMIKA RACIONALNIH DIFERENTNIH JEDNAČINA SA NELINEARNIM ČLANOVIMA

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Naida Mujić



Jasmin Bektešević



Amil Pečenković

ABSTRACT:

This paper is devoted to obtaining an explicit expression for the prime period-two solution and to analysing the global behaviour of a quadratic rational difference equation of order one, under the requirement that both the parameters and the initial conditions are nonnegative. The results identify the basins of attraction for every equilibrium and for period-two solutions, which in turn enables a complete characterization of the global behaviour of the equation and give a comprehensive description of the dynamics throughout the entire parameter space.

Keywords: difference equation, equilibrium, period-two solution(s), asymptotic stability, basin of Attraction.

SAŽETAK:

Ovaj rad posvećen je formulisanu eksplicitnog izraza za periodična rješenja perioda dva i analizi globalnog ponašanja kvadratne racionalne diferentne jednačine prvog reda, uz uslov da su i parametri i početne vrijednosti nenegativni. Dobijeni rezultati određuju bazene privlačenja svake tačke ekvilibrijuma i periodičnih rješenja perioda dva rješenja, što omogućava potpunu karakterizaciju globalnog ponašanja jednačine i daje sveobuhvatan opis dinamike u cijelom parametarskom prostoru.

Ključne riječi: diferentna jednačina, ekvilibrijum, period-dva rješenje(a), asimptotska stabilnost, bazen atrakcije.

PREDICTING UNIVERSITY SUCCESS: VALIDATING MACHINE LEARNING MODELS FOR SOCIAL MEDIA USER ENGAGEMENT

PREDVIĐANJE USPJEHA UNIVERZITETA: VALIDACIJA MODELA MAŠINSKOG UČENJA ZA ANGAŽMAN KORISNIKA NA DRUŠTVENIM MREŽAMA

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Engin Obucic



Mersid Poturak



Dino Keco

ABSTRACT:

This research validates the original machine learning study that predicts user engagement with Facebook image posts of 24 leading universities in the United States, United Kingdom, and Australia. With an emphasis on user engagement classification (high, medium, low), this study benchmarks seven algorithms with different validation techniques, including 66% and 90% train-test splits and 10-fold cross-validation. The results not only validate the original study but confirm that ensemble classifiers, specifically XGBoost and Random Forest, exceed the performance recorded in the original study by consistently achieving high accuracy of above 95% and high performance stability under validation conditions. The findings confirm visual content use for accurate social media user engagement prediction and offer a scalable solution for data-driven content strategy in higher education marketing.

Keywords: *Machine learning, social media engagement, visual content, predictive modeling, higher education marketing.*

THE IMPACT OF GENERATIVE AI TOOLS ON STUDENT ACADEMIC PERFORMANCE: MACHINE LEARNING APPROACH

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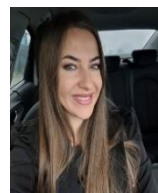
Vladan Čolić



Enes Sukić



Milica Tufegdžić



Marija Mojsilović

ABSTRACT:

Generative artificial intelligence (GAI) tools like ChatGPT are rapidly transforming higher education, yet empirical evidence on their impact on student academic achievement remains limited. This study investigates how three key AI-related factors, AI comprehension support (Q10), AI task assistance (Q16), and learning satisfaction (Q17), predict student achievement (Q18) in AI-supported learning environments. Using a comparative machine learning approach, survey data from 147 IT university students were analyzed with five algorithms: Logistic Regression, Random Forest, Gradient Boosting, CatBoost, and XGBoost. Random Forest achieved the best performance with 66.67% accuracy, outperforming other algorithms. The model demonstrated excellent recall (94%) for high performances, but struggled with minority classes due to severe class imbalance (60.5% high, 32.7% medium, 6.8% low achievement). Feature importance analysis identified learning satisfaction (Q17) as the most important predictor, followed by AI comprehension support (Q10), while AI task assistance (Q16) showed the weakest influence. These findings indicate that attitudes and perceptions matter more than usage frequency for academic achievement. The study provides evidence-based recommendations emphasizing the need for larger balanced samples, SMOTE analysis, and pedagogical approaches that foster positive learning experiences rather than mandating tool adoption.

Keywords: ChatGPT, academic performance, machine learning algorithms, higher education.

NAWI VERIFICATIONS DATA ANALYSIS WITH MACHINE LEARNING TOOLS FOR METROLOGICAL SUPERVISION

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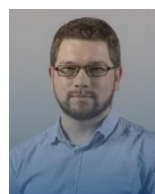
Haris Memić



Šejla Ališić



Almira Softić



Jasmin Kevrić

ABSTRACT:

This paper highlights the advantages of Industry 4.0, specifically in processes of automatic data collection, processing, and data analysis, which significantly contribute in the measurement instruments characteristics. This can be applicable in legal metrology, highly supporting metrological supervision and industrial metrology using feedback from instruments in use. Industry 4.0 has introduced the data analysis, based on the large number of generated metrological reports, previously stored as raw data without relevant overall analyses. The machine learning tools contributed to identifying patterns, generating reports, and creating predictive models. However, with the introduction of Industry 5.0, the role of human and scientific expertise becomes crucial again, as the reliability offered by machine learning tools and artificial intelligence is not guaranteed without human involvement to provide expert judgment and decision-making on the measurement results. This paper presents data analysis of measurement instruments through machine learning tools, implemented through WEKA software that offer fast data retrieval, transformation into databases, and extensive data processing. The focus is on non-automatic weighing instruments (NAWI) as key instruments in legal and industrial metrology, requiring metrological control to ensure accuracy and reliability, protect consumers, prevent fraud, and support fair trade. These progressive tools will support scientific research and metrological supervision of reliable measurements for the end users, as well as the producer for the further improvement of the NAWI, with the human expertise on decision-making.

Keywords: *metrology, data analysis, measurement instruments, machine learning techniques, NAWI, metrological supervision, decision-making.*

AI-DRIVEN TRAJECTORY OPTIMIZATION FOR LARGE-SCALE CONSTRUCTION 3D PRINTING

OPTIMIZACIJA TRAJEKTORIJE VOĐENA UMJETNOM INTELIGENTNOM SISTEMOM ZA 3D ŠTAMPANJE VELIKIH GRAĐEVINSKIH OBJEKATA

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Dašić



Vladimir
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Yevgeniy
Ostroverkh

ABSTRACT:

This study presents a comprehensive evaluation of seven state-of-the-art Large Language Models (LLMs) for construction 3D printing trajectory optimization, G-code generation, and quality assurance. A systematic three-level testing methodology and novel 100-point evaluation framework were developed to assess LLM performance across progressively complex tasks involving five geometric models. Results demonstrate that Claude Sonnet 4.5 achieved production-ready performance, while critical findings reveal that material flow rate constraints govern concrete printing optimization.

Keywords: Construction 3D Printing, Trajectory Optimization, Large Language Models, G-Code Generation, AI-Assisted Manufacturing, Concrete Additive Manufacturing.

REZIME:

Ova studija predstavlja sveobuhvatnu evaluaciju sedam najsuvremenijih modela velikih jezika (LLM) za optimizaciju putanje 3D ispisa u građevinarstvu, generiranje G-koda i osiguranje kvalitete. Razvijena je sustavna metodologija testiranja na tri razine i novi okvir za evaluaciju sa 100 točaka za procjenu performansi LLM-a u progresivno složenim zadacima koji uključuju pet geometrijskih modela. Rezultati pokazuju da je Claude Sonnet 4.5 postigao performanse spremne za proizvodnju, dok ključni nalazi otkrivaju da ograničenja brzine protoka materijala upravljaju optimizacijom ispisa betona.

Ključne riječi: 3D printanje u građevinarstvu, optimizacija trajektorije, modeli velikih programskih jezika, generiranje G-koda, proizvodnja potpomognuta vještačkom inteligencijom, aditivna proizvodnja betona.

QUANTIFYING THE IMPACT OF IMPUTATION QUALITY ON AIR QUALITY FORECASTING MODELS

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Grega Vrbančič



Benjamin Petelinek



Vili Podgorelec



Lucija Brezočnik

ABSTRACT:

Missing values are common in air-quality monitoring due to sensor outages and communication failures, and forecasting models typically require a fully observed input sequence. This work investigates how the choice of imputation method impacts downstream multi-step forecasting performance for particulate matter (PM₁₀). We conduct a controlled case study on two Slovenian monitoring stations using three block-missingness scenarios with identical missing rates but different gap lengths. We evaluate conventional imputers (linear interpolation, moving average, linear regression, KNN) alongside learned imputers (BRITS, SAITS, and transformer-based model) and evaluate both point-wise predictive performance as well as the error growth across the full 72-hour horizon. The results show that longer contiguous gaps generally increase forecasting error and that imputer rankings vary substantially across missingness scenarios, forecast horizons, and forecasting architectures.

Keywords: Time-Series Imputation, Air Quality Forecasting, LSTM, Machine Learning, Environmental Monitoring

REAL ESTATE PRICE FORECASTING USING RANDOM FOREST REGRESSION

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²University of Sarajevo, Faculty of Electrical Engineering, Sarajevo, Bosnia and Herzegovina



Lamija Lemeš



Edin Tabak



Samir Omanović

ABSTRACT:

Accurate real estate price prediction is a critical challenge in data-driven decision-making. This study explores the application of Random Forest Regression for real estate valuation, demonstrating its advantages over traditional predictive models. By effectively capturing complex, non-linear relationships among housing features, the model enhances prediction accuracy and robustness. Two experiments were conducted to analyze model optimization strategies. Experiment 1 investigated the impact of increasing the number of features in a predictor, revealing that more features do not necessarily improve accuracy. Experiment 2 examined the influence of hyperparameters on prediction performance, showing that increasing the number of trees had a greater impact on accuracy than adjusting tree depth or feature count. The results confirm that Random Forest Regression offers reliable performance on commercial real estate datasets. These findings highlight the model's potential for real-world applications and suggest that future research should focus on hyperparameter tuning, feature selection techniques, and ensemble learning strategies to further refine predictive accuracy.

Keywords: Machine Learning, Random Forest Regression, Real Estate, Price Forecasting

ARCHITECTURAL THREAT AND TRUST MODELS IN DISTRIBUTED INFORMATION SYSTEMS

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ABSTRACT:

This paper addresses security of distributed information systems from an architectural perspective by integrating threat modeling and trust modeling. Scalability, automation, multi-domain deployment, and dynamic resource management expand the attack surface and complicate the definition of correct trust boundaries. Approaches focused only on perimeter defense or vulnerability catalogs overlook systemic risks caused by implicit assumptions about isolation, delegated authority, and component behavior. We propose a conceptual architectural framework that represents the system as layered components (infrastructure, platform, service, application) separated by explicit trust boundaries and controlled interaction points. For each layer, typical threat categories, threat sources, and characteristic trust assumptions are identified to explain conditions for lateral and vertical threat propagation. A central element is mapping threat categories to trust assumptions at architectural boundaries, enabling detection of high-risk architectural decisions associated with excessive or transitive trust. The model supports secure design by minimizing trust scope, making assumptions explicit, strengthening isolation, and evaluating trade-offs between security, performance, and operational complexity early in the life cycle. The approach is applicable to cloud-based, service-oriented, edge, and cyber-physical architectures and provides a basis for systematic risk analysis and security management.

Keywords: *attack surface, trust boundary, transitive trust, control plane, lateral movement, isolation, delegation, risk analysis, security-by-design, multi-domain system.*

HYBRID POST-QUANTUM QUIC HANDSHAKES ON CONSTRAINED EDGE DEVICES: DESIGN AND EVALUATION

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Andrii
Koliada



Liubov
Bovnegra



Raul
Turmanidze



Giorgi
Popkhadze

ABSTRACT:

Post-quantum cryptography (PQC) is approaching standardization for large-scale deployment, yet its computational and communication costs on resource-constrained devices and within modern transport protocols remain insufficiently characterized. This study presents a comprehensive experimental evaluation of hybrid key exchange, combining classical elliptic-curve Diffie–Hellman (ECDH) and post-quantum key-encapsulation mechanisms (KEMs), integrated into the QUIC (Quick UDP Internet Connections) protocol for low-power edge nodes. An open testbed was developed to implement hybrid handshakes in a modified QUIC stack and to assess their performance on constrained platforms representative of Internet of Things (IoT) gateways and embedded clients. A dedicated measurement framework captures handshake latency, central processing unit (CPU) and memory utilization, energy draw, packetization and maximum transmission unit (MTU) effects, and goodput under controlled network impairments. The results demonstrate that well-tuned hybrid configurations can achieve acceptable end-to-end latency on contemporary edge-class processors while incurring measurable but manageable overheads relative to classical QUIC. The proposed framework provides a reproducible, script-driven analysis environment for benchmarking QUIC + PQC implementations and incorporates statistically grounded methodologies for evaluating performance across diverse network conditions. These artifacts support independent verification and facilitate future extensions to emerging post-quantum algorithms and transport-layer deployments.

Keywords: QUIC, post-quantum cryptography, edge computing.

A MACHINE LEARNING FRAMEWORK FOR PREDICTING HUMAN PUBIC BONE MORPHOMETRIC PARAMETERS

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Milica Tufegdžić



Milan Mitković



Đorđe Mirjanić



Nevena Tufegdžić

ABSTRACT:

Machine learning (ML) offers promising tools for non-invasive prediction of anatomical parameters in orthopedic research. This study evaluates the feasibility of estimating human pubic bone (os pubis) morphometric parameters using ML models trained on five synthetic datasets derived from CT-based polygonal surface models. Eight anatomical landmarks and ten morphometric parameters were measured. Input features included d_{45} , d_{47} - d_{49} , and d_{57} , while output features consisted of d_{46} , d_{50} - d_{56} , and d_{58} . Several ML algorithms, including K-Nearest Neighbors (KNN), Random Forest, Extra Trees, boosting methods, and Support Vector Regression, were tested. Model performance was assessed using root mean square error (RMSE) and coefficient of determination (R^2). The KNN model trained on the second dataset (NumPy vectorized sampling) achieved the best results, with RMSE values of 0.009 - 0.014 and R^2 values of 0.996 - 0.998 across all output features. Feature-specific analysis showed d_{50} was predicted most accurately, while d_{54} and d_{58} exhibited the best fit. These results demonstrate that ML models, particularly KNN, can reliably predict morphometric parameters of the human pubic bone using synthetic datasets, providing a cost-effective, non-invasive approach for orthopedic assessment and planning.

Keywords: Synthetic datasets, Human pubic bone, Machine learning (ML), Root mean square error (RMSE), Coefficient of determination (R^2), Data augmentation.

ANALYSIS OF WATER QUALITY IN SWIMMING POOLS: APPLICATION OF STATISTICS AND MACHINE LEARNING

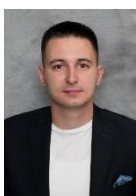
Mirza Pasic^{1*}, Nedim Hamzic², Izet Bjelonja¹, Hadis Bajric¹

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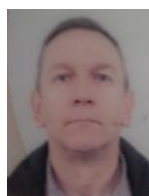
²Secondary School Center “Nedžad Ibrišimović” Ilijas, Kakanjska 16, 71380 Ilijas, Bosnia and Herzegovina



Mirza Pasic



Nedim Hamzic



Izet Bjelonja



Hadis Bajric

ABSTRACT:

Water quality in swimming pools is one of the most important factors for safeguarding users' health and meeting safety standards. In this study, data collected from an Olympic swimming pool were analyzed using machine learning methods, with the aim of predicting and better understanding the relationships between key water quality parameters. Unsupervised learning with the K-means algorithm was applied to identify different operational regimes, while the optimal number of clusters was determined using the Elbow method and the Silhouette coefficient. The resulting clusters were then classified using a multilayer perceptron, and model performance was evaluated based on accuracy and the confusion matrix. The model with four clusters was identified as the most reliable, as it captured stable morning regimes with optimal parameters, as well as afternoon variations influenced by visitor load, temperature, and disinfection conditions. An analysis of feature importance showed that redox potential and temperature had the strongest impact on classifying the operational regimes of the pool's technical system, while the time of measurement played a significant role in the case of the recreational pool. The obtained results enable more precise monitoring and control of water quality and can serve as a foundation for improving treatment optimization systems in swimming pool facilities.

Keywords: *water quality, physico-chemical characteristics of swimming pool water, neural networks, clustering.*

PERFORMANCE EVALUATION OF MULTI-ANTENNA MILLIMETER-WAVE COMMUNICATION SYSTEMS IN INDUSTRIAL SCENARIOS

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¹Institute of Telecommunications, TU Wien, Vienna, Austria



Faruk Pašić

ABSTRACT:

Future industrial wireless systems are expected to use millimeter wave (mmWave) frequency bands to achieve data rates beyond the capabilities of conventional sub-6 GHz systems. To guide the design and deployment of mmWave wireless systems, it is crucial to evaluate their performance under realistic conditions, using conventional sub-6 GHz as a reference. In this study, we assess achievable data rates through dynamic multi-band channel measurements, enabling a fair comparison between the two bands. Measurements are conducted in an indoor industrial environment at 2.55 GHz (sub-6 GHz) and 25.5 GHz (mmWave), with transmit antenna velocities of 50 km/h and 100 km/h. The results show that mmWave systems are highly sensitive to Doppler shifts, leading to significantly reduced performance in dynamic scenarios compared to sub-6 GHz channels.

Keywords: millimeter-wave, sub-6 GHz, measurements, industrial environments, performance evaluation

INTERACTIVE SIMULATION AND VISUALIZATION OF CHAOTIC NONLINEAR DYNAMIC SYSTEMS USING PYTHON

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²University of Maribor, Faculty of Electrical Engineering and Computer Science,
2000 Maribor, Slovenia



*Elmir
Kevilj*



*Ernest
Gungl*



*Zmago
Brezočnik*

ABSTRACT:

This paper presents an interactive simulation and visualization of the chaotic nonlinear dynamics of a double pendulum using Python. The equations of motion are derived using Lagrangian mechanics and solved numerically with SciPy's odeint method. Time-domain plots and animations illustrate sensitivity to initial conditions and the transition from quasi-periodic to chaotic motion. The approach offers a robust framework for investigating nonlinear mechanical systems in educational and research settings.

Keywords: *simulation, visualization, nonlinear dynamics, double pendulum, Python*

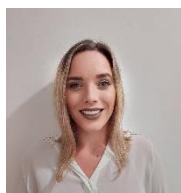
FUZZY GRAPHS AND AGGREGATION FUNCTIONS IN VISUAL DATA SEGMENTATION

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Irma Ibrišimović



Nebojša M. Ralević



Lidija Čomić



Bratislav D. Iričanin

ABSTRACT:

Fuzzy graphs equipped with aggregation functions offer a flexible mathematical framework for representing uncertainty, gradual transitions, and complex relational structures in medical image data. Unlike classical graph models that rely on the existence of sharp edges and binary similarity in images, fuzzy graphs encode variable degrees of connectivity and allow the integration of multiple image features through custom aggregation operators. Therefore, they may be particularly relevant in segmentation tasks in images where boundaries are not precise, contrast may be low, or structures exhibit very heterogeneous visual characteristics.

In this paper, we examine the potential of applying fuzzy graph theory to digital image segmentation. Nodes and edges are defined as fuzzy entities, while aggregation functions use intensity, structure, and texture information, combining them to form unique similarity measures. Such a framework allows pixel regions to be represented with different degrees of membership, reflecting gradual transitions and local variations. By integrating multiple sources of information, fuzzy graphs provide a more flexible representation of local and global relationships within an image compared to traditional graph-based models.

Although this study is at a conceptual stage, we outline how different aggregation strategies can influence the formation of fuzzy relations and their impact on segmentation outcomes. The goal of this approach is to offer a structured yet adaptable way of modelling uncertainty and heterogeneity in visual data. By investigating the fuzzy graph representation and aggregation methods in image processing, this paper highlights promising directions for future research in nuanced image segmentation and analysis, especially in contexts where classical methods may have difficulty detecting some very subtle variations and ambiguous boundaries.

Keywords: Fuzzy graphs, Aggregation functions, Image segmentation, Uncertainty modelling, Medical images

TOWARDS A SUSTAINABLE MODEL OF EQUESTRIAN FACILITIES

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Hari Bibezić



Nerma Smajlović Orman

ABSTRACT:

Sustainable equestrian facilities require careful architectural planning that supports environmental performance, functional efficiency, and the welfare of horses. Although international examples demonstrate advanced approaches, knowledge about equestrian architecture is scattered across disciplines and often lacks a clear architectural synthesis. This study uses a qualitative desktop research approach to identify key principles defining contemporary sustainable equestrian facilities worldwide. Using a synthesis of recent literature and technical guidelines, the study groups these principles into five main categories: spatial organization and circulation, bioclimatic passive design strategies, vernacular materials and design, circular resource systems, and welfare-oriented environments. The findings highlight that successful facilities rely on climate-responsive siting, natural ventilation, appropriate material selection, and spatial layouts that support safe movement, social interaction, and air quality. An architectural framework is proposed to guide the development of sustainable equestrian centers in diverse contexts, providing generally applicable guidelines that integrate sustainability and horse welfare into facility design.

Keywords: sustainability, equestrian facilities, energy efficiency, local materials, bioclimatic design, semi-urban context, horse welfare, circular systems, renewable energy

AURELIA – AN EEG-BASED NEUROADAPTIVE AUDIO SYSTEM FOR MENTAL STATE CLASSIFICATION IN ADHD AND AUTISM

AURELIA – EEG-BAZIRAN NEUROADAPTIVNI AUDIO SISTEM ZA KLASIFIKACIJU MENTALNOG STANJA KOD ADHD-A I AUTIZMA

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Amina Radončić



Mehrija Hasičić

ABSTRACT:

Attention-Deficit/Hyperactivity Disorder (ADHD) and autism spectrum disorder (ASD) are neurodevelopmental conditions associated with distinct electroencephalographic (EEG) signatures. This study presents a neuroadaptive audio recommendation system **AURELIA**, developed in Julia, that analyzes quantitative EEG features to classify mental states and deliver personalized therapeutic soundscapes for individuals with ADHD and ASD. EEG data from 64 participants were processed using standardized preprocessing, spectral analysis across five frequency bands, and feature extraction including TBR, spectral entropy, and Hjorth parameters. The results demonstrate AURELIA's ability to differentiate neurodivergent populations using established EEG biomarkers and generate clinically grounded audio recommendations, highlighting its potential for real-time, closed-loop neuroadaptive interventions.

Keywords: EEG biomarkers, Theta/Beta Ratio, ADHD, Autism, Neurofeedback

REZIME:

Poremećaj pažnje s hiperaktivnošću (ADHD) i poremećaj iz autističnog spektra (ASD) su neurološki razvojni poremećaji povezani s različitim elektroencefalografskim (EEG) karakteristikama. Ova studija predstavlja AURELIA, neuroadaptivni sistem audio preporuka razvijen u Juliji koji analizira kvantitativne EEG karakteristike kako bi klasificirao mentalna stanja i pružio personalizirane terapijske zvukove za osobe s ADHD-om i ASD-om. EEG podaci od 64 učesnika obrađeni su korištenjem standardizirane predprocesiranja, spektralne analize u pet frekvencijskih opsega i ekstrakcije karakteristika uključujući TBR, spektralnu entropiju i Hjorth parametre. Rezultati pokazuju sposobnost AURELIA-e da diferencira neurodivergentne populacije koristeći utvrđene EEG biomarkere i generira klinički utemeljene audio preporuke, ističući njen potencijal za neuroadaptivne intervencije u stvarnom vremenu, zatvorene petlje.

Ključne riječi: EEG biomarkeri, Theta/Beta omjer, ADHD, Autizam, Neurofeedback

PORTABLE HIGH-PERFORMANCE GEMV AND GEMM ON VULKAN COMPUTE SHADERS FOR AI AND ML WORKLOADS

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¹University of Sarajevo, Faculty of Electrical Engineering

¹University “Džemal Bijedić” of Mostar, Mechanical Faculty



Izudin Džafić



Safet Isić

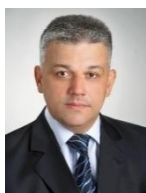
ABSTRACT:

This paper presents a vendor-neutral approach to accelerating GEMV and GEMM using Vulkan compute shaders, targeting not just NVIDIA hardware, but also other GPU manufacturers such as AMD, Apple, and Intel. A set of Vulkan-based linear algebra kernels that incorporate hierarchical tiling, shared-memory blocking, vectorized memory access and subgroup operations in order to maximize arithmetic throughput across heterogeneous GPU architectures is designed and evaluated. The presented implementation achieves competitive performance relative to vendor libraries. The paper also explores architectural differences such as wavefront size, shared-memory layout and cache behavior to show how a single compute back-end in Vulkan is adaptable to all of them. By implementing high-performance GEMV and GEMM with compute shaders, the authors show that Vulkan can serve as a practical, cross-vendor GPU compute solution for modern AI and ML workloads.

Keywords: *Vulkan Compute Shaders, GPU Computing, GEMV, GEMM, High-Performance Computing, Machine Learning Acceleration, AI Workloads*

A METHOD FOR PROTECTING DIGITAL DOCUMENTS FROM UNAUTHORIZED MODIFICATION BASED ON AN IMPROVED RDH ALGORITHM USING ADAPTIVE NOISE REDUCTION

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Anatolii Hrytsak



Iryna Zoria

ABSTRACT:

The conditions of global documents' flow digitalization stipulate for ensuring the integrity and authenticity of digital documents, which is a priority task for information security. Traditional cryptographic protection methods allow to detect an interference, but they mostly do not provide the localization of changes and require to store the additional metadata.

Traditional cryptographic protection methods allow detecting tampering, but mostly do not provide localization of changes and require the storage of additional metadata. The paper substantiates the feasibility of using steganographic methods to protect documents from unauthorized modification by integrating verification information directly into the content structure.

The authors have developed a mathematical model and algorithm for reversible embedding of digital watermarks (DWM) in PDF and JPEG documents. The proposed approach is based on a method of histogram modification using discrete wavelet transform (DWT) in the mid- and high-frequency regions. To minimize visual distortions and increase steganographic stability, an adaptive container noise reduction mechanism has been implemented.

Based on the improved method, a software application was developed and a series of experimental studies were conducted. Analysis of the testing results confirmed the superiority of the proposed solution in terms of qualitative and quantitative indicators compared to the basic method. It has been established that the use of modified DWT coefficients allows to increase the algorithm's resistance to destructive influences on the stegocontainer by an average of 7%, which proves the practical feasibility of implementing the method for protecting digital document flow.

Keywords: RDH (reversible data hiding), DWT (discrete wavelet transform), DWM (digital watermark), digital documents, protection against unauthorized modification.

DATA-DRIVEN ASSESSMENT OF DELIVERY TIME PERFORMANCE IN UNIVERSAL POSTAL SERVICES WITHIN A MULTI-OPERATOR ENVIRONMENT

PROCJENA PERFORMANSI VREMENA DOSTAVE UNIVERZALNE POŠTANSKE USLUGE ZASNOVANA NA PODACIMA U VIŠESTRUKOM OPERATORSKOM OKRUŽENJU

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Ermin Muharemović



Muhamed Begović



Amel Kosovac



Samir Čaušević

ABSTRACT:

The paper presents the results of the statistical processing of data collected during the pilot project for measuring the quality of the universal postal service in Bosnia and Herzegovina for the year 2024. The measurement was conducted in accordance with the European standards BAS EN 13850:2023 and BAS EN 14508:2017. This measurement represents the first attempt to establish an independent and standardized system for monitoring the transmission time of letter mail items in domestic postal traffic in a multi-operator environment. This dataset covers 900 test letter mail items sent by 83 anonymous panelists all over Bosnia and Herzegovina, involving three public postal operators. The paper aims to see how the dispatch day influences delivery times for postal items in Bosnia and Herzegovina. It looks for patterns that reveal which days are best for using postal services in the universal postal network.

Keywords: universal postal service, service quality, transmission time, statistical analysis

SAŽETAK:

Rad predstavlja rezultate statističke obrade podataka prikupljenih tokom pilot-projekta mjerenja kvalitete univerzalne poštanske usluge u Bosni i Hercegovini za 2024. godinu. Mjerenje je provedeno u skladu s evropskim standardima BAS EN 13850:2023 i BAS EN 14508:2017. Ovo mjerenje predstavlja prvi pokušaj uspostavljanja nezavisnog i standardiziranog sistema za praćenje vremena prenosa pismovnih pošiljaka u domaćem poštanskom saobraćaju u višestrukum operatorskom okruženju. Skup podataka obuhvata 900 testnih pismovnih pošiljaka koje je poslalo 83 anonimna panelista širom Bosne i Hercegovine, uz učešće tri javna poštanska operatora. Cilj rada je ispitati kako dan otpreme utiče na vrijeme dostave poštanskih pošiljaka u Bosni i Hercegovini. Analizom se nastoje identifikovati obrasci koji ukazuju na to koji su dani najpovoljniji za korištenje poštanskih usluga u okviru univerzalne poštanske mreže.

Ključne riječi: univerzalna poštanska usluga, kvalitet usluge, vrijeme prenosa, statistička analiza

DIGITAL INFRASTRUCTURE AND THE SECURITY DISCOURSE: ONLINE MEDIA COVERAGE OF FEMICIDE IN BOSNIA AND HERZEGOVINA

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Adem Olovic



Dzenana Telalagic



Ajla Aljovic

ABSTRACT

Femicide in Bosnia and Herzegovina is not only an individual act of violence but a socially and politically mediated phenomenon, actively shaped by online media narratives. This paper examines how digital news outlets and social platforms construct discourses of threat, institutional responsibility, and societal response regarding femicide. Drawing on discourse analysis of online articles published between 2023 and 2025, the study investigates linguistic strategies, metaphorical framing, and representation of victims, perpetrators, and institutions. Particular attention is given to how digital infrastructure and media logic facilitate the dissemination and reinforcement of security narratives in order to covertly influence public perception and legitimize societal norms. The analysis demonstrates that online media operate not merely as information channels, but as sites where cultural, political, and gendered assumptions are reproduced and contested. The findings underscore the importance of critical engagement with digital communications in the context of gender-based violence and highlight the potential of media literacy and technological interventions to mitigate harmful narratives.

Keywords: femicide, gender-based violence, security discourse, online media, digital infrastructure.

DIGITAL INTEGRITY MECHANISMS AND EXPERT E-SYSTEMS AS DETERMINANTS OF EFFECTIVE INSPECTION CONTROL

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Đevad Šašić



Merima Tanović

ABSTRACT:

In the context of rapidly evolving digital environments and increasing demands for accountability, transparency and operational reliability, the introduction of digital integrity mechanisms together with expert e-systems represents a key determinant for improving inspection functions and institutional oversight. The objective of this research is to examine how automated integrity verification, real-time anomaly detection, secured data trails and intelligent decision-support modules influence the accuracy, responsiveness and efficiency of inspection control. The study investigates employees' perceptions regarding system-guided inspection procedures, reliability of digital integrity safeguards, clarity of algorithm-driven decision outputs, and the extent to which expert e-systems support standardization, traceability and regulatory enforcement. The research paper examines advanced modalities of monitoring and oversight aimed at the early detection of corruption, with particular focus on the use of big data tools for asset tracing as well as the operational methods of analytical anti-corruption intelligence embedded within expert e-systems that support the prevention and suppression of corrupt activities. The findings are expected to offer practical guidelines for integrating advanced digital assurance tools into inspection frameworks, especially in environments transitioning toward automation, predictive analytics and AI-assisted evaluation. Furthermore, the research sample extends to include analyzes corruption-risk management mechanisms and their impact on the operational efficiency of inspection authorities, alongside the effectiveness of inspection controls in ensuring legal compliance.

Keywords: Digital Integrity, Anti-Corruption Intelligence, Expert E-Systems, Inspection Control, Traceability, Decision-Support Automation

DIGITAL EVIDENCE AND REPORTING ON THE RESOLUTION OF ADMINISTRATIVE MATTERS IN ADMINISTRATIVE PROCEDURES

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Emir Mehmedović



Rijad Delić



Đevad Šašić

ABSTRACT:

The quality and timeliness of administrative decision-making represent an important indicator of the state of public administration, particularly with regard to the quality of public services. Research findings confirm that the quality of public services is directly correlated with the level of public trust in administration, ease of doing business, and overall social development. Assessing the efficiency of administrative authorities in deciding on the rights, obligations, and legal interests of natural and legal persons requires the availability of objective and reliable data, which can be ensured through appropriate records on the resolution of administrative matters. This paper analyzes the normative framework and practice of recording and reporting on administrative procedures in Bosnia and Herzegovina, with a particular focus on the institutions of Bosnia and Herzegovina in the period 2019–2024. The paper proposes the introduction of a digital model of recording and reporting based on the principles of e-government. The proposed model includes standardized recording templates, automated reporting, real-time performance indicators, and advanced analytics. The aim of the paper is to demonstrate that the digitalization of administrative records is a key prerequisite for improving administrative decision-making, strengthening accountability, and achieving alignment with the standards of the European administrative space.

Keywords: Digital evidence, reporting, administrative procedure, administrative sectors, annual report on the resolution of administrative matters.

MODELLING MARKET FACTORS INFLUENCING THE PRICING OF DIGITAL ASSETS

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Olena Chukurna



Yuliia Olvinska



Hanna Yatvetska



Tetiana Tardaskina

ABSTRACT:

The article presents an improved and in-depth methodological approach to assessing the impact of market factors on the pricing process of digital assets. In particular, the tools for modelling the effect of currency fluctuations on their market value are refined, which allows for a more accurate account of the role of global financial shocks in the functioning of digital markets. The proposed model is based on the use of ARIMA methodology to study the relationship between the US dollar exchange rate and the market value of digital assets formed on the basis of NFT technologies. This approach provides the ability to identify short-term and medium-term trends caused by changes in the currency environment and increases the accuracy of assessing the level of volatility in the digital asset market. The feasibility of using the ARIMA model for forecasting and identifying the presence or absence of the effect of currency fluctuations on the process of forming the value of digital assets has been proven. The use of this model provides the opportunity to statistically correctly assess the relationship between changes in exchange rates and the price dynamics of digital assets, including cryptocurrencies and tokenized instruments.

As a result of modelling the effect of exchange rate pass-through on the value of cryptocurrencies, it was found that there are time lags between changes in exchange rate indices and the corresponding reaction of the digital asset market. This indicates that the reaction of cryptocurrency prices to currency shocks is not instantaneous and is formed under the influence of a number of market and behavioural factors.

Keywords: modelling, market factors, pricing, digital assets

A COMPARATIVE ANALYSIS OF CLUSTERING ALGORITHMS FOR EMPLOYEE SEGMENTATION IN HUMAN RESOURCE MANAGEMENT INFORMATION SYSTEMS

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Arda Alp



Filiz Ersöz

ABSTRACT:

The increasing availability of employee-related data has created new opportunities for human resource management to move beyond intuition-based decision-making toward analytical and evidence-driven practices. However, the multidimensional and unlabeled nature of human resources data makes it difficult to extract meaningful patterns using traditional evaluation methods. In this study, unsupervised machine learning techniques are employed to explore the internal structure of a company's human resources dataset and to identify potential employee segments based on similarity patterns. The proposed approach integrates data preprocessing, dimensionality reduction, and clustering analysis within a unified analytical framework. K-Means and hierarchical clustering algorithms are applied to the dataset, and their outcomes are evaluated using internal validation measures. Rather than imposing predefined performance categories, the analysis focuses on uncovering natural groupings that emerge from the data itself. The results indicate that while distinct employee segments can be identified, the overall structure of the dataset exhibits a relatively high degree of homogeneity, limiting the sharp separation of clusters. These findings highlight both the potential and the limitations of clustering-based approaches in human resource analytics. From a practical perspective, the study demonstrates how unsupervised learning can support HR decision-making by offering an objective view of workforce structure. From an academic standpoint, it provides an applied example of exploratory analysis in an HR context and emphasizes the importance of cautious interpretation when deploying clustering methods on real-world organisational data.

Keywords: human resources management, human research information system, machine learning, K-means, hierarchical clustering, classification

ENHANCING HEMATOLOGY INTERPRETATION WITH RAG: A PRELIMINARY STUDY ON AI-GUIDED CLINICAL DECISION SUPPORT

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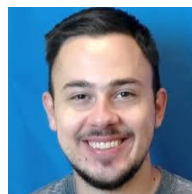
²Faculty of Electrical Engineering University of Sarajevo



Merim Jusufbegovic



Vahidin Hasic



Kenan Sehic

ABSTRACT:

This paper investigates the use of Retrieval-Augmented Generation (RAG) to improve the safety and reliability of large language models in hematology report generation. We compare a baseline GPT-4 model with a RAG pipeline grounded in authoritative hematology sources using 50 clinical cases. Two certified medical laboratory scientists independently evaluated report quality on a five-point Likert scale. The RAG approach reduced the proportion of poor or fair reports and improved inter-rater reliability, increasing Cohen's κ from negative agreement to fair agreement. While one reviewer showed a modest improvement in mean score, the other remained unchanged, indicating persistent variability. The results suggest that ungrounded language models pose significant clinical risks, while domain-specific retrieval provides measurable but limited improvements. We conclude that current models should be considered probabilistic decision aids rather than autonomous diagnostic tools, and that further large-scale validation is required before clinical deployment.

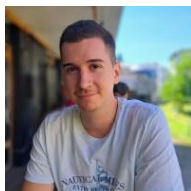
Keywords: Computational Hematology, Large Language Model, GPT-4, Laboratory Automation, Clinical Decision Support.

DEVELOPMENT OF A COST-EFFECTIVE IoT-BASED PROTOTYPE FOR HAZARDOUS SUBSTANCE DETECTION IN SMART HOMES

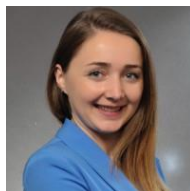
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*Adisa Hasković
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*Nazif
Salihović*

ABSTRACT:

Real-time detection of hazardous substances represents a critical safety requirement in industrial and public environments, including smart homes. Conventional alarm systems predominantly rely on single sensors and fixed thresholds, which limits their reliability and makes it difficult to distinguish complex situations. This paper presents a modular and cost-effective IoT system prototype that integrates readings from multiple sensors to enable contextual classification of four states: normal conditions, elevated pollution levels, gas leakage, and fire. The proposed system architecture consists of a hardware layer for data acquisition based on the Arduino platform and a software layer for data processing and decision-making implemented in the Node-RED environment. The functionality of this system was validated through a prototype designed for indoor environment monitoring, where experimental results confirmed reliable identification of the defined states and activation of appropriate safety responses. The proposed approach provides a practical foundation for the development of intelligent, scalable, and economically viable IoT safety solutions for smart homes and related environments.

Keywords: *IoT (Internet of Things), hazardous materials detection, multi-sensor systems, context-aware analysis, Arduino, Node-RED.*

STRATEGIES FOR EFFICIENT COST MANAGEMENT IN HYBRID CLOUD IT INFRASTRUCTURE

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ABSTRACT: Hybrid cloud infrastructures offer organizations substantial flexibility, elasticity, and operational scalability; however, they also introduce complex financial risks associated with multi-cloud environments, including hidden costs related to resource consumption, data transfers, licensing models, and ongoing maintenance. Effective cost management in such ecosystems requires an integrated governance framework that combines financial discipline with technical optimization and operational efficiency. This study examines key strategies for achieving financial control in hybrid cloud environments, emphasizing the role of FinOps as a collaborative model that aligns IT, finance, and business units in decision-making. Core mechanisms include policy-as-code for automated enforcement of cost-related rules, accurate capacity planning and right-sizing of resources, as well as workload placement based on performance, compliance, and cost metrics. Additionally, techniques such as data location optimization, caching, compression, and the use of spot/preemptible instances are highlighted as essential approaches for reducing operational expenditures. Advanced capabilities including real-time observability, multi-cloud cost dashboards, and artificial intelligence-driven dynamic resource allocation further enhance financial predictability and operational efficiency. Emerging trends such as cross-cloud management fabrics, distributed data mesh governance, and the convergence of cost optimization with security requirements demonstrate that the long-term success of hybrid cloud strategies depends on proactive governance, intelligent workload orchestration, and architectural choices designed for economic sustainability.

Keywords: Hybrid cloud, artificial intelligence, cost management.

ARM-AI: A MULTI-AGENT ARCHITECTURAL PARADIGM FOR AUTONOMOUS RISK MANAGEMENT IN SOFTWARE ENGINEERING

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Claudiu Florin
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Aurel Mihail
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Ioan Danut
Iuonaș

ABSTRACT:

Risk management in software engineering is becoming increasingly complex due to accelerated development cycles and the high interdependence of modern systems. This paper presents ARM-AI, a novel multi-agent architectural paradigm designed to autonomously identify, assess, and mitigate risks throughout large-scale software development processes. The framework integrates three core agents—Detection, Decision, and Compliance—which operate collaboratively within DevSecOps pipelines to ensure continuous monitoring and adaptive response. ARM-AI leverages machine learning models and rule-based reasoning to enhance predictive accuracy, reduce reaction times, and automate the implementation of corrective actions. Experimental evaluation conducted on real-world development environments indicates substantial improvements in early risk detection, mitigation efficiency, and process compliance compared to traditional manual or semi-automated approaches. The findings demonstrate that ARM-AI represents a scalable and reliable solution for modern software organizations aiming to strengthen their resilience and operational stability.

Keywords: Multi-Agent Systems, Risk Management, Software Engineering, DevSecOps, Autonomous Decision-Making, Predictive Analytics

PRACTICAL CYBERSECURITY AND INTEROPERABILITY ANALYSIS IN HETEROGENEOUS IEC 61850 NETWORKS

PRAKTIČNA ANALIZA CYBER SIGURNOSTI I INTEROPERABILNOSTI U HETEROGENIM IEC 61850 MREŽAMA

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Burhan Ljubović



Nedim Osmić

ABSTRACT:

This paper presents an experimental analysis of cybersecurity and interoperability in IEC 61850 substation automation. A heterogeneous testbed was configured using Siemens Siprotec 5 and GE F650 relays, establishing bidirectional GOOSE communication between them. By developing a dedicated packet injection software tool, a vulnerability assessment was conducted through "spoofing" and "replay" attacks. Comparative analysis reveals that modern IEDs utilize stricter non-cryptographic validation (e.g., sequence tracking) compared to legacy models, yet these defenses are not impenetrable. The paper demonstrates the successful bypass of these mechanisms via a precise "race condition" attack, confirming that vulnerabilities of the unauthenticated GOOSE protocol represent a significant risk requiring defense-in-depth strategies.

Keywords: IEC 61850, GOOSE protocol, cybersecurity, interoperability, spoofing, race condition, substation automation.

SAŽETAK:

Ovaj rad predstavlja eksperimentalnu analizu cyber sigurnosti i interoperabilnosti u IEC 61850 automatizaciji podstanica. Konfigurisano je heterogeno testno okruženje korištenjem Siemens Siprotec 5 i GE F650 releja između kojih je uspostavljena dvosmjerna GOOSE komunikacija. Razvojem namjenskog softverskog alata za injektiranje paketa, provedena je procjena ranjivosti kroz "spoofing" i "replay" napade. Komparativna analiza otkriva da moderni IED uređaji koriste strožiju nekriptografsku validaciju (npr. praćenje sekvence) od starijih modela, ali te odbrane nisu neprobojne. Rad demonstrira uspješno zaobilazanje ovih mehanizama preciznim napadom "utrke stanja" (eng.: race condition), potvrđujući da ranjivosti neautentifikovanog GOOSE protokola predstavljaju značajan rizik koji zahtijeva strategije dubinske odbrane.

Ključne riječi: IEC 61850, GOOSE protokol, cyber sigurnost, interoperabilnost, spoofing, race condition, automatizacija podstanica.

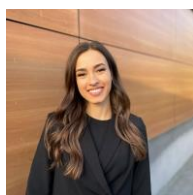
DIGITAL AND AI TOOLS IN EDUCATION: INSIGHTS FROM EDUCATORS AND LEARNERS

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Mubina Kamberović



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Senka Krivić

ABSTRACT:

Digitalization and the rapid development of artificial intelligence (AI)-based tools are increasingly influencing modern education and highlighting the need for its adaptation. Learners and educators in Bosnia and Herzegovina (B&H) are already using these tools, but due to insufficient digitalization of education and the lack of clear guidelines for pedagogically informed use of AI technologies, their application is often inadequate. To better understand the perceptions and needs of educators and learners, we conducted group discussions as part of a workshop with participants from B&H, Montenegro, Albania, and Kosovo. Participants highlighted the risks of maintaining existing practices, including reduced development of learners' cognitive skills, irresponsible use of digital tools, and lowered social interaction, empathy, and practical skills. Educators additionally emphasized challenges in integrating technology, such as the digital skills gap, lack of support and training, and financial constraints. In this paper, we present the discussion results in detail and discuss the potential consequences that maintaining current practices could have on education and broader societal development in B&H.

Keywords: digitalization in education, artificial intelligence in education, teacher and learner perceptions.

A REVIEW OF AREAS OF ARTIFICIAL INTELLIGENCE APPLICATION IN RAILWAY SYSTEMS

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Aida Kalem



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ABSTRACT

Artificial Intelligence (AI) is increasingly transforming the railway sector, offering significant potential to enhance efficiency, safety, and operational management. This paper provides an overview of AI application areas in railway systems, focusing on key segments such as train movement control, traffic management, infrastructure and rolling stock maintenance, and safety. Traditionally, railway operations have been based on rigid timetables and manual decision-making processes, which often reduce operational flexibility and overall efficiency. AI enables real-time decision-making, predictive maintenance, and optimized traffic planning, surpassing conventional methods. By examining current applications and future prospects, this paper highlights AI as an advanced technical solution capable of improving operational planning, safety, and overall performance in modern railway traffic.

Keywords: *artificial intelligence, railways, traffic, train control, traffic management*

DIGITAL TOOLS FOR DATA COLLECTION AND PROCESSING FOR THE DEVELOPMENT OF THE TRANSPORT MODEL OF CITY ŽIVINICE

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ABSTRACT:

Developing a transport model requires the collection and integration of large volumes of diverse data, including traffic movements, characteristics of the transport system, and socioeconomic indicators. In practice, the greatest challenge lies in merging these heterogeneous sources into a coherent and usable dataset. This paper presents the application of modern digital technologies in the process of collecting and processing data for the development of the transport model of the City of Živinice, with the aim of demonstrating their practical value and facilitating future research efforts. Special emphasis is placed on the digital acquisition and processing of data obtained through traffic counts, surveys, analysis of transit flows, and trip assignment to the transport network. Microsoft Access was used for data structuring and management, Google Forms for digital survey collection, and DTK Solutions software for license plate recognition and transit flow identification. QGIS was applied for network digitalization and the creation of spatial databases. The results show that the use of digital tools enables consistent, efficient, and accurate preparation of input data for transport modelling. The presented methodology provides a practical, scalable, and replicable approach that can serve as a reference framework for similar projects in urban environments.

Keywords: digital tools, transport surveys, transport model

APPLICATION OF ARTIFICIAL INTELLIGENCE TOOLS IN MODERN AUDITING

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ABSTRACT:

Modern auditing is being transformed and taking on new dimensions with the development of artificial intelligence (AI). Globally, practices that apply AI tools in control testing, detection of irregularities, and processing of unstructured data have already been developed and proven highly successful, indicating both the need and significant potential for introducing such practices in audit firms in Bosnia and Herzegovina. The advantages of using AI tools in auditing are reflected in increased accuracy in data verification necessary for forming an audit opinion, faster generation of reports, more efficient analysis of large datasets, automation of routine tasks, and quicker identification of irregularities that indicate business areas requiring more detailed examination. This paper presents primary research conducted on a sample of audit professionals with the aim of examining their perceptions regarding the use of AI. The defined sample consists of 126 respondents who answered 40 survey questions. In addition to professionals from Bosnia and Herzegovina, the research also includes, to a lesser extent, professionals from Serbia and Slovenia, enabling a clearer overview of both the current situation and the potential for the application of AI in auditing. The research conclusions were drawn using appropriate statistical methodologies applied to primary descriptive scales, which enable the measurement of the impact and interrelationships of respondents' attitudes, thereby ensuring an adequate assessment of perceptions regarding the methods and effects of AI usage in auditing.

Keywords: Artificial intelligence, audit, technological innovations, auditing practice, Bosnia and Herzegovina.

EXPLORING THE ROLE OF EMERGING DIGITAL TECHNOLOGIES IN ENHANCING MANAGERIAL DECISION-MAKING

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ABSTRACT:

Digital transformation has become a central driver of organizational performance, particularly within engineering and management fields. Emerging technologies such as artificial intelligence (AI), data analytics, and Internet of Things (IoT) systems offer significant potential to improve the speed, accuracy, and strategic value of managerial decision-making. However, many organizations still face challenges in understanding how these technologies can be effectively integrated into existing workflows. This paper presents a preliminary study aimed at identifying key digital tools that support decision processes within engineering-intensive organizations and assessing their perceived benefits and barriers. The research methodology includes a literature review and an exploratory survey conducted among early-career engineers and managers. Early findings indicate that while awareness of digital technologies is high, their adoption remains uneven due to limited training, unclear implementation strategies, and organizational resistance to change. The study contributes to the ongoing conversation about technology-enabled management by outlining initial insights and proposing directions for deeper empirical research as part of future doctoral work.

Keywords: Digital transformation, managerial decision-making, emerging technologies, data analytics, organizational performance.

ARTIFICIAL INTELLIGENCE-DRIVEN INNOVATION IN FINTECH: USER PERCEPTION AND TRUST AS CATALYSTS FOR TECHNOLOGY ADOPTION

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ABSTRACT:

The successful implementation of Artificial Intelligence (AI) in Financial Technology (FinTech) services fundamentally depends on user acceptance rather than technical sophistication alone. This empirical study examines determinants influencing perceived innovation impact in AI-enabled FinTech through a quantitative investigation of 100 digitally literate university students in Malaysia. Employing descriptive statistics, reliability analysis, Pearson correlation, and multiple regression, we investigate how AI familiarity, perceived benefits, perceived risks, and user trust collectively shape innovation perceptions. Results reveal that user trust and perceived benefits emerge as primary innovation drivers, while technical familiarity and perceived risks demonstrate no statistically significant effects when analyzed collectively. These findings challenge conventional assumptions by demonstrating that trust-building and tangible value propositions drive technology adoption more powerfully than technical knowledge or risk awareness alone. This research provides actionable guidance for FinTech organizations, emphasizing the critical importance of developing trustworthy, transparent, and user-centric AI systems. The study contributes novel insights into AI adoption dynamics in financial services and offers strategic guidance for successful technology deployment in the evolving FinTech ecosystem

Keywords: Artificial Intelligence, FinTech, Technology Adoption, User Trust, Innovation Perception.

A SYSTEMATIC REVIEW OF RESEARCH ON DIGITAL PLATFORMS - DEEPTech INNOVATION: BROADENING OUR HORIZONS

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ABSTRACT:

In digital platforms, constructs are a critical issue that can affect the development and diffusion of innovations in organizations. Our goal is to identify the constructs to strengthen DeepTech innovations in innovation ecosystems. Through a comprehensive review, we offer a new perspective on this challenge. We begin by identifying and grouping the constructs. We found robust evidence to show the strength of digital platform constructs for DeepTech innovation in a sample of literature (scientific articles and book chapters) from the past few years. Our review indicates that the value construct is the most substantive construct for generating DeepTech innovations. Our findings, therefore, contribute to the conversation about the relevance of constructs for orchestrating DeepTech innovations in innovation ecosystems. As digital platforms enhance value generation, DeepTech innovations become stronger. Our study provides a timely reminder about the importance of digital platform constructs for diffusing and scaling innovations in DeepTech startups in innovation ecosystems. This approach aims to pave the way for future studies to accelerate the development of DeepTech innovations in innovation ecosystems.

Keywords: *digital platform, construct, resources, DeepTech innovation, DeepTech startups, DeepTech entrepreneurship, innovation ecosystem, systematic literature review.*

CONNECTED VEHICLES DATA SOURCES FOR NATIONAL ACCESS POINT IMPLEMENTATION

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ABSTRACT:

This paper analyzes data sources from connected vehicles that are suitable for implementation within the National Access Point. Vehicle data is collected from several communication technologies and devices used in the vehicle, as well as cooperative communication technologies, which enable data exchange with external systems. Key technologies include: OBD-II (On-Board Diagnostics), CAN (Controller Area Network), V2X communication (V2V, V2I, V2N), mobile communication networks (4G/5G), in-vehicle sensor systems, eCall system, etc.

Keywords: *National Access Point, Connected Vehicles, Multi-source data fusion, In-vehicle environmental sensors*

**ANALYSIS OF TRANSACTIONAL FACTORS AND LOGISTICS
CHARACTERISTICS OF DELIVERY IN E-COMMERCE USING MULTIPLE
LINEAR REGRESSION**

**ANALIZA TRANSAKCIONIH FAKTORA I LOGISTIČKIH KARAKTERISTIKA
ISPORUKE U E-TRGOVINI PRIMJENOM VIŠESTRUKA LINEARNE
REGRESIJE**

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Amel Kosovac



Adisa Medić



Naida Šehić



Izudina Palo

ABSTRACT:

The aim of this research is to analyze the impact of logistics and transactional factors on the timely delivery of products in e-commerce. A dataset with 10,999 records was used, which includes data describing transactional and logistical factors. The selected method for analyzing this data is multiple linear regression. The results of the analysis indicate that transactional have a statistically significant impact on delivery timeliness, while logistical factors in aggregate form do not show statistical significance, with the exception of as the only logistical indicator with a measurable effect. Graphical analysis and ANOVA further confirm the regression results. The conclusions obtained provide insight into the planning of logistics processes and the optimization of business decisions in e-commerce systems.

Keywords: e-commerce, on-time delivery, transactional factors, logistics

SAŽETAK:

Cilj ovog istraživanja je analiza uticaja logističkih i transakcionih faktora na pravovremenu isporuku proizvoda u e-trgovini. Korišten je dataset sa 10.999 zapisa koji uključuje podatke koji opisuju transakcione i logističke faktore. Odabrana metoda kojom se ovi podaci analiziraju je višestruka linearna regresija. Rezultati analize ukazuju da transakcioni faktori imaju statistički značajan uticaj na pravovremenost isporuke, dok logistički faktori u agregiranom obliku ne pokazuju statističku značajnost, uz izuzetak težine proizvoda kao jedinog logističkog pokazatelja sa mjerljivim efektom. Grafička analiza i ANOVA dodatno potvrđuju rezultate regresije. Dobijeni zaključci pružaju uvid u planiranje logističkih procesa i optimizaciju poslovnih odluka u e-commerce sistemima.

Ključne riječi: e-trgovina, pravovremena isporuka, transakcioni faktori, logistika

THE INFLUENCE OF INFORMATION ON THE UNCERTAINTY OF CONTROL PROCESSES IN INTELLIGENT TRANSPORTATION SYSTEMS

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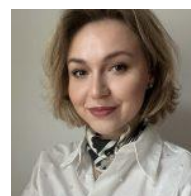
Drago Ezgeta



Samir Čaušević



Ajdin Džananović



Jasmina Sikira

ABSTRACT:

The application of information and communication technologies in transport systems has enabled the development of intelligent transport systems that enable the collection of large amounts of data. Transport systems are complex and open systems whose state is described by a large number of system state variables. The values of the variables change at different time intervals, which leads to system uncertainty. Data collection and processing in intelligent transport systems enables the generation of a large amount of information about the state of the system, which can significantly reduce the uncertainty of ITS. Given that the transport system has a large number of components, the interactions between them are very different. Models for predicting the state of the transport system and managing traffic processes should enable the measurement of their uncertainty. Modeling the uncertainty of the ITS system allows for the determination of the required amount and type of data that need to be collected and processed for individual ITS services. This approach enables the optimal selection of measuring equipment and the required performance of information and communication technologies. Measuring the uncertainty of intelligent transport systems contributes to increasing the performance of ITS service management processes.

Keywords: data, information, uncertainty, intelligent transportation systems

**THE ROLE OF NETWORKING IN INTELLIGENT TRANSPORTATION
SYSTEMS AND SERVICES**
**ULOGA UMREŽAVANJA U INTELIGENTNIM TRANSPORTNIM SISTEMIMA I
USLUGAMA**

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Robert Rijavec

ABSTRACT:

Almost twenty years ago, to connect Slovenia with the pan-European transport network, the Slovenian ITS Association - ITS Slovenia was established. Since then, it has actively contributed to the development and implementation of Intelligent Transport Systems and Services (ITS) in Slovenia and the European Union as the non-profit professional organisation. Today, ITS Slovenia unites sixteen legal entities and over fifty individual members, supported by the Electrotechnical Association of Slovenia as a technical society. As an active member of Network of National ITS Associations - ITS Nationals, it collaborates with similar organizations across Europe. The Ministry of Infrastructure serves as the national authority for ITS, linking ministries, municipalities, and private stakeholders. This paper presents the role and purpose of ITS Slovenia within the national and European ITS community, outlines its key achievements, and looks ahead to future developments. In Europe, the future of ITS will focus on interoperability, harmonised standards, and seamless cross-border data and service integration.

Keywords: ITS Slovenia, ITS Nationals, Intelligent transport systems, networking

SAŽETAK:

Kako bi se povezali s paneuropskim transportnim sistemom, prije skoro dvadeset godina u Sloveniji je osnovano Slovenačko društvo za inteligentne transportne sisteme - ITS Slovenije, koje aktivno učestvuje u planu uvođenja ITS-a u zemlji i EU. Danas je u ITS Slovenija uključeno 16 pravnih i više od pedeset fizičkih lica. Istovremeno, ITS Slovenije je aktivni član Network of National ITS Associations - ITS Nationals, koji je mrežna organizacija u Evropi. Krovno slovenačka ministarstva za uvođenje inteligentnih transportnih sistema i usluga je Ministarstvo za infrastrukturu, koje gradi veze s drugim ministarstvima, općinama i zasebnim subjektima uključenim u ITS. Ovaj rad predstavlja ulogu i svrhu ITS-a Slovenije unutar nacionalne i evropske ITS zajednice, ocrtava njegova ključna dostignuća i osvrće se na budući razvoj. U Evropi, budućnost ITS-a će se fokusirati na interoperabilnost, usklađene standarde i besprijekornu prekograničnu integraciju podataka i usluga.

Ključne riječi: ITS Slovenije, ITS Nationals, inteligentni prometni sustavi, umreživanje

CONTRIBUTION TO THE RESEARCH OF THE HYBRID METHOD OF CATEGORIZATION OF ROAD TUNNELS IN THE TRANSPORT OF HAZARDOUS MATERIALS

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Mirza Berković



Irma Pervić



Samir Džaferović

ABSTRACT:

The transport of hazardous materials through road tunnels represents one of the most complex challenges in the field of transport infrastructure security, since it carries a high risk for people, the environment and property. The European agreement on the international transport of dangerous goods by road (ADR) defines the classification of tunnels into safety categories (A–E), based on which the restrictions and conditions of the transport of dangerous goods are basically prescribed. Nevertheless, the procedure for determining the tunnel category requires a deeper analysis of a wide range of technical, traffic, environmental and organizational criteria, which makes it complex and potentially subject to subjective assessments. The paper investigates a hybrid multi-criteria decision-making approach that integrates the Analytical Hierarchy Process (AHP) and the TOPSIS method. The analytical hierarchical process enables the evaluation of pairwise comparisons and the reliable determination of the relative weights of the criteria. The resulting weights are then used in the TOPSIS method to rank the alternatives based on their distance from the positive and negative ideal solutions. The hybrid method achieves greater precision, transparency and repeatability, thereby reducing the influence of subjectivity and facilitating decision-making in complex security assessment scenarios. The significance of regulating the road transport of hazardous materials through tunnel facilities, in the context of Bosnia and Herzegovina, according to EU standards, is particularly evident due to the absence of a single legal framework of the country in the subject area, as well as the integration of the road network into the TEN-T framework, as well as its further indicative expansion. In the final part of the paper, the authors consider the design of the methodological framework for the implementation of this approach, with the aim of showing how the hybrid method can improve the process of analysis and decision-making when working with complex and loaded data sets. The research results contribute to the development of the theory of modern and transparent decision-making methods in the field of tunnel safety classification.

Keywords: *road tunnels, transport of dangerous goods, multi-criteria decision making, hybrid integration*

UTILIZING DATA FROM PUBLIC MOBILE TELECOMMUNICATIONS NETWORKS IN INTELLIGENT TRANSPORT SYSTEMS

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ABSTRACT:

Intelligent Transport Systems (ITS) represent a modern approach to addressing the accumulated problems in traffic and transport (inefficiency, traffic safety, unreliability, etc.). In this context, there is an increasing recognition of the need to utilize various data sources related to traffic and transport. Today, this is particularly important from the perspective of developing National Access Points as a unique infrastructure for data exchange among different users. Public mobile telecommunications networks and data from telecommunications infrastructure, as well as data from associated devices (mobile terminals and corresponding applications), contain several potential data sources that have the potential to be used in ITS applications. This paper describes the possibilities of applying signaling data from probing systems, CDR, IPDR, and data available through performance management systems

Keywords: Intelligent Transport Systems, National Access Point, Mobile Telecommunications Networks

**METHODOLOGICAL FRAMEWORK FOR THE INTRODUCTION OF ENERGY
EFFICIENT ELECTRIC VEHICLES ON OPTIMAL ROUTES IN THE
TRANSPORT CHAIN OF MUNICIPAL WASTE COLLECTION AND REMOVAL**

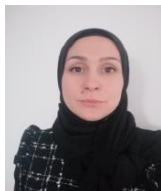
**METODOLOŠKI OKVIR UVOĐENJA ENERGETSKI EFIKASNIH ELEKTRIČNIH
VOZILA NA OPTIMALNE RUTE U TRANSPORTNOM LANCU PRIKUPLJANJA I
ODVOZA KOMUNALNOG OTPADA**

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Aida Kalem



Samir Džaferović

ABSTRACT:

The aim of the paper is to propose an innovative methodological framework for introducing energy-efficient electric vehicles on optimal urban routes in the transport chain for the collection and disposal of municipal waste. The problem to be solved arises from the fact that there is still no single methodology, and the existing traditional way of introducing electric municipal vehicles for the collection and disposal of waste, due to its characteristics, still negatively affects urban mobility and often results in low energy efficiency of the transport chain. Due to their technical characteristics, electric municipal vehicles are often limited in urban areas by the availability of infrastructure, terrain characteristics and other factors. Therefore, it is necessary to pay special attention to the phase of introducing these vehicles on urban routes. The energy efficiency of electric vehicles is often limited by capacity, physical dimensions and narrow city streets. The optimization of routes of the electric vehicle fleet should be carried out by applying the principle of minimum energy consumption, which is achieved by selecting acceptable and feasible routes. The purpose of the paper is to establish an innovative methodological matrix with geometry and dynamics for collection lines by type of electric vehicle - based on a mathematical model that will facilitate decision-making and the implementation of waste management measures. The ultimate goal of optimizing the choice of electric vehicles on city routes is to reduce energy consumption, minimize congestion in urban areas, reduce safety risks associated with the collection and disposal of municipal waste, and improve the quality of services. The work is essentially multidisciplinary and emphasizes the need to define this type of methodology.

Keywords: *municipal waste collection, electric utility vehicles, energy efficiency, optimal route*

STUDY REGARDING THE DIGITAL TRANSFORMATION OF QUALITY MANAGEMENT IN KNOWLEDGE-BASED INDUSTRIAL ORGANIZATIONS

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Sorin Constantin Nacu



Aurel Mihail Titu

ABSTRACT:

The paper examines how digital technologies transform quality assurance processes in knowledge-based organizations, from data collection and processing to reporting and continuous improvement. It focuses on environments where knowledge, collaboration and fast access to reliable information are critical for organizational performance and innovation. The study evaluates solutions such as integrated digital quality management platforms, automated approval workflows, audit and nonconformity management modules, as well as advanced data analytics and business intelligence tools. It proposes a conceptual model for integrating these technologies into existing processes, with emphasis on reducing human errors, increasing traceability, standardizing procedures and shortening response times. The model is aligned with organizational maturity levels and governance structures, highlighting the conditions under which automation generates measurable improvements in quality performance. The paper includes scenarios and use cases that illustrate how end-to-end digital workflows and real-time quality indicators can support faster and better-informed managerial decisions. Based on these analyses, the study formulates recommendations for prioritizing digital investments in quality assurance, guiding organizations from basic digitization of documents and records towards integrated, data-driven quality management. The results underline the contribution of well-designed automation initiatives to strengthening a quality-oriented culture and enhancing the responsiveness and competitiveness of knowledge-based organizations.

Keywords: Digital technologies, Quality assurance, Integrated platforms, Automated workflows, Advanced data analytics, Managerial decision, Organizational maturity.

PROCESS AUDIT AS A TOOL FOR QUALITY OPTIMIZATION IN ELECTRICAL DISCHARGE MACHINING (EDM) WITHIN THE AUTOMOTIVE INDUSTRY

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ABSTRACT:

Electrical Discharge Machining (EDM) plays a central role in the manufacturing of high-precision components for the automotive industry, where dimensional accuracy and surface integrity are essential. Due to the stochastic nature of EDM, ensuring process stability remains a significant challenge. This paper investigates the use of process audits as a structured tool for optimizing EDM quality performance. The study proposes an audit framework aligned with IATF 16949 and risk-based thinking, focusing on parameter verification, equipment capability, electrode management, and documentation flow. Results show that applying systematic audits enables early detection of deviations, reduction of recurring defects, and improved control of process variability. The findings highlight that integrating advanced audit techniques into EDM operations enhances overall process transparency and contributes to higher product conformity, supporting the quality requirements of modern automotive manufacturing.

Keywords: EDM Process, Audi, Automotive Manufacturing, Quality Optimization, IATF 16949, Surface Integrity

ASSESSMENT OF PERFORMANCE AND SAFETY PARAMETERS BETWEEN THE ILSy RWY 11 AND THE NEW RNP RWY 11 APPROACH PROCEDURE AT SARAJEVO INTERNATIONAL AIRPORT

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Damir Džubur



Muharem Šabić



Haris Mehić

ABSTRACT:

This study presents a comprehensive assessment of the performance and safety parameters between the ILS Y RWY 11 and the new RNP RWY 11 approach procedures at Sarajevo International Airport (LQSA). The airport's complex terrain and meteorological conditions pose significant challenges to aircraft approach and landing operations, making the evaluation of precision and non-precision procedures particularly relevant. The research compares both procedures in terms of navigation accuracy, operational minima, obstacle clearance altitude/height, missed approach point and missed approach climb gradients, and overall reliability under varying weather conditions. Using data from the Aeronautical Information Publication (AIP), flight simulations, and real operational performance metrics, the study quantifies differences in vertical and lateral guidance precision, approach availability, and required equipment standards both on the ground and in the aircraft. Additionally, safety parameters such as decision height, minimum descend altitude, and obstacle clearance altitude/height are analyzed through statistical and simulation-based methods. The findings aim to determine the operational advantages and limitations of each procedure, contributing to optimized decision-making for aircraft approach selection in mountainous environments. The study further provides recommendations for enhancing the implementation of Performance-Based Navigation (PBN) within Bosnia and Herzegovina's national airspace system.

Keywords: ILS Y RWY 11; RNP RWY 11; PBN; Approach Procedures; Performance Assessment; Safety Analysis; Terrain Constraints; Instrument Landing System; Flight Procedure Optimization.

A SAFETY-BASED INFRASTRUCTURE AND LEGAL FRAMEWORK FOR ELECTRIC SCOOTERS

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Ajdin Džananović



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Alem Čolaković

ABSTRACT

The rapid expansion of electric scooter use in urban environments introduces new challenges related to safety, mobility management, and the definition of traffic regulations. These challenges are particularly evident in cities that lack adequate infrastructure to support the safe operation of electric scooters. The aim of this study is to determine impact active safety elements, defined by the technical and operational characteristics of electric scooters, on determining the infrastructural solutions and management mechanisms governing their movement. Within this framework, appropriate solutions will be identified through conflict analysis and injury severity in collisions involving electric scooters and various categories of road users. Kinematic methods will be used to determine the speed, acceleration, and trajectory of electric scooters and the rider's body. Collision theory will be applied to assess changes in kinetic energy, impulse, and force transfer during impact. Injury severity will be evaluated using standardized biomechanical indicators. Risk assessment methods will be used to identify and categorize conflict situations, as well as to determine the probability and severity of negative outcomes in each analyzed scenario. The findings will serve as a foundation for developing a coherent and applicable legal framework that aligns infrastructural solutions with safety requirements, thereby facilitating the safer integration of electric scooters into contemporary urban mobility systems.

Keywords: *electric scooters, safety, infrastructure, legal framework*

ASYMMETRIES IN LEGAL STATUS AND MARKET CONDITIONS BETWEEN SOUTHEAST EUROPEAN AND EU TRANSPORT OPERATORS

Izudin Botić¹, Mirzet Sarajlić², Muhamed Fetić³

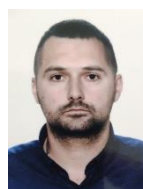
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Izudin Botić



Mirzet Sarajlić



Muhamed Fetić

ABSTRACT:

*The economic and legal disparities between transport operators from Southeast Europe and those based in the European Union significantly influence competitiveness, market access, and operational efficiency within the international transport sector. This paper analyzes the consequences of differing regulatory frameworks, licensing requirements, labor standards, and financial obligations that shape the business environment for non-EU carriers. Special emphasis is placed on cabotage restrictions, bilateral transport agreements, compliance with EU road transport regulations, and the impact of the EU Mobility Package on third-country operators. From an economic perspective, the study examines cost structures, barriers to market entry, competitive pressures, and the resulting asymmetries in service pricing and fleet modernization. Legally, it evaluates issues related to jurisdiction, enforcement, permit quotas, and alignment with EU *acquis*. The findings indicate that unequal regulatory burdens create structural disadvantages for Southeast European carriers, affecting their long-term sustainability, regional integration, and capacity to compete fairly within the European transport market. The paper highlights potential pathways for harmonization and policy adjustments aimed at fostering a more balanced and equitable transport ecosystem.*

Keywords: *transport operators; Southeast Europe; European Union; regulatory disparities; Mobility Package; market access; cabotage; economic impact; legal framework; competitiveness.*

A COOPERATIVE APPROACH WITHIN POSTAL SECURITY SYSTEM

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²Croatian Post

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Kljak Tomislav



Škorput Pero

ABSTRACT:

Due to the increasing crime incidences, the postal system must be continuously upgraded with tailored security management solutions supported by appropriate protective measures. This paper presents possible guidelines, emphasizing the concept of a cooperative threat-control system within the postal network, which may ultimately lead to the realization of a Total Safety Management model. This concept is based on the implementation of technical and organizational solutions grounded in an advanced platform of Cooperative Intelligent Transport Systems (C-ITS) and an extended Internet of Things (IoT) framework. At the same time, the introduction of these and other technological solutions must be aligned with the subjective perceptions of stakeholders within the postal system as well as those operating in its near physical environment. By adopting such an approach, security and protection engineers from various fields would gain access to a common platform through which they could share resources, instead of the current partial and fragmented duplication of efforts. The resulting outcome may be highly beneficial both in terms of the economic sustainability of the protection system and the overall synergistic effect, thereby enhancing safety, trust, and reliability not only within the postal system, but also across interconnected surrounding systems.

Keywords: *postal security, cooperative intelligent transport systems, synergy, safety*

THE IMPACT OF ELECTRIC VEHICLES ON REDUCING CARBON EMISSIONS IN MUNICIPAL WASTE LOGISTICS

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Mirzet Sarajlić



Maida Eljazović



Nedim Kamenjašević

ABSTRACT:

The decarbonization of municipal waste management logistics represents a critical component of sustainable urban development and climate change mitigation. This paper examines the role of electric vehicles (EVs) as a technological and operational solution for reducing greenhouse gas emissions within waste collection and transport systems. By analyzing the environmental benefits, operational performance, and economic viability of EV adoption, the study highlights the potential for significant reductions in carbon intensity compared to conventional diesel-powered fleets. Key considerations include vehicle range, charging infrastructure, battery durability, and route optimization tailored to waste collection patterns. Additionally, the paper explores policy mechanisms and financial incentives that can accelerate the transition toward electric mobility in the municipal waste sector. The findings indicate that integrating EVs into waste management logistics can substantially enhance environmental performance while contributing to broader urban sustainability goals, provided that implementation challenges are strategically addressed.

Keywords: electric vehicles; municipal waste management; decarbonization; logistics; sustainable mobility; greenhouse gas reduction; charging infrastructure; fleet electrification; urban sustainability.

**TECHNO-ECONOMIC ANALYSIS OF RESIDENTIAL SOLAR COLLECTORS
FOR CARBON DIOXIDE EMISSION REDUCTION IN BOSNIA AND
HERZEGOVINA**

**TEHNO-EKONOMSKA ANALIZA SOLARNIH KOLEKTORA U
DOMAĆINSTVIMA ZA SMANJENJE EMISIJA UGLJEN-DIOKSIDA U BOSNI I
HERCEGOVINI**

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Bosnia and Herzegovina



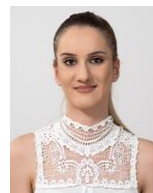
Damir Špago



Adin Ahmetbegović



Emir Nezirić



Merima Gadara

ABSTRACT:

This paper assesses the techno-economic performance of solar thermal collectors for domestic hot water in households in Bosnia and Herzegovina, with a focus on CO₂ emission reduction. Based on long-term solar irradiance data for five cities, the results show that solar systems can cover 30–60% of annual demand in central and northern regions and over 80% in southern areas, with full coverage during summer months. Replacing electricity, coal, and natural gas with solar thermal systems leads to substantial CO₂ emission reductions, especially when substituting coal- and electricity-based heating. Annual household energy cost savings range from 200 to 500 BAM, with payback periods of 6–10 years, confirming the economic viability of solar thermal systems.

Keywords: GHG emissions, DHW systems, solar thermal energy, emission reduction potential.

REZIME:

Ovaj rad analizira tehno-ekonomske pokazatelje solarnih termalnih kolektora za pripremu potrošne tople vode u domaćinstvima u Bosni i Hercegovini, s naglaskom na smanjenje emisija CO₂. Na osnovu dugoročnih podataka o sunčevom zračenju za pet gradova, rezultati pokazuju da solarni sistemi mogu pokriti 30–60% godišnjih potreba u centralnim i sjevernim područjima te više od 80% u južnim krajevima, uz potpuno pokrivanje tokom ljetnih mjeseci. Zamjenom električne energije, uglja i prirodnog gasa solarnim termalnim sistemima ostvaruju se znatna smanjenja emisija CO₂, posebno pri zamjeni grijanja na ugalj i električnu energiju. Godišnje uštede troškova energije u domaćinstvima iznose 200–500 KM, uz period povrata ulaganja od 6 do 10 godina, što potvrđuje ekonomsku opravdanost solarnih termalnih sistema.

Ključne riječi: Emisije stakleničkih gasova, sistemi za pripremu potrošne tople vode (PTV), solarna termalna energija, potencijal smanjenja emisija.

EFFECTS OF BRIDGE STRUCTURES ON RIVER HYDRAULICS AND FLOOD RISK: A CASE STUDY

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Hata Milišić



Emina Hadžić



Suvada Šuvalija

ABSTRACT:

Bridges are essential infrastructural elements whose safety depends on their interaction with natural hydraulic conditions in river systems. The construction of bridge structures such as abutments and piers within natural waterways narrows the channel and increases upstream water levels. The maximum rise in water level (afflux) is considered a primary flood-related risk following the construction of a new bridge, making its accurate assessment a critical component of the design process.

This paper evaluates the hydraulic impact of a newly designed bridge on the Ograjina River (municipality of Žepče, Bosnia and Herzegovina), with emphasis on channel conveyance capacity, backwater effects, and the potential for local scour around bridge piers. Using the HEC-RAS numerical model in combination with empirical methods, hydraulic calculations were performed for the 100-year flood event. Results indicate a minimal backwater effect, reflecting favourable hydraulic performance of the structure and suggesting that the bridge does not significantly alter the natural flow regime. The maximum expected local scour depth around the bridge piers was also estimated, and appropriate protection measures were proposed. The study highlights the importance of detailed hydraulic assessment in bridge design, particularly for torrential watercourses, to ensure safety, resilience, and structural durability.

Keywords: bridge, HEC-RAS, afflux, floods, local scour, hydraulic analysis.

IMPLEMENTATION OF INTEGRATED URBAN WATER MANAGEMENT

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Hata Milišić



Emina Hadžić



Biljana Buhavac

ABSTRACT:

There are many pressures on water resources and urban water systems. The challenge of effective water management in urban areas is, among other things, to reduce the risk of floods and ensure sufficient quantities of quality water for all users. In connection with these challenges, a new approach called Integrated Urban Water Management (IUWM) has been developed. IUWM is described as the practice of managing freshwater, wastewater and stormwater, as elements of a river basin management plan. The current issue is the possibility of implementing this integrated management approach as effectively as possible. In this sense, new platforms/projects, such as Water4Cities, for example, are emerging. Water4Cities contributes to the vision of the IUWM, which is a key concept in sustainable water management. The Water4Cities project aims at the greater implementation of information and communication technology (ICT) for monitoring, visualising and analysing urban waters in a holistic urban environment, in order to provide decision support services to multiple stakeholders in the water sector. In addition to ICT, challenges for more effective IUWM include the circular economy and nature-based solutions (NBS). The paper provides an overview of some lessons learned through IUWM implementation projects/platforms in some case studies, with the aim of more fully realizing the benefits of IUWM implementation.

Keywords: Integrated Urban Water Management (IUWM), stakeholder consensus, case studies, lessons learned.

SUSTAINABLE WATERSHED MANAGEMENT AND MORPHOMETRIC CHARACTERISTICS: THE BIJELO POLJE BASIN, MONTENEGRO

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Branislav Dudic

ABSTRACT:

River basin management is a key segment of modern natural resource management, based on an integrated approach to land, water and spatial protection. This research analyzed the basins of the lower part of the Bijelo Polje basin: Kisjele vode, Sutivanska rijeka, Orahovčka rijeka, Bistrica and Miočki potoks in northeastern Montenegro. The aim of the research was to determine the basic geometric and topographic characteristics of the basins, using morphometric analysis, GIS tools and computer graphics models, and to assess their hydrological potential as a basis for sustainable management of river systems. The results indicate that the observed basins have pronounced mountainous characteristics, moderate to high compactness ($A = 0.55\text{--}0.95$), and a moderately developed drainage network ($G = 0.22\text{--}0.55$). Average slopes ($I_{sr} = 20.9\text{--}32.5\%$) and elevation differences ($D = 300\text{--}565$ m) confirm the presence of active, but stable mountain systems. A comparative analysis with river basins in Morocco, Iran, Nepal, Brazil and Serbia showed that the Bijelo Polje basin belongs to the group of morphologically stable, but hydrologically active mountain areas. The obtained results confirm the applicability of the IntErO, River Basins models and GIS methods in quantitative assessment of land protection measures planning, and represent a significant contribution to the development of integrated and sustainable river basin management in Montenegro and similar mountainous regions of Southeast Europe.

Keywords: management, watersheds, morphometry, IntErO, GIS, erosion, Montenegro.

URBANISATION AND PROTECTION OF WATER SOURCES: A REVIEW OF INTEGRATED AND INTERDISCIPLINARY APPROACHES TO WATER PROTECTION ZONE MANAGEMENT

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Emina Hadžić



Hata Milišić



Suvada Šuvalija

ABSTRACT:

The protection of source zones represents one of the key challenges in modern water resources management, particularly in a period of accelerated urban development and increasingly intense anthropogenic pressure on the environment. The expansion of cities, the outward growth of residential and commercial areas, the increase in transport infrastructure, as well as rising industrial and municipal pollution, collectively create a complex set of pressures that directly threaten the quality and quantity of both groundwater and surface water. The changes resulting from urban growth and expansion are occurring increasingly at the expense of protective zones, reducing their functionality and heightening the risk of degradation of these vital water resources. Although legislation in the field of water management defines sanitary protection zones and prescribes restrictive measures, experience shows that the normative framework alone is insufficient to halt negative trends. Ensuring long-term protection of water resources and safeguarding protected zones—while allowing cities to develop in a sustainable and controlled manner—requires far more than merely identifying problems and addressing them once they arise. Timely planning, grounded in scientific evidence and realistic spatial needs, is fundamental for preventing damage that later becomes difficult or impossible to mitigate.

This paper examines the issue of protecting water sources located in and adjacent to urban areas, where balancing the needs of the population, infrastructure development, and the preservation of ecological functions presents particular challenges. The focus is on identifying key pressures, analysing existing plans and regulations, and proposing strategic guidelines for improving the protection of these sensitive and critically important zones..

Keywords: *urbanisation, water source protection, protection zones, integrated water resources management, integrated spatial planning, sustainable development.*

MULTI-HAZARD RISK, LANDSLIDES AND DROUGHT IN THE MONTENEGRIN COASTAL REGION: EVIDENCE, EXPOSURE PATTERNS AND GOVERNANCE GAPS

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Velibor Spalevic



Ivana Tomasevic



Nikola Abramovic



Rajko Novicevic

ABSTRACT:

This study contributes to the knowledge of the interaction between landslide risk and successive droughts during summer periods in the Montenegrin coastal region, with the idea of assessing exposure patterns, vulnerability drivers and opportunities for strengthening preventive monitoring and resilience planning. It highlights key gaps in multi-hazard management and evidence in the areas characterized by steep terrain, complex lithology and rapid urbanization. Data sets from multiple sources for the period 1995–2025 were processed. In the analyses, we combined data from municipal protection and rescue plans, disaster risk assessments, rehabilitation records, field inventories, expert consultations; with results obtained from stakeholder interviews, and matched all of this with geospatial interpretations. We consolidated the landslide inventory and improved the drought impact database. Furthermore, SWOT and GAP analyses were conducted, all in order to assess monitoring capacities, management coherence and resilience constraints. We marked 50 landslides on maps, concluding that the highest concentration of landslides is in Herceg Novi, Budva, and Bar. It is confirmed that drought-related revenue losses average 11.45 million euros per year. The droughts particularly affect vineyards, olive groves, citrus orchards and, to a lesser extent, forage crop systems. The findings indicate persistent multi-hazard hotspots in the rural areas on unstable slopes. No less negative impact is felt in infrastructure corridors and areas of intensive urbanization. All of them are negatively affected by limited monitoring, incomplete data systems and reactive remediation practices. The systematic monitoring of multiple parameters and improved geotechnical integration in planning, with pilot implementations of wireless sensor networks, could significantly improve the preventive management of these risks. Finally, we emphasize that the limitation of this study is the uneven historical reporting and the project-based nature of the monitoring datasets.

Keywords: multi-hazard risk; landslides; drought; monitoring and resilience; Montenegro coastal region; governance and exposure

MECHANICAL DAMAGE OF FOREST ECOSYSTEMS AFTER LOGGING – A CASE STUDI OF „RISOVAC – KRUPA“

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Fatima Muhamedagic



Zemira Delalić

ABSTRACT:

Forest ecosystems, in terms of damage caused by logging, are often a subject of interest both in forestry and ecology. Although they are in the final stages of ecological succession, these ecosystems remain highly sensitive to anthropogenic impacts. The consequences of logging most often manifest through various types and forms of tree damage across different locations.

The study was conducted in the Unsko-sanski Canton, in compartment 57 of the forest management unit „Risovac–Krupa“, managed by the Public Forestry Enterprise „Unsko-sanske šume“ d.o.o. Bosanska Krupa, covering a total area of 70.1 ha. Three locations were analyzed: main skid trail, secondary skid trail, and stand. The aim of the study was to determine the proportion of trees according to the type of damage (new and old damage) and according to the form of damage (broken crown, broken branches, bark bruising, bark stripping, and uprooted tree).

The total sample included 673 trees of dominant forest species: *Abies alba* Mill., *Fagus sylvatica* L., *Acer pseudoplatanus* L., and *Tilia cordata* Mill. The results showed that a total of 207 trees were damaged. The highest share of damage was recorded along the main skid trail (59.4%), with new damage predominating, particularly in *Fagus sylvatica* (26.9%) and *Abies alba* (21.7%). Bark stripping was the most common form of damage at this location. Statistical analysis (χ^2 test) revealed significant differences in the frequency of damage between different tree species and locations ($p < 0.05$).

Keywords: forest ecosystems, forest exploitation, forest skid trail, tree damage.

RESEARCH ON THE IMPACT OF INCREASED TRAFFIC ON ACCIDENT RATE IN LOCALITY DURING MARTIAL LAW

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Oleg Sitovskiy



Oleksandr Dubytskyi



Pavlo Mazylyuk



Danylo Yalovenko

ABSTRACT:

The article highlights the results of research on traffic changes in the city of Lutsk, and accordingly, changes in accident rates on the city's roads and streets, which are caused by the introduction of martial law in Ukraine and the migration of internally displaced persons. During the active phase of the war, there was a significant increase in traffic in the western regions of Ukraine, which led to an increase in road accidents.

The accident rate on the roads of the city of Lutsk in 2022-2024 during martial law was studied. Such cardinal changes in vehicle traffic during martial law cannot be artificially created during ordinary peaceful life. The results of these studies can be effectively used when modeling elements of transport infrastructure.

The recurrence of the same types of accidents is characteristic - collisions of vehicles, hitting a pedestrian, hitting a cyclist.

A model for predicting changes in accident rates based on the growth rates of traffic intensity is proposed, which made it possible to estimate a probable increase in accident rates by 10–18% in the next two years in the absence of engineering interventions. To assess the impact of increased traffic, an elasticity coefficient was introduced, which allows predicting changes in accident rates and allows justifying the need for engineering measures to reduce accident rates.

Keywords: road accident, traffic, vehicle, accident concentration areas.

IoT–GIS SYSTEM FOR GEOSPATIAL ANALYSIS OF GREEN AREAS IN THE CITY OF SARAJEVO

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Alem Čolaković



Elmin Pezo



Belma Memić



Muhamed Begović

ABSTRACT:

Green areas play a crucial role in enhancing urban resilience, regulating the microclimate, and improving air quality. This paper presents the development and testing of a prototype integrated IoT–GIS system for monitoring microclimatic parameters in the green areas of the City of Sarajevo. The system consists of sensor nodes based on the ESP32 platform (DHT22 and MQ-135), which periodically transmit measurement data to a Raspberry Pi gateway. The collected data are stored in CSV format and analyzed within the QGIS environment using spatio-temporal maps and heat maps. The system implementation was tested at five locations in Sarajevo during the period 19–26 July 2025, enabling the identification of daily patterns of temperature, relative humidity, and air quality deterioration in the urban core. The obtained results confirm that an affordable and energy-efficient IoT–GIS approach can represent a valuable tool for local planning and monitoring of urban green spaces. Future research directions include the expansion of the sensor network, the introduction of additional environmental parameters, and the validation of measurements against reference calibrated monitoring stations.

Keywords: *IoT, GIS, urban green areas, ESP32, Raspberry Pi, QGIS, sustainable development, smart cities, NDVI, microclimate.*

SIMULATION OF AN ACCIDENTAL POLLUTANT RELEASE IN THE NERETVA RIVER DOWNSTREAM OF THE MOSTAR HYDROPOWER PLANT

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Dževad Imamović



Hata Milišić



Haris Kalajdžisalihović

ABSTRACT:

Accidental pollution represents a significant risk for surface-water systems, particularly during low-flow periods when dilution capacity is reduced and downstream water uses may be endangered. This study develops a modelling framework for assessing the transport and fate of an accidental pollutant release in the Neretva River downstream of the Mostar Hydropower Plant (HPP Mostar). The approach integrates one-dimensional hydrodynamic modelling and advection–dispersion simulations using the MIKE 11 software package. The model covers a 27-km river section and incorporates updated cross-sectional geometry, calibrated roughness values, and characteristic low-flow discharge conditions. A realistic industrial spill scenario was defined based on typical incident types documented in European river basins. The hypothetical event assumes a sudden discharge of pollutant-rich wastewater from an industrial installation located several kilometres downstream of HPP Mostar, with two alternative spill durations used to evaluate differences in pollutant propagation and attenuation. The established modelling setup enables analysis of expected pollutant travel time, mixing patterns, and concentration evolution at critical downstream locations, including areas of ecological importance and the public water-supply intake. The methodology provides a technical basis for future risk assessments, supports emergency response planning, and contributes to improving water-resource protection in the Neretva River basin.

Keywords: *accidental pollution, hydrodynamic modelling, advection–dispersion, MIKE 11, Neretva River, water-quality protection.*

DEVELOPING GREEN INFRASTRUCTURE IN PODGORICA: CHALLENGES, OPPORTUNITIES, AND NEW TECHNOLOGIES

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Radovan Rosic



Velibor Spalevic

ABSTRACT:

The aim of the research was to assess the current state, challenges, and needs for the development and management of urban green spaces in Podgorica, while also determining to what extent the existing parks meet the needs of residents and modern standards of sustainable urban planning. We focused on the key issues of fragmentation of green spaces, their coverage and sufficiency of shade and the content of parks. At the same time, we analyzed the pressures of rapid urbanization, and critically reviewed the limited use of digital tools in management. Using mixed methods, we combined an online survey ($n = 511$), followed by semi-structured interviews (with 12 experts in urban planning, ecology, and municipal services), and concluded the research with a focus group with 6 participants. The findings indicate that although residents frequently use parks, there is a strong demand for larger, more functional, and more diverse green spaces. Of the total number of respondents, 88.6% of respondents stated that Podgorica needs additional parks. We observed uneven maintenance practices. Spatial fragmentation is evident. Irrigation systems are inadequate, while focus group participants highlighted deficiencies in coverage-shade, accessibility of the parks themselves, safety, cultural and recreational facilities. Of the four hypotheses set, only one was not partially confirmed. According to our findings, Podgorica has significant potential for the development of a modern network of green infrastructure with the need to improve the quality and functionality of parks. In management and planning, the maintenance system needs to be strengthened and digitalization improved. We believe that the study's limitations are an insufficiently representative research sample and the absence of objective measurements of environmental impact.

Keywords: urban green spaces, parks, Podgorica, participation, urbanization, ecosystem services.

INTENSITY OF NOISE AS AN ENVIRONMENTAL RISK FACTOR: AN ANALYSIS OF MEASUREMENTS IN THEN MUNICIPALITY OF KLJUČ

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ABSTRACT:

Noise represents a significant environmental risk factor and is one of the most widespread forms of pollution caused by anthropogenic activities. The increase in urbanization, traffic intensity, and industrialization leads to higher noise levels in the environment, resulting in numerous negative effects on human health. In addition to hearing impairment, noise affects mental health, reduces quality of life, and can lead to sleep disturbances, stress, or decreased concentration. Noise sources are present in almost all segments of human activity – from traffic, construction, and industrial processes to public musical events – and pose a risk not only to humans but also to wildlife and overall ecological stability.

The aim of this study was to analyze noise intensity as an environmental risk factor in the municipality of Ključ through field measurements conducted during the summer of 2025, at the peak of the tourist season and immediately afterward. Measurements were carried out at three locations in the immediate vicinity of residential buildings to determine whether the recorded values exceed the prescribed limit levels and what potential risk they pose to the local population and the environment.

Keywords: *noise, environmental risk, noise measurement, limit values, municipality of Ključ.*

FROM HAZARD RECOGNITION TO RISK REDUCTION: A COMPREHENSIVE STUDY OF PROFESSIONAL LORRY DRIVERS IN ROAD FREIGHT TRANSPORT

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Alexandru Covaci

ABSTRACT:

Road freight transport is a crucial element of today's global economy. A small disruption can lead to delays and issues all across the supply chain. Therefore, managing risks must be a priority for organisations operating within this field. Even if some risks cannot be avoided nor controlled by the organisation, it is important to identify methods of reducing their occurrence or propose strategies to shorten the time it takes to react and find an alternative solution. In order to accomplish this, it is necessary to understand that most risks are linked to the profession of truck drivers. Although over time innovation has made its presence felt in terms of modernising the means of transport used in road freight transport and increasing the efficiency of safety systems, there is still a series of risks to which professional drivers are exposed every day. This paper aims to identify, analyse and quantify these risks by developing a risk analysis within a medium-sized road freight transport organization, focused on the role of professional driver. Subsequently, taking into account aspects such as the cause, severity and probability, measures will be proposed to reduce the individual and overall level of risk.

Keywords: road freight transport, risks factors, risk management, safety, quality management

LONG-TERM PRECIPITATION ANALYSIS – METEOROLOGICAL STATION: SARAJEVO-BJELAVE

ANALIZA DUGOROČNIH PADAVINA – METEOROLOŠKA STANICA: SARAJEVO–BJELAVE

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Mirza Mujčić

ABSTRACT:

Precipitation constitutes one of the fundamental components of the hydrological cycle, determining the flow of water within the natural environment. Its particular significance stems from the fact that precipitation is the primary source of water supply to catchment areas, and therefore the analysis of precipitation typically serves as the initial step in evaluating runoff processes within a basin. An additional advantage of precipitation data analysis lies in its relative ease and reliability of measurement at a single observation site. In this study, precipitation records from the meteorological station Sarajevo–Bjelave were analysed. The analysis covers the station's entire operational period, from 1892 to 2024, and includes evaluations at annual, seasonal, monthly, and daily temporal scales. To assess long-term variability, the full observation period was divided into four discrete temporal intervals, enabling a more detailed characterization of precipitation patterns over time. The results indicate a stable precipitation regime throughout the observed period, with no statistically significant trends of either increase or decrease in total precipitation amounts.

Keywords: precipitation, hydrological cycle, meteorological station: Sarajevo-Bjelave, analyses

REZIME:

Padavine predstavljaju jednu od osnovnih komponenti hidrološkog ciklusa, koje definiraju kretanje vode u prirodi. Poseban značaj njihovog poznavanja ogleda se u tome što su glavni izvor snabdijevanja slivova vodom, pa se od analize padavina najčešće i polazi pri razmatranju ciklusa otjecanja na slivu. Prednost analize podataka o padavinama zasniva se na tome da se one relativno jednostavno mogu mjeriti na jednoj lokaciji. U ovom radu analizirani su podaci sa meteorološke stanice Sarajevo–Bjelave. Za čitav period rada stanice, od 1892. do 2024. godine, analizirane su padavine na godišnjem, sezonskom, mjesečnom i dnevnom nivou. Ukupan period osmatranja podijeljen je na četiri vremenska intervala kako bi se dobila jasnija slika o promjenama padavina kroz vrijeme. Rezultati pokazuju stabilan režim padavina u posmatranom periodu, bez statistički značajnog trenda porasta ili smanjenja ukupnih količina padavina.

Ključne riječi: padavine, hidrološki ciklus, meteorološka stanica: Sarajevo-Bjelave, analize

ARTIFICIAL INTELLIGENCE IN BOSNIA AND HERZEGOVINA: SCENARIOS AND STRATEGIC PATHWAYS FROM THE PERSPECTIVE OF PUBLIC ADMINISTRATION

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ABSTRACT

Although artificial intelligence is globally positioned as a key driver of public sector modernization, the public administration of Bosnia and Herzegovina still fails to fully capitalize on its potential. The rapid increase in the practical use of AI tools among civil servants is unfolding without an adequate institutional framework or formal training, which deepens the gap between technological possibilities and the current level of system readiness. This very discrepancy constitutes the foundation of this analysis.

Through focus groups with representatives of state institutions and a structured foresight approach, the paper: (i) identifies the most plausible scenarios for broader AI adoption in the public administration of Bosnia and Herzegovina, (ii) maps the economic, social, technological, political, and legal implications of this process, and (iii) proposes prioritized strategic interventions up to 2033. The findings indicate that key prerequisites for responsible AI transformation include systemic training of civil servants, clear guidelines and procedures, strong institutional leadership, and pilot projects with direct impact on the efficiency of public services.

The paper contributes to understanding how Bosnia and Herzegovina can progress from sporadic and individual AI use toward a coordinated, secure, and sustainable development of public administration grounded in artificial intelligence.

Keywords: artificial intelligence, Bosnia and Herzegovina, AI ecosystem, strategic planning, business sector, human capital

ARTIFICIAL INTELLIGENCE IN BOSNIA AND HERZEGOVINA: SCENARIOS AND STRATEGIC PATHWAYS FROM THE PERSPECTIVE OF SCIENCE AND THE BUSINESS SECTOR

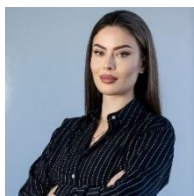
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ABSTRACT:

Although artificial intelligence is globally recognized as a key driver of economic growth and innovation, Bosnia and Herzegovina has yet to capitalize on the potential theoretically attributed to it. The specific characteristics of the post-transition environment, such as fragmented institutional structures, reliance on imported technological solutions, outflow of highly qualified professionals, and slow technology transfer, further widen the gap between strategic ambitions and the realistic capacity for AI implementation in business processes. This paper addresses this very discrepancy by examining how the broader adoption of artificial intelligence and the global competition for AI experts may shape the transformation of labour markets, industrial structures, and institutional capabilities in Bosnia and Herzegovina.

Through an analysis of focus groups with representatives from academia and companies in the country, the paper: (i) identifies the most plausible scenarios for AI adoption in the business sector, (ii) maps their economic, social, legal, political, technological, and environmental consequences, and (iii) proposes strategic interventions for the 2025–2033 period. The findings provide actionable guidelines for building a sustainable AI ecosystem, emphasizing institutional coordination, human-capital development, responsible risk management, and stronger collaboration between science and industry. In doing so, the paper contributes to a clearer understanding of what is required for Bosnia and Herzegovina to move from declarative support for artificial intelligence to its genuine and systemic deployment.

Keywords: artificial intelligence, Bosnia and Herzegovina, AI ecosystem, strategic planning, business sector, human capital

INTEGRATION OF BIKE-SHARING SERVICES INTO MULTIMODAL JOURNEY PLANNERS: IMPORTANCE, BENEFITS AND CHALLENGES

INTEGRACIJA USLUGA JAVNIH BIKIKALA U MULTIMODALNE PLANERE PUTOVANJA: VAŽNOST, PREDNOSTI I IZAZOVI

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ABSTRACT:

Bike-sharing services have become an important element of urban mobility, but their potential is often not fully exploited if they are treated as a separate, stand-alone system. When bike-sharing services are seamlessly integrated into Multimodal Journey Planners (MJPs), users can see them as a natural part of door-to-door journeys, alongside public transport and walking. This paper discusses why information integration between bike-sharing services and MJPs is crucial, how it can support better decision-making process for users and which new functions and service concepts could be developed on top of such integration.

Keywords: bike-sharing services, urban mobility, Multimodal Journey Planners (MJPs), integration

REZIME:

Usluge javnih bicikala postale su važan element urbane mobilnosti, no njihov se potencijal često ne iskorištava u potpunosti ako se promatraju kao zaseban, samostalan sustav. Kada se usluge javnih bicikala učinkovito integriraju u multimodalne planere putovanja (MPP), korisnici ih mogu doživjeti kao prirodan dio putovanja „od vrata do vrata“, uz javni prijevoz i pješaćenje. U ovom radu razmatra se zašto je integracija informacija između usluga javnih bicikala i MPP-ova ključna, na koji način ona može poduprijeti kvalitetniji proces donošenja odluka korisnika, te koje se nove funkcionalnosti i koncepti usluga mogu razviti na temelju takve integracije.

Ključne riječi: usluge javnih bicikala, urbana mobilnost, multimodalni planeri putovanja (MPP), integracija

STRATEGIES FOR MONITORING BRIDGES USING 3D SURVEYING TECHNOLOGIES IN CONTEXTS OF GEOLOGICAL SUBSIDENCE

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Caterina
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Marco
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ABSTRACT:

Infrastructures located in geodynamically active areas are increasingly exposed to slow but persistent phenomena that can compromise their safety and functionality over time. Among these, bradyseism represents a particularly critical condition, as it induces progressive ground movements that are difficult to detect using traditional inspection techniques. In this context, the availability of accurate, objective, and repeatable spatial documentation is a fundamental prerequisite for the development of effective monitoring strategies.

This paper proposes an integrated three-dimensional survey approach applied to a road bridge located along the Naples ring road, near the Pozzuoli exit, within the bradyseismic area of the Campi Flegrei. The methodology adopted combines Mobile Laser Scanning (MLS), Terrestrial Laser Scanning (TLS), and close-range photogrammetry techniques to generate a multi-scale, multi-resolution digital dataset capable of describing both the infrastructural context and the detailed geometry of the most significant structural elements.

Keywords: Infrastructure monitoring, Digital documentation, Bradyseismic areas, Risk-based infrastructure management

TOWARDS INTELLIGENT MARITIME SEARCH AND RESCUE: A CONCEPTUAL FRAMEWORK FOR UAV INTEGRATION IN COASTAL SAR

PREMA INTELIGENTNOM TRAGANJU I SPAŠAVANJU NA MORU: KONCEPTUALNI OKVIR ZA INTEGRACIJU BESPILOTNIH LETJELICA U OBALNIM SAR OPERACIJAMA

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Dario Medić



Mario Bakota

ABSTRACT:

For maritime search and rescue (SAR) to be effective, Unmanned Aerial Vehicles (UAVs) must do more than provide data – they must be seamlessly integrated into time-critical decision-making. To achieve this, this paper presents a conceptual framework, centred on a Dynamic Situation Model (DSM). The DSM serves as a central hub, continuously updating the mission picture by fusing UAV sensor feeds, environmental drift predictions, and asset status. This approach supports coordinated action through a continuous decision process in which human operators retain control, while automated functions assist judgement rather than replace it. Key performance indicators focusing on decision speed and coordination are defined to support future evaluation through simulation, human-in-the-loop studies, and controlled field testing.

Keywords: maritime search and rescue; unmanned aerial vehicles; decision support; situational awareness; Bayesian search; human-in-the-loop.

SAŽETAK:

Za učinkovito traganje i spašavanje na moru, bespilotne letjelice imaju veći zadatak od jednostavnog prikupljanja podataka – moraju biti učinkovito integrirane u donošenje odluka u vremenski kritičnim situacijama. U tu svrhu u radu se predstavlja konceptualni okvir, utemeljen na Dinamičkom situacijskom modelu (DSM). DSM djeluje kao središnji element sustava, kontinuirano ažurirajući sliku misije objedinjavanjem podataka senzora s bespilotnih letjelica, predviđanja zanošenja uzrokovanih okolišnim uvjetima te statusa raspoloživih sredstava. Takav pristup omogućuje koordinirano djelovanje kroz kontinuirani proces odlučivanja, pri čemu ljudski operateri zadržavaju kontrolu, dok automatizirane funkcije služe kao potpora prosudbi, a ne kao njezina zamjena. Definirani su pokazatelji uspješnosti usmjereni na brzinu donošenja odluka i razinu koordinacije, koji služe kao temelj za buduću evaluaciju putem simulacija, ispitivanja s ljudskim nadzorom i kontroliranih terenskih testiranja.

Ključne riječi: traganje i spašavanje na moru; bespilotne letjelice; potpora odlučivanju; situacijska svjesnost; Bayesovsko traganje; ljudski nadzor.

INTEGRATION OF BUILDING INFORMATION MODELING (BIM) AND GEOGRAPHIC INFORMATION SYSTEM (GIS): THE CASE STUDY OF THE 'EX-MOLINO MINETTI' IN CORDOBA, ARGENTINA

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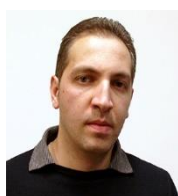
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Michele
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Costanza
Bollatti



Francesco
Villecco

ABSTRACT:

The implementation and monitoring of urban transformations defined by planning instruments require effective control by the responsible territorial authorities to ensure compliance with the technical and regulatory provisions of current plans. Given the complexity of the urban and territorial scale, professionals need tools capable of addressing planning, design, and management requirements of urban space. The large amount of data and the ability to manage multiple layers of information within a BIM model can be effectively integrated and extended beyond the single-building scale, moving from purely architectural design toward the broader domain of spatial and urban planning. In this broader context, the GIS-BIM approach represents a genuine paradigm shift, enabling a more effective management of the complexity inherent in urban processes.

Keywords: Autodesk Revit, ArcGIS, Urban Planning, Architecture, Cultural Heritage

DIGITAL PT SCHEME IN THE METAL INDUSTRY - CASE STUDIES

DIGITALNE PT ŠEME – NEKI PRIMERI

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Vidosav Majstorović



Dragan Rajnović



Jasminka Milosavljević



Vesna Vučić

ABSTRACT:

This paper investigates the development of digital proficiency testing (PT) schemes in accordance with the ISO 17043 standard in the metal industry, with a focus on case studies. The paper analyzes the application of digital PT schemes through different case studies: LGC ARMI, which uses automated software to evaluate the mechanical/chemical composition of alloys, CompaLab, focused on accredited PT programs for mechanical/metallographic testing, and a provider that implements a cloud-based platform for NDT testing - BINDT-PCN. Results show that digital PT providers reduce data processing time (up to 35%), increase accuracy of results and facilitate compliance with ISO 17043 (online audit). The paper highlights the importance of digitization for improving product quality in the metal industry and provides recommendations for the development of digital PT providers, including investment in digital tools and cooperation with accredited bodies. The paper also presents the state of development of the domestic PT scheme, KOMIM, for testing metals.

Keywords: Digital PT schemes, ISO 17043, metal industry, case studies, digitization, quality control, KOMIM.

ABSTRACT:

Ovaj rad istražuje razvoj digitalnih proficiency testing (PT) šema u skladu sa standardom ISO 17043 u metalnoj industriji, sa fokusom na studije slučaja. Rad analizira primenu digitalnih PT šema kroz različite studije slučaja: LGC ARMI, koji koristi automatizovane softvere za evaluaciju hemijskog sastava legura, CompaLab, fokusiran na akreditovane PT programe za mehanička/metalografska ispitivanja, i provajder koji primenjuje platformu zasnovanu na cloud za NDT ispitivanja – BINDT-PCN. Rezultati pokazuju da digitalni PT provajderi smanjuju vreme obrade podataka (do 35%), povećavaju tačnost rezultata i olakšavaju usklađenost sa ISO 17043 (online audit). Rad naglašava značaj digitalizacije za unapređenje kvaliteta proizvoda u metalnoj industriji i pruža preporuke za razvoj digitalnih PT provajdera, uključujući ulaganje u digitalne alate i saradnju sa akreditovanim telima. Rad takođe prikazuje stanje razvoja domaće PT šeme, KOMIM, za ispiitivanje metala.

Keywords: Digitalne PT šeme, ISO 17043, metalna industrija, studije slučaja, digitalizacija, kontrola kvaliteta, KOMIM.

**FINAL MANUFACTURING OPERATION EXCELLENCE IN AUTOMOTIVE
COMPANY: A CASE STUDY LEAN SIX SIGMA APPROACH WITHIN OEM PART
ASSEMBLY PROCESS FROM BOSNIA AND HERZEGOVINA**

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ABSTRACT:

The paper put the most stress on final manufacturing operation excellence of original equipment manufacturers (hereinafter OEM) from automotive industry in Bosnia and Herzegovina. Industrial revolutions in the last two centuries has driven the vehicle on to pedestal of entire economy. The vehicle has become the most important sector that presents technological upturn or stagnancy, civilization progress and flop.

Actually, supply chain of automotive industry is designed by OEM's of entry materials, then follows OEM's of separate pieces, then come OEMs of components, after that the suppliers of modules and vehicle systems, in order to reach the final of the vehicle manufacturer. This paper presents Lean Six Sigma (hereinafter LSS) approach in manufacturing supply chain and assembly of final products. In this research, we were aiming to reach a level of assembly final operation excellence in company from automotive sector. This paper shows example of the application of LSS methods within manufacturing assembly process in automotive company.

Key words: *Lean Six Sigma (LSS), manufacturing excellence, Original Equipment Manufacturer (OEM), assembly, automotive.*

ROBUST-LEAN DESIGN OF AN AUTOMOTIVE AIR-CONDITIONING TUBE PRODUCTION LINE USING DISCRETE-EVENT SIMULATION UNDER UNCERTAINTY

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Lidija Rihar



Primož Podržaj



Tomaž Požrl



Marjan Jenko

ABSTRACT:

Lean manufacturing improves flow and delivery performance; however, its benefits are often overstated when product variability, random short-duration stoppages, changeovers, and quality-driven rework are modelled deterministically. Unlike conventional lean production, which primarily targets average performance improvements, the proposed robust-lean approach explicitly incorporates variability absorption mechanisms to improve schedule reliability under uncertainty. We develop and evaluate a robust-lean redesign of an automotive air-conditioning tube production line using discrete-event simulation (DES) with explicit representation of uncertainty across five machine-level workstations (P1–P5). Processing times follow expert-elicited distributions, while leakage-driven rework is modelled according to simulated test-station results. Three scenarios are assessed: a baseline system (S0), lean stabilisation (S1), and a robust-lean redesign (S2) combining lean measures with targeted decoupling buffers, parallel testing capacity, and preventive maintenance. The results demonstrate that improving mean key performance indicators (KPIs) alone is insufficient; production robustness requires deliberate variability absorption focused on the dominant system constraint. The proposed modelling approach and robustness-oriented KPIs are transferable to confidentiality-constrained industrial environments.

Keywords: lean manufacturing, discrete-event simulation, uncertainty, robust-lean, automotive, leakage testing, bottleneck management.

**VALUE CHAIN EXCELLENCE: A CASE STUDY LEAN SIX SIGMA
REORGANISATION OF LAYOUT AND INDUSTRIAL PROCESSES IN
COMPANY FROM BOSNIA AND HERZEGOVINA**

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ABSTRACT:

The article will offer examples of a case study Lean production Six Sigma reorganisation of Layout and industrial processes in domestic firm in order to achieve value chain excellence. In the world of the processing industry, dominated by high quality standards, tight deadlines and tightly controlled costs, the issue of series profitability takes on an additional dimension. We find the solution in the application of the Lean production-Six Sigma tool in order to reorganize and optimize the working space and industrial processes.

The least profitable series is not the one with the smallest number of pieces launched into production, but the minimum order quantity that manages to meet the minimum requirements in three key segments of production efficiency: Preparation and adjustment (SET-up) of the machine; Utilization and efficiency of workers and OEE (Overall Equipment Effectiveness).

The paper put the most stress on manufacturing supply chain excellence of original equipment manufacturers (hereinafter OEM) from automotive industry in Bosnia and Herzegovina through monitoring of measured values at current level and expected target value after LSS improvement programme is done. This paper shows example of the application of LSS methods like as: spaghetti diagram, 5S, PCE, etc.

Key words: *Lean Six Sigma (LSS), value chain excellence, layout, manufacturing, Bosnia and Herzegovina.*

TOTAL PRODUCTIVE MAINTENANCE (TPM) CASE STUDY: APPLICATION OF INCIDENT METRICS IN WORKING CONDITIONS OF FIRM THROUGH LSS PROJECT

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ABSTRACT:

This article presents importance and role of the maintenance process as part of a production one. Technical systems during exploitation, but also during downtime, are exposed to wear and aging, and this leads to a change in their working capacity. In this regard, maintenance takes all conservation measures working capabilities of technical systems and realization of economical production. Maintenance, as an integral part of the production process, requires resources that include trained staff, tools and equipment for testing and diagnostics, spare parts and material, means of transport, technical documentation, etc. In this article, we presents indicators of incident metrics of cleaner machine in metalworking company through Lean Six Sigma project.

Key words: *Lean Six Sigma (LSS), Maintenance, Total Productive Maintenance (TPM), production process analysis, maintenance planning, costs.*

LABOUR FORCE SHRINKING – IMPLICATIONS FOR POLICY

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ABSTRACT:

Bosnia and Herzegovina (BiH) is experiencing a persistent demographic decline, driven by a negative natural increase and extensive emigration. These processes exert profound effects on virtually all dimensions of social and economic life. The country's trend GDP growth rate of merely 2.6% underscores the structural weaknesses constraining its long-term convergence with high-income economies. In alignment with the objectives of the EU's "twin transition," BiH is expected to harmonize its development trajectory with EU standards by fostering sustainable, innovation-driven growth and progressively decoupling economic expansion from carbon intensity and resource dependency. This transformation requires a fundamental reorientation of the country's growth model toward productivity enhancement and knowledge-based competitiveness.

Given the ongoing demographic contraction, five broad policy directions are essential: (i) facilitating immigration, (ii) investing in reskilling and lifelong learning, (iii) attracting foreign direct investment (FDI), (iv) moving up global value chains, and (v) implementing comprehensive pro-natality measures.

A productivity-centered growth must become the cornerstone of BiH's development strategy. In practical terms, the country's only viable policy pathway involves achieving gradual reductions in relative costs through sustained productivity gains. As Salter (1960) insightfully observed, "behind productivity lie all the dynamic forces of economic life." Within this framework, the present paper focuses on three key policy pillars: (i) retraining and reskilling of the labor force, (ii) upgrading within global value chains, and (iii) attracting and embedding foreign direct investment.

However, BiH's institutional order remains fragmented and uncoordinated, inhibiting coherent policymaking. After three decades of largely unsuccessful top-down reform efforts, the country's renewal may depend on bottom-up approach that leverage the potential of subnational entities. In this regard, regions/cantons could serve as critical drivers of economic, social, and political modernization, acting as laboratories of reforms and innovations.

Keywords: productivity, reskilling, FDI, global value chains, "twin transition", EU

UPDATING THE MECHANICAL ENGINEERING STUDY PROGRAM BASED ON THE EXPERIENCES OF THE PILOT PROJECT

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Darko Lovrec



Mirko Ficko

ABSTRACT:

The Industry 5.0 (I5.0) concept offers a modern vision of industry, whose objectives extend beyond efficiency and productivity as the only goals, as it strengthens the role and contribution of industry to society, with all stakeholders, in all processes of society. It places the well-being of workers at the centre of the production process, "appropriately equipped" with the necessary knowledge and skills required by current and emerging technologies. In this way, I5.0 complements the existing Industry 4.0 approach by placing research and innovation at the service of the transition to a sustainable, human-centred and resilient European industry.

An important role in this is played by new knowledge that employees in modern production facilities need. They can acquire this additional knowledge in various ways. One of these is a modern approach in the form of shorter, thematically oriented training courses based on the micro-credentials principle. The paper presents the starting points leading to micro-credentials system, as well as the experiences gained from the three-year period of implementation of the pilot project – the implementation of shorter content-oriented training courses within the framework of the Green2Eng project, implemented by the Faculty of Mechanical Engineering at the University of Maribor. The acquired insights are the basis for changes in curricula that include more knowledge for the needs of industry, for the green transition to a resilient knowledge society.

Keywords: *mechanical engineering, industry, training courses, implementation of experience, study program updating.*

QUANTUM DOT-BASED HETEROGENEOUS PHOTOCATALYSTS FOR EFFICIENT CO₂ REDUCTION

HETEROGENI FOTOKATALIZATORI NA BAZI KVANTNIH TAČKI ZA EFIKASNU REDUKCIJU CO₂

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Amra Bratovic

ABSTRACT:

Semiconductor quantum dots (QDs) have emerged as highly efficient photocatalysts for CO₂ reduction due to their tunable band structures, strong visible-light absorption, and high surface reactivity. This review highlights the advances in QD-based photocatalytic systems, including metal oxide, transition metal chalcogenide, carbon, perovskite, and MXene QDs, with particular emphasis on heterojunction and S-scheme designs that enhance charge separation and suppress recombination. The Cs₂CuBr₄/TiO₂ heterojunctions achieve superior CO and CH₄ generation with high selectivity, while dual Z-scheme systems incorporating MXene QDs extend activity into the near-infrared region, enabling multi-electron CO₂ reduction pathways. The integration of QDs with 2D supports, surface ligands, and step- or S-scheme architectures significantly improves light absorption, charge transport, and CO₂ activation, offering a versatile platform for solar-driven artificial photosynthesis.

Keywords: quantum dots, CO₂ reduction, S-scheme heterojunction, perovskite, MXene.

REZIME:

Poluvodičke kvantne tačke (QD) pojavile su se kao vrlo učinkoviti fotokatalizatori za redukciju CO₂ zbog svojih podesivih struktura pojaseva, jake apsorpcije vidljive svjetlosti i visoke površinske reaktivnosti. Ovaj rad ističe napredak u fotokatalitičkim sistemima temeljenim na QD-ovima metalnih oksida, halkogenida prijelaznih metala, ugljika, perovskita i MXene QD-ova, s posebnim naglaskom na dizajne heterospojeva i S-sheme koji poboljšavaju razdvajanje naboja i potiskuju rekombinaciju. Heterospojevi Cs₂CuBr₄/TiO₂ postižu superiorno stvaranje CO i CH₄ s visokom selektivnošću, dok dvostruki Z-shema sustavi koji uključuju MXene QD-ove proširuju aktivnost u blisko infracrveno područje, omogućujući višeelektronske puteve redukcije CO₂. Integracija QD-ova s 2D nosačima, površinskim ligandima i stepenastim ili S-shemskim arhitekturama značajno poboljšava apsorpciju svjetlosti, transport naboja i aktivaciju CO₂, nudeći svestranu platformu za umjetnu fotosintezu pokretanu sunčevom energijom.

Gljučne riječi: kvantne tačke, smanjenje CO₂, heterospoj S-sheme, perovskit, MXene.

SUSTAINABLE DEVELOPMENT OF ORGANIC FRUIT PRODUCTION IN MONTENEGRO WITH SPECIAL EMPHASIS ON BERRY CROPS (2016-2024)

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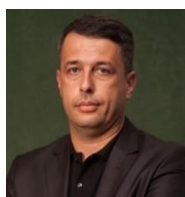
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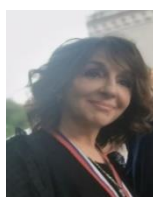
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Dejan Zejak



Ivan Glisic



Zora Dajic Stevanovic



Velibor Spalevic

ABSTRACT:

The research deals with the development of organic fruit production in Montenegro in the period from 2016 to 2024. A focus is given to berries, where certain trends have been identified among certified organic producers, related to changes in certified cultivated areas, as well as structural changes in organic fruit plantations. The focus has further shifted to analyses of organic fruit production, and its importance for sustainable rural development. The analyses applied quantitative, empirical and descriptive approaches, using secondary statistical data obtained from the Statistical Office of Montenegro (MONSTAT). The research covered the entire population of these producers and the area on which production was carried out during the period of the last decade. Descriptive statistical methods were used. Comparative analysis was used to calculate percentage changes, and in addition, we also used index analysis, and finally created a graphical presentation of trends. An increase in the number of certified organic producers was recorded for the period indicated as the study period. The number increased from 280 (2016) to 532 (2024), an expansion of 31% was also recorded in the total certified organic agricultural area. Permanent crops have increased significantly, and the area under certified organic fruit has expanded more than fivefold, from 87 ha to 460.53 ha. Decrease in production in cherry plantations, but on the other hand, the areas under apple, plum, walnut and berry trees have increased. This fluctuation at annual levels remains a key challenge in fruit production in Montenegro.

Keywords: organic agriculture; organic fruit production; certified producers; berry crops; Montenegro; agricultural statistics.

LANDSLIDE RISK ASSESSMENT BASED ON REAL-TIME RAINFALL DATA AND GROUNDWATER FLUCTUATION MODELLING

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ABSTRACT:

This research focuses on assessing landslide risk triggered by rainfall through numerical modelling of groundwater level fluctuation and slope stability. The methodology is based on real-time field measurements and meteorological data obtained from hydrometeorological stations. The proposed approach is structured into three main phases. The first phase involves defining the relationship between rainfall characteristics—such as intensity, cumulative precipitation, runoff coefficient, and soil permeability—and the corresponding change in groundwater level. The second phase consists of developing a detailed geotechnical model of the slope, incorporating its geometry, stratigraphy, and soil parameters, with groundwater level as an input derived from the first phase. In the third phase, numerical simulations of slope stability are carried out using finite element software, where groundwater level is treated as a variable parameter. The objective is to determine the critical groundwater level at which slope failure occurs, defined by a Factor of Safety (FS) equal to 1.0. Based on the analysis results, the study aims to help develop a predictive equation that links cumulative rainfall to groundwater level and slope stability.

Keywords: *Landslide, Groundwater, Rainfall, FEM Analysis.*

THE SCDCM MODEL FOR SUPPLY CHAIN DEVIATION ANALYSIS IN THE AUTOMOTIVE INDUSTRY: AN INTEGRATED APPROACH TO QUALITY IMPROVEMENT AND SUPPLIER DEVELOPMENT

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ABSTRACT:

Deviations occurring within automotive supply chains represent one of the primary sources of quality variation, influencing both internal process stability and supplier relationships. This paper introduces and develops the Supply Chain Deviation Convergence Model (SCDCM), an original conceptual framework integrating four critical dimensions: technical, process, collaborative, and operational. The model focuses on the convergence of information derived from supplier processes, metrological assessments, organizational behavior and operational impact, enabling practitioners to distinguish between true nonconformities and cosmetic deviations, to support evidence-based technical decisions, and to foster supplier maturity. Compared to traditional problem-solving tools (8D, Ishikawa, 5 Why), SCDCM provides a systemic perspective, emphasizing deviation dynamics and the interactions between supply chain actors. The paper demonstrates the applicability of the model through real industrial case studies and highlights its potential as both a predictive instrument and a foundation for supplier maturity assessment in future research.

Keywords: supply chain, supplier maturity, SCDCM, automotive, quality management

THE ROLE OF EMPLOYER FAMILIARITY IN SHAPING EXPECTED FUNCTIONAL BENEFITS OF EMPLOYER ATTRACTIVENESS AMONG FINAL- YEAR STUDENTS

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Milena Radenovic



Ensar Mekic



Lejla Sehanovic

ABSTRACT:

The purpose of this study is to explore the effects of the telecommunication industry's Employer Familiarity on different aspects of Functional Benefits of Employer Attractiveness: Economic, Development, and Application Value. A structured questionnaire was administered to collect data, and 103 respondents participated. Participants were students in the final years of bachelor's and master's programs in economics, law, and electrical engineering at higher education institutions in Bosnia and Herzegovina. Structural equation modelling was employed to assess the model's validity and reliability and to test six hypotheses. PLS Algorithm results, such as Cronbach's Alpha, Composite Reliability, AVE values, HTMT, and Fornell-Larcker's test, indicated no issues with the validity and reliability of the measures. The bootstrapping algorithm revealed support for three hypotheses. Direct effects of Employer Familiarity demonstrated statistically significant impact on economic, development, and application value, while age did not exhibit substantial moderating effects on any of the three mentioned relationships. The main limitation of this study is its small sample size. Future studies are recommended to re-explore the hypothesized relationships using larger samples. Practical and theoretical implications are discussed.

Keywords: Employer familiarity, Functional Benefits of Employer Attractiveness, Economic Value, Application Value, Development Value, Telecommunications Industry

HOW EMPLOYER FAMILIARITY SHAPES EMPLOYER BRAND EQUITY: INVESTIGATING MODERATING EFFECTS OF AGE AND GENERALIZABLE DECISION PROCESSING

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Milena Radenovic



Lejla Sehanovic



Samira Avdic



Mersid Poturak

ABSTRACT

The primary goal of this study is to understand the impact of the telecommunication industry's Employer Familiarity on Employer Brand Equity. The secondary goal of this study is to investigate the moderating role of Age and Generalizable Decision Processing (GDP) in the relationship mentioned above. A total of 103 participants, students in the final years of bachelor's and master's programs in economics, law, and electrical engineering at higher education institutions in Bosnia and Herzegovina, responded to a structured questionnaire. Structural equation modelling was employed in Smart PLS4 to assess the validity and reliability of the model and test three hypotheses. PLS Algorithm results indicated no issues with the measures' validity and reliability, while bootstrapping supported the primary hypotheses. Direct effects of Employer Familiarity demonstrated statistically significant impact on Employer Brand Equity, while age and Generalizable Decision Processing did not present substantial moderating effects. The main limitation of this study is the relatively small sample size. Practical and theoretical implications are discussed.

Keywords: *Employer familiarity, Employer Brand Equity, Generalizable Decision Processing, Age, Telecommunications Industry.*

**VARIABILITY OF THE MORPHOMETRIC CHARACTERISTICS OF THE
BALKAN GOLDEN LOACH (*Sabanejewia balcanica*) FROM THE WATERS OF
THE SAVA RIVER BASIN**

**VARIJABILNOST MORFOMETRIJSKIH ODLIKA BALKANSKOG ZLATNOG
VIJUNA (*Sabanejewia balcanica*) IZ VODA SLIVNOG PODRUČJA RIJEKE SAVE**

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Alen Bajrić



Edina Hajdarević



Isat Skenderović

ABSTRACT:

The importance of morphometric measurements was given by the development of information and computer systems, which is why there are two approaches today, traditional morphometry and, in the last few decades, geometric morphometry. This paper presents comparative results of classical and geometric morphometry of analyzed populations of *Sabanejewia balcanica* from the waters of Bosnia and Herzegovina. 98 individuals of the studied species, grouped into eight populations, were analyzed. Statistically significant differences were determined for a large number of analyzed morphometric parameters.

Keywords: balkan golden loach, morphometry, Sava, measurement.

SAŽETAK:

Značaj morfometrijskim mjerenjima dao je razvoj informatičkih i računarskih sistema, radi čega danas postoje dva pristupa, tradicionalna morfometrija i u posljednjih nekoliko decenija geometrijska morfometrija. U ovom radu predstavljeni su uporedni rezultati klasične i geometrijske morfometrije analiziranih populacija *Sabanejewia balcanica* iz voda Bosne i Hercegovine. Analizirano je 98 jedinki istraživane vrste, grupisanih u osam populacija. Za veliki broj analiziranih morfometrijskih parametara utvrđene su statistički značajne razlike.

Ključne riječi: balkanski vijun, morfometrija, Sava, mjerenje

PRECIPITATION OF HEAVY METALS FROM GALVANIC WASTEWATER USING CaO DERIVED FROM EGGSHELL WASTE

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Sabina
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Amra
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ABSTRACT:

With the increase in the global population, egg consumption has risen, leading to the generation of large amounts of eggshell waste. Eggshells are rich in CaCO_3 , which converts to CaO upon calcination. This study investigated the efficiency of CaO derived from eggshell waste as a precipitating agent for the removal of Cu(II) , Ni(II) , and Zn(II) ions from synthetic solutions by analyzing key precipitation parameters. The highest precipitation efficiency was achieved under the following conditions: initial pH 10, CaO dosage of 120 mg, stirring speed of 100 rpm, stirring time of 5 minutes, solution temperature of 25 °C, and initial concentration of 100 ppm. The removal efficiencies of Cu(II) , Ni(II) and Zn(II) ions from galvanic wastewater reached 99,89%, 99,99% and 99,94%, respectively, under the parameters defined based on the synthetic solution tests.

Keywords: eggshell-derived CaO , precipitation parameters, galvanic wastewater

SAŽETAK:

Sa povećanjem globalne populacije, konzumiranje jaja je poraslo, što dovodi do stvaranja velikih količina otpadne ljuske. Ljuske jajeta bogate su CaCO_3 , koji se pri kalcinaciji pretvara u CaO . Ovo istraživanje je ispitivalo efikasnost CaO dobijenog iz otpadne ljuske jajeta kao precipitacionog sredstva za uklanjanje Cu(II) , Ni(II) i Zn(II) iona iz sintetskih rastvora analiziranjem ključnih precipitacionih parametara. Najveća efikasnost precipitacije postignuta je pri slijedećim uslovima: početna pH 10, doza dodanog CaO 120 mg, brzina miješanja 100 rpm, vrijeme miješanja 5 minuta, temperatura rastvora 25 °C i početna koncentracija 100 ppm. Efikasnosti uklanjanja Cu(II) , Ni(II) i Zn(II) iona iz galvanske otpadne vode dostigle su 99,89%, 99,99% i 99,94%, respektivno pod parametrima definisanim na osnovu testova sa sinteskim rastvorima.

Ključne riječi: CaO dobijen iz ljuski jaja, parametri precipitacije, galvanska otpadna voda

DETERMINATION OF Mn(II) IONS FROM NATURAL WATERS BY FAAS METHOD AFTER PRECONCENTRATION BY ZEOLITE

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*Sabina
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*Indira
Šestan*

ABSTRACT:

The analytical method employing zeolite as a sorbent for the preconcentration of Mn(II) ions from natural waters using a polyethylene cartridge tube was described. Under the optimized conditions (pH 9, sorbent mass 25 mg, flow rate 7 mL min⁻¹, eluent: 7 mL of 1 mol/L HNO₃, preconcentration factor 5), the recovery of Mn(II) ions reached 105%. The sorbent was characterized using FTIR-ATR, XRD, and SEM-EDS techniques to determine its physicochemical properties. The obtained results confirmed that the investigated material is a natural zeolite of the clinoptilolite type. The point of zero charge (pHpzc) of the zeolite sorbent was determined to be 5.55, and the maximum adsorption capacity for Mn(II) was 18.2 mg/g. The high recovery values (>96%) obtained for Mn(II) ions in spiked natural lake water samples demonstrate both the efficiency of the zeolite sorbent and the suitability of the proposed method for trace metal determination in environmental samples.

Keywords: *Mn(II) ions, FAAS, zeolite, preconcentration*

INFORMATION SYSTEM FOR DECISION SUPPORT FOR EFFECTIVE MANAGEMENT OF BIOLOGICAL WASTEWATER TREATMENT

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ABSTRACT:

Management of the biological wastewater treatment process often occurs under conditions of informational uncertainty caused by the complexity of biochemical reactions and the variability of wastewater composition and volume. Traditional control methods are insufficiently effective in such circumstances. This study proposes a hybrid architecture combining deep neural networks and logic-based programming within the framework of Neuro-Symbolic AI. The neural network performs data recognition and generalization, while Prolog-based logic provides reasoning and explanation capabilities, enabling comprehensive analysis and decision support.

The research focuses on developing and training a YOLOv8 deep learning model for automated recognition of bioindicators in microscopic images of activated sludge. The model demonstrates high accuracy and robustness under varying lighting and contrast conditions. A Python-based software module (Automated Workplace – AWP) was implemented to support operational control, offering calculations and recommendations for adjusting treatment regimes. Additionally, an expert system built in Prolog integrates neural network outputs and analytical results to optimize technological parameters, ensuring flexible and precise evaluation of biological processes.

Keywords: object recognition, image analysis, deep learning, neural networks, YOLOv8, bioindicators.

WHAT MATTERS TO THEM? GENERATION Z AND THEIR EXPECTATIONS AS FUTURE EMPLOYEES: A RESEARCH PATH TOWARDS COMPARING TWO CONTEXTS

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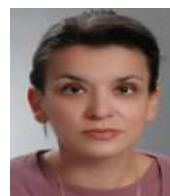
Zijada Rahimić



Zlatko Nedelko



Vojko Potočan



Munira Šestić

ABSTRACT:

The focus of this paper is on Generation Z (Gen Z)- the generation consisting of young people born between 1995. and 2010, since it is the generation that is currently dominantly entering the labor market. As other generations, Gen Z is distinguished by its characteristics, influencing their working behaviors. Despite being called a global generation - as they share common elucidation that influences them worldwide - Gen Z do not share the same personal values and life experiences. This presents a challenge for researchers to reveal an insight into their differences regarding life values and work attitude, for business endowment. The aim of this paper is to portray a research path for analyzing the differences related to life values and work attitudes of Generation Z in two different contexts of Bosnia and Herzegovina, and Slovenia. This research opportunity is interesting nowadays, as two countries share deep historical interrelationship. Furthermore, these interrelations have intensified through changes in global work boundaries due to migration, and paper contribution implies possible path to human resource (HR) attraction and retention strategies, as well as multicultural and multigenerational HR management strategies.

Keywords: Generation Z, Life Values, Work Behavior, Country context

NEW TECHNOLOGIES IN STUDYING ADOLESCENTS' YOUTH–NATURE INTERACTIONS: INSIGHTS FROM A MIXED-METHODS APPROACH

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ABSTRACT:

This study investigated how adolescents in Montenegro perceive the impact of the natural environment on their well-being, environmental awareness, and health-related behaviors. We analysed how people understand the role of the natural environment and changing lifestyle patterns in relation to their mental health in a time of strong digitalization. During the research, we used an online questionnaire distributed to respondents via mobile phones as one of the methods. During the research we used an online questionnaire distributed to 373 respondents across all regions of Montenegro via mobile phones. We used LimeSurvey to prepare surveys; then semi-structured expert interviews with two professionals; and finally a focus group of six qualitative participants. During the research, the application of modern technologies played a key role in data collection and analysis. The results showed that adolescents strongly associate natural environments, such as clean air, preserved landscapes, and diverse geolocations, with improved mood, reduced stress, increased motivation, and a sense of resilience. Most of the initial hypotheses were confirmed. This showed that nature is widely considered a protective factor for mental health among young people in Montenegro. Overall, the findings highlight the importance of establishing diverse nature-based youth work programs, the significance of environmental education, and the value of integrating modern digital tools in research of this type.

Keywords: adolescents, well-being, ecology, nature, digital tools, Montenegro

**INHABITING THE CITY: SPATIAL ECOLOGIES FOR ACTIVE AGEING.
ENVIRONMENTAL QUALITY, PROXIMITY-BASED SYSTEMS, AND HOME
AUTOMATION AS KEY ENABLERS**

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Letizia Carrera

ABSTRACT:

The rapid ageing of the European population demands a reconfiguration of housing models and place-based welfare systems. This contribution proposes a conceptual framework that interprets public space and domestic space as interdependent components of a spatial ecology oriented toward active ageing. The article highlights how integrating urban design, proximity-based policies, and technological innovation can support autonomy, social participation, and well-being among older adults, thereby contributing to the development of resilient and inclusive environments. When integrated into a framework of territorial governance, these dimensions can serve as strategic levers for the construction of long-lived, inclusive, and resilient cities.

In conclusion, promoting active ageing entails recognizing the home, the neighbourhood and the whole city as complementary infrastructures of well-being and orienting technological innovation toward objectives of spatial equity and social cohesion.

Keywords: active ageing, public space, proximity, home automation, environmental quality, quality of life.

COMPARISON OF THE E-COMMERCE MARKETS IN SLOVAKIA AND BOSNIA AND HERZEGOVINA

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ABSTRACT:

E-commerce has affected all business sectors and it has essentially changed the shopping behaviour of consumers. The online purchase represents the standard way of getting possession of goods and services. E-commerce in Slovakia, as well as in Bosnia and Herzegovina has been gaining the popularity very fast in the last 10 years. There are essential differences present between the e-commerce market in Slovakia and Bosnia and Hercegovina despite the mutual similarity of these countries, either concerning the market directly or e-commerce companies and the number of customers.. People feel more and more comfortable when shopping online in Slovakia and in Bosnia and Herzegovina. The aim of this paper is to analyse the development and current state of online shopping in the selected countries of Slovakia and Bosnia and Hercegovina in the period of 2014 till 2030. The growing e-commerce trend is going to continue also in the future.

Keywords: *e-commerce, users, Slovakia, Bosnia and Herzegovina.*

THE IMPACT OF COMMUNITY MARKETING ON CRYPTOCURRENCY PERFORMANCE: EMPIRICAL INSIGHTS FROM ONLINE SEARCH ACTIVITY

UTICAJ MARKETINGA ZAJEDNICE NA PERFORMANSE KRIPTOVALUTA: EMPIRIJSKI UVIDI IZ AKTIVNOSTI ONLAJN PRETRAŽIVANJA

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Marko Trišić



Ivan Lazović



Dejan Antanasković

ABSTRACT

The scientific paper examines the impact of community marketing on the market performance of cryptocurrencies, while focusing on Bitcoin (BTC), Ethereum (ETH), and Ripple (XRP), and covering a full twelve-month period in 2025. The paper is based on the assumption that decentralized crypto-economies operate without formal marketing structures, which is why the main research treats digital attention and community engagement as a key marketing resource. Community marketing was presented through Relative Search Interest (RSI), while market performance was measured by the average monthly prices of the previously mentioned cryptocurrencies. The methodological framework includes descriptive analysis, Pearson's correlation analysis, and simple linear regression, which enables comparison of the strength and direction of the relationship between digital attention and market performance. The results of the paper indicate the existence of a positive correlation for all three cryptocurrencies, with a clearly differentiated intensity of that relationship. Bitcoin shows a moderate association, which suggests a predominantly informational role of community marketing, while Ethereum and especially Ripple exhibit a stronger association, indicating more pronounced behavioral and narrative-driven community effects. In conclusion, the scientific paper shows that community marketing presents a relevant but heterogeneous factor in shaping the market performance for these cryptocurrencies. Its impact depends on the market identity of the cryptocurrency and the structure of its community, thus confirming that digital signals of attention have a measurable but non-uniform importance for crypto-market performance.

Keywords: *community marketing, online information demand, cryptocurrency markets, price dynamics.*

CONSUMER PERCEPTION OF HEALTHY FOOD BRANDS WITH A FOCUS ON ORGANIC PRODUCTS

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Branislav Dudic

ABSTRACT:

This paper examines consumer perceptions of healthy food brands, with a particular focus on organic products, in the Montenegrin market. The primary aim of the research was to identify the factors shaping consumer perceptions, purchasing motives, and the barriers influencing behaviour in the selection of healthy and organic food products. The study was conducted on a sample of 328 respondents of varying ages, educational backgrounds, and socioeconomic profiles. A survey questionnaire was employed as the research instrument, and the data were analysed using descriptive statistical methods. The results indicate that health is the primary motive for purchasing healthy food products (73.8%), while the most significant barriers are high prices (76.2%) and limited product availability. Consumers of healthy food in Montenegro primarily obtain information through social media, and they perceive brands as symbols of trust, authenticity, and local origin. Although most respondents express positive attitudes and an intention to purchase healthy food products more frequently in the future, a “gap between attitudes and behaviour” is observed, driven by economic constraints and a lack of information. The findings suggest that the development of the healthy and organic food market requires strengthening transparency, consumer education, and the digital communication of brands. In this way, the paper contributes to a better understanding of consumer perceptions and behaviour in Montenegro, emphasizing the importance of branding, trust, and accessibility in shaping demand for healthy and organic products.

Keywords: healthy eating, organic products, consumer perception, brand, consumer behavior.

QUALITATIVE DATA ANALYSIS FOR AN STUDY OF WINE TOURISTS

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Danijela
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ABSTRACT:

Wine tourism is recognized as a growing segment of the tourism industry, offering visitors diverse sensory and cultural experiences. This study examines visitor perceptions by analyzing Google Reviews from ten Serbian wineries, using MAXQDA version 24 for qualitative data analysis. The results show that wine quality was the most influential factor in visitor satisfaction, followed by service quality, the environment, and food offerings. Overall, the findings indicate that visitors generally reported positive experiences, though service quality was the most frequently criticized aspect. The findings also emphasize the need for improved service quality to further enhance winery competitiveness.

Keywords: wine tourism, wineries, visitor perception, qualitative analysis, Serbia.

THE EFFECTS OF DIGITAL TECHNOLOGIES ON LANGUAGE AND COMMUNICATION AMONG YOUTH IN MONTENEGRO

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Velibor Spalević

ABSTRACT:

The research aimed to determine how new technologies affect the language of young people in Montenegro. Special emphasis was placed on changes in vocabulary, spelling, syntax and stylistic patterns of communication. The problem examined was the increasing deviation from the standard language norm, which indicated the dominance of digital platforms and the transfer of elements of informal Internet language into a formal context. The research was conducted using a combined method. The research included a survey among young people, two semi-structured interviews with experts and a focus group. The analysis was then continued using the analytical models SWOT, GAP and PESTEL. The sample included young people aged 14–24 from urban environments, as well as teachers and media professionals who observe the language practice of young people. The most important findings showed a high frequency of abbreviations, anglicisms, emoticons and simplified syntax, as well as a decrease in reading culture and spelling accuracy, with the simultaneous development of digital and media literacy and faster acquisition of the English language. The main conclusion is that new technologies represent both a resource and a challenge: they stimulate creativity and communication efficiency, but weaken standard norms and linguistic identity. The limitations of the study relate to the small and predominantly urban sample and the possibility of socially desirable responses. The findings indicate the need for systemic development of digital and media literacy, as well as for further research that would monitor long-term language changes under the influence of technological development.

Keywords: new technologies, youth language, communication, digital literacy, netspeak.

WOMEN IN BUSINESS IN THE 21ST CENTURY: CHALLENGES OF THE SOCIO-ECONOMIC TRANSITION IN SPECIFIC CONTEXTS

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Marija Ivaniš



Munira Šestić



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ABSTRACT:

This paper explores the perspectives of women in business in specific contexts of the Western Balkans, with a focus on Bosnia and Herzegovina with additional data. Women in business are increasingly recognized as a vital driver not only of economic growth and poverty reduction, but of overall improvements in living standards within transition contexts. Despite the significant progress made by women in business in the Western Balkans region, they continue to face numerous socio-economic challenges that hinder their full potential. The paper provides an analysis of the key obstacles and stereotypes that persist for women in business in the 21st century in these specific contexts. Particular attention is paid to the challenges of reconciling professional and family responsibilities, which often limit women's participation in business activities, especially in rural and smaller communities. On the other hand, the paper also highlights new opportunities and positive developments in recent years, as digital technologies, social media and online platforms offer women wider market access and flexibility in organizing their business operations. The paper concludes that empowering women in business is crucial both for sustainable economic development, but also for fostering needed social equality and broader progress for contexts in transition.

Keywords: Women in Business, Transition, Equality, Inclusion

EDUCATIONAL INNOVATIONS FOR INDUSTRY 4.0/5.0: PEDAGOGICAL PERSPECTIVES ON INTELLIGENT SYSTEMS AND EMERGING TECHNOLOGIES

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Izet Pehlić



Nermin Tufekčić

ABSTRACT:

The accelerated development of generative artificial intelligence (AI) and intelligent tutoring systems is transforming contemporary education and raising complex pedagogical, ethical, and regulatory questions. This paper examines the integration of AI into formal education from the perspective of educational sciences, emphasizing the principle of pedagogy first, technology second. Drawing on constructivist and sociocultural theories of learning, it argues that AI can enhance instructional adaptability and personalization, while human agency, responsibility, and ethical reflection remain essential to meaningful educational processes. Building on UNESCO guidelines for generative AI, the OECD's Digital Education Outlook, and the European Union's AI Act, the paper situates educational applications of AI within a global policy and regulatory framework. Recent meta-analyses indicate that AI-based tools can improve learning outcomes and support the development of 21st-century competencies, although effects are heterogeneous and context-dependent. In response to these challenges, the paper proposes the PTA model (Pedagogy–Technology–Agency), encompassing five dimensions: learning outcomes, instructional design, ethics and data governance, teacher agency, and equity. Two case studies from secondary and higher education illustrate the model's practical application. The findings suggest that AI in education yields substantial benefits only when embedded in a robust pedagogical framework, guided by ethical standards, and supported by institutional and regulatory policies.

Keywords: *active artificial intelligence; educational sciences; pedagogy; 21st-century competencies; EU AI Act; constructivism; ethics in education.*

PRIORITY TYPES OF INDEPENDENT WORK FOR ENGINEERING STUDENTS IN THE DIGITAL EDUCATIONAL ENVIRONMENT: EVOLUTION, ANALYSIS AND PROSPECTS

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Tatyana
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Anna
Mezentseva



Marina
Stanojević



Ivana
Marjanović

ABSTRACT:

This article provides a comprehensive diachronic analysis of the evolution of Independent Work of Students (IWS) in engineering higher education from the 1980s to the present day. The study employs a multi-faceted methodological approach, combining historical-pedagogical analysis of curriculum changes with a review of contemporary educational technologies. It systematically traces the dynamics in the allocated volume of IWS hours, identifies the dominant forms of independent cognitive activity within the digital paradigm (such as interactive simulations, MOOCs, and project-based learning), and evaluates their correlation with student academic outcomes. A significant portion of the research is dedicated to examining the integration and efficacy of specific tools, including virtual laboratories (e.g., MATLAB Simulink, LabVIEW), online learning platforms (Coursera, edX, national equivalents), and automated assessment systems. By synthesizing global trends in engineering training with retrospective data, the paper not only delineates established patterns but also forecasts emerging trajectories for IWS development. The findings culminate in practical recommendations for educators and curriculum designers in engineering disciplines, aimed at optimizing the pedagogical design of independent work to enhance the quality of graduate training and align it with modern industry demands.

Keywords: independent work of students (IWS), engineering education, digital educational environment, virtual laboratories, historical analysis, academic performance.

A SYSTEMATIC REVIEW OF INVESTOR/CLIENT FACTORS CAUSING CONSTRUCTION DELAYS

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Emir Bračković



Sanin Džidić

ABSTRACT:

The persistent and most enduring challenge in the construction sector worldwide is the problem of project delays. While some definitions may include cost overruns in addition to time overruns, the basic concept of this re-search focuses on an extension of the project duration. This research conducts a multifactorial analysis of the causes of delays in construction projects. Combining comparative study analysis and stakeholder-based assessment, this study identifies problems caused by the investor/client - such as unclear contractual roles, changing project scope, poor communication, and weak internal coordination - as the main factors contributing to time over-runs. In addition, the roles of other participants in construction, such as contractors, designers and others, are analyzed but not presented in this paper. The research contributes to a deeper understanding of the phenomenon of construction project delays that can significantly reduce delays and improve construction results. This research ultimately aims to inform all participants and improve practice in real projects and possibly offer practical strategies for increasing efficiency and overall performance in the implementation of construction projects in the future.

Keywords: *construction delays, construction management, risk management.*

WHICH TYPE OF EDUCATION SHAPES ENTREPRENEURIAL MINDSET? EVIDENCE FROM VET SCHOOLS IN BOSNIA AND HERZEGOVINA

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Admir Salihagic



Ermin Cero

ABSTRACT:

This study examines how different forms of entrepreneurship education shape entrepreneurial mindset (EM) traits among vocational education and training (VET) students in Bosnia and Herzegovina. Drawing on Human Capital Theory, EM traits are conceptualized as non-cognitive competencies developed through educational investment. Structural equation modeling was conducted on data from 607 students exposed to mandatory courses, elective courses, and extracurricular activities inside and outside school. Results show that extracurricular activities outside school have the strongest and most consistent positive effects on key EM traits, including opportunity recognition, creativity, persistence, teamwork, and execution. In contrast, mandatory and elective courses show limited or negative associations with most traits. The findings underscore the greater impact of informal, experiential learning environments in developing entrepreneurial competencies and offer practical implications for improving the design of entrepreneurship education in VET systems.

Keywords: Entrepreneurial mindset, Extracurricular activities, Formal education, Informal education, Structural equation modeling.

**REMOTE WORK PRODUCTIVITY AND ORGANIZATIONAL POLICIES:
EMPLOYEE' PERCEPTIONS IN BOSNIA AND HERZEGOVINA**

**PRODUKTIVNOST RADA NA DALJINU I ORGANIZACIJSKE POLITIKE:
PERCEPCIJE ZAPOSLENIH U BOSNI I HERCEGOVINI**

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Elvir Šahić



Munira Šestić



Anes Hrnjić



Delila Tucaković

ABSTRACT:

The aim of this paper is to analyze organizational policies regulating remote work to determine the extent to which their implementation affects the productivity of this work modality, specifically concerning employees' perceptions of satisfaction and stress levels. The paper analyzes some challenges associated with regulating specific organizational policies related to remote work, which produce various effects on employees, both positive and negative. In this context, the most common remote work organizational policies implemented by organizations in Bosnia and Herzegovina are identified, along with a presentation of their impact on employees. Key findings from the empirical research indicate the significance of understanding remote work dynamics and the necessity for adapting organizational policies in line with contemporary trends, with particular regard to employee perceptions.

Keywords: Remote Work Productivity, Organizational Policy, Employees' Perceptions

SAŽETAK:

Cilj ovog rada je analizirati organizacijske politike kojima se reguliše rad na daljinu kako bi se utvrdilo u kojoj mjeri njihovo provođenje utiče na produktivnost takve vrste rada, specifično u segmentu percepcije zaposlenih spram zadovoljstva i nivoa stresa. U radu se analiziraju izazovi povezani sa regulisanjem specifičnih organizacijskih politika rada na daljinu, koje proizvode različite efekte na zaposlene, kako u pozitivnom, tako i negativnom smislu. S tim u vezi, identificirane su najčešće organizacijske politike rada na daljinu koje provode organizacije u Bosni i Hercegovini, uz prikaz njihovog uticaja na zaposlene. Ključni nalazi provedenog empirijskog istraživanja ukazuju na značaj razumijevanja dinamike rada na daljinu i neophodnost prilagođavanja organizacijskih politika u skladu sa savremenim trendovima, uz posebno uvažavanje percepcija zaposlenih.

Ključne riječi: Produktivnost rada na daljinu, Organizacijska politika rada, Percepcije zaposlenih

FEMALE ENTREPRENEURS 4.0 IN BOSNIA AND HERZEGOVINA: IS 4IR AN OPPORTUNITY OR A THREAT?

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Munira Šestić



Elvir Čizmić



Zijada Rahimić



Azra Mujagić

ABSTRACT:

The Fourth Industrial Revolution (4IR) is bringing fundamental changes to the global social context, ushering technologies such as automation and artificial intelligence. For female entrepreneurship in Bosnia and Herzegovina, this era represents a specific duality: on one hand, digitalization offers opportunities to overcome traditional gender barriers and facilitates easier access to the global market; on the other hand, it poses a threat by further deepening the digital divide and marginalizing sectors where women-led businesses are traditionally most prominent. The paper explores the position of female entrepreneurs in Bosnia and Herzegovina by analyzing current trends in both, the accessibility and utilization of 4IR resources. The objective is to answer a key question: does technological disruption serve as a catalyst for gender equality or as a new barrier within the transitional economic landscape of Bosnia and Herzegovina for women-led micro and small enterprises? While answering research questions, this paper is yet offering actionable strategic recommendations for policymakers, emphasizing the need for specific digital inclusion programs for female entrepreneurs in Bosnia and Herzegovina in the 4.0 era.

Keywords: Female entrepreneurship, 4IR, Bosnia and Herzegovina, Gender equality

ARTIFICIAL INTELLIGENCE IN HRM AND ORGANIZATIONAL LEARNING CULTURE: IMPACTS ON LEADERSHIP AND TEACHER PERFORMANCE

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Ismail



Masrina Nadia
Mohd Salleh



Noor Azlina
Yusoff

ABSTRACT:

This study investigates the interplay between artificial intelligence-driven human resource management (AI-driven HRM), organizational learning culture, leadership effectiveness, and employee performance within the education sector in Johor, Malaysia. Drawing on the Ability–Motivation–Opportunity (AMO) framework, the research develops and tests a holistic model that integrates technological practices, relational leadership skills, and cultural preconditions. Data were collected through a cross-sectional survey of 131 teachers across Malaysian schools, analyzed using partial least squares structural equation modeling (PLS-SEM). Results demonstrate that AI-HRM and organizational learning culture significantly enhance leadership effectiveness, which in turn positively influences employee performance. Moreover, leadership effectiveness mediates the relationship between AI-HRM, organizational learning culture, and performance outcomes, underscoring its critical role as a bridging mechanism. The findings contribute to theory by addressing conceptual fragmentation in HRM research and highlighting the importance of organizational culture in technology adoption. Practically, the study emphasizes the need for school leaders to balance digital innovation with human-centered leadership to foster teacher engagement and performance.

Keywords: AI-driven HRM; leadership effectiveness; Malaysia; employee performance; teachers

EFFECTS OF DIGITALIZING CIVIL REGISTRY RECORDS IN THE FEDERATION OF BOSNIA AND HERZEGOVINA

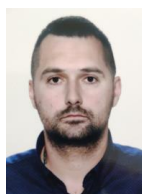
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Enes Saletović



Muhamed Fetić



Đulaga Hadžić

ABSTRACT:

This paper examines the effects of digitalizing civil registry records in the Federation of Bosnia and Herzegovina (FBiH) and the role of digitalization in protecting citizens' civil status rights. Based on statistical analysis and a review of existing digital services, it presents key measurable and non-measurable effects of the process. The paper also addresses major benefits and potential risks, especially regarding the security of citizens' identification data. Furthermore, it analyzes the legal framework and discusses possibilities for introducing new digital services, drawing on local and international good practices.

Keywords: digitalization, civil registry, security.

SAŽETAK:

Ovaj rad razmatra efekte digitalizacije matičnih knjiga u Federaciji Bosne i Hercegovine (FBiH) te ulogu digitalizacije u zaštiti osnovnih prava građana iz oblasti građanskog stanja. Na osnovu statističke analize i pregleda postojećih digitalnih usluga, predstavljeni su ključni mjerljivi i nemjerljivi efekti ovog procesa. Rad također razmatra glavne prednosti i potencijalne rizike, posebno u pogledu sigurnosti i zaštite identifikacionih podataka građana. Nadalje, analizira se pravni okvir te razmatraju mogućnosti uvođenja novih digitalnih usluga, uz oslanjanje na domaće i međunarodne primjere dobre prakse.

Ključne riječi: digitalizacija, matični registar, sigurnost.

MODEL FOR THE ASSESSMENT OF FINANCIAL REPORTING QUALITY IN CONTEMPORARY MANAGEMENT

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Haris Jahić



Amela Piralić



Lejla Demirović

ABSTRACT:

The quality of financial information is a key assumption for making efficient business decisions. Assessing the quality of financial statements, as a complex non-financial aspect of information, requires consideration of several factors that influence their reliability and relevance. This paper analyzes the quality of financial statements based on the structure and oscillations of their elements, as well as through key financial and analytical indicators. The goal of the paper is the development of a model that enables a quick and simple assessment of the level of quality of financial statements and the level of confidence in the presented information, including the assessment of the probability of the existence of a significant substantive error. Empirical research was conducted on a sample of companies from Bosnia and Herzegovina whose securities were traded on the Sarajevo and Banja Luka Stock Exchanges for a period of 6 years, and the sample includes a total of 100 companies. The condition for the selection of the sample was the continuous six-year public publication of financial and audit reports. Binomial logistic regression was used for modeling, where the dependent variable is the quality of financial statements, and the independent variables are selected, characteristic elements of financial statements.

Keywords: financial statements, quality, assessments, predictive model, financial indicators.

STATE-OWNED ENTERPRISES IN BOSNIA AND HERZEGOVINA: FOOTPRINT, PERFORMANCE AND FISCAL IMPACT

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Aida Soko



Mirza Kršo

ABSTRACT:

This paper assesses the footprint, performance, and fiscal impact of Bosnia and Herzegovina's SOEs within a fragmented, multi-level governance system. Using a consolidated dataset of 540 SOEs (2021-2024), we benchmark outcomes against private firms and regional norms via ratio analysis focusing on ROA, ROE, revenue per employee, leverage, and liquidity metrics.

Findings show persistent structural underperformance. SOEs control assets near 82% of GDP and employ 9% of the workforce yet record negative returns and roughly 50% lower productivity. Using a conservative repayment-capacity screen, we estimate high-risk short-term liabilities of about 5.4% of GDP that are likely to require government intervention. While leverage ratios are comparable to those observed in peer countries in Central and Eastern Europe, rising liabilities, weak short-term repayment capacity, tax arrears, and reliance on budget transfers indicate increasing fiscal risks.

Keywords: State-owned enterprise, public sector efficiency, contingent liabilities, SOE governance
JEL Classification: H32, H63, L32, P35, E62

DIGITAL TRANSFORMATION OF CAREER COUNSELING IN ALBANIA: AMELORA PLATFORM

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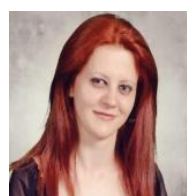
Valbona
Habili Sauku



Fleura
Shkëmbi



Ana
Memo



Silva
Ibrahim

ABSTRACT:

Career counseling in Albanian schools faces significant challenges, including fragmented institutional support, insufficient professional training, and a critical absence of collaborative networks among practitioners. This paper presents the Amelora platform, a digital knowledge hub designed to transform career counseling by fostering a sustainable Community of Practice. Grounded in Wenger's theory of Communities of Practice and in the principles of digital transformation, Amelora provides a comprehensive ecosystem that connects counselors, teachers, students, parents, and industry experts. Empirical data from surveys of Albanian career counselors reveal widespread professional isolation, resource scarcity, and strong demand for a collaborative digital solution. The platform's architecture includes a digital library, professional development modules, discussion forums, a material marketplace, and virtual mentoring capabilities. Implementation recommendations for governmental bodies, schools, and international partners are provided, alongside a sustainability model. The Amelora platform represents a strategic intervention to modernize Albania's career counseling infrastructure, standardize practices, and improve student outcomes through enhanced professional support and resource accessibility.

Keywords: career counseling, digital transformation, professional community, Amelora platform, Albania, education technology

RISK SOCIETY AND TECHNOLOGY: THE TECHNOSPHERE – A SPHERE OF POSSIBILITIES AND RISKS

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Halima Sofradžija



Abdel Alibegović



Ajdin Sofradžija



Irena Praskač-Salčin

ABSTRACT:

Modern technology opens entirely new possibilities for constructing and deconstructing the world. The technosphere, as a space of unstoppable dynamism, continuously places society at elevated levels of ongoing transformation and transformative processes. It is an incessant weaving of contemporary human existence in which established boundaries are constantly crossed. Innovative technologies are undeniably a fusion of countless possibilities and risks—two doors that seem to open simultaneously. It is therefore essential to understand the dialectics of technique, as well as the complex processes and consequences of our challenging age of technoculture. The reshaping of the digital world, which has penetrated all spheres of life, requires us to comprehend the medium of technology as the most recognizable and omnipresent medium—one that poses numerous challenges to contemporary society. As our experience of life changes on all levels, new prisms emerge through the ever flowing and inexhaustible river of innovations, revealing the creative power of human agency and the many modalities of inquiry within the new architecture of the age in which we live.

Keywords: technology, technosphere, technoculture, transformation, social risk, digitalization.

SAŽETAK:

Savremena tehnologija otvara sasvim nove mogućnosti gradnje i razgradnje svijeta. Tehnosfera, koja je prostor nezaustavljive dinamike, neprekidno drži društvo na visokim razinama kontinuirane transformacije i transformativnih procesa. Tehnosfera je neumorno tkanje savremenog čovjeka u kojoj se neprekidno prelaze postojeće granice. Inovativne tehnologije neosporno su spoj nebrojenih mogućnosti i rizika, čini se da su to dvojna vrata koja se naporedo otvaraju. Potrebno je razumjeti dijalektiku tehnike, sve složene procese i posljedice našeg izazovnog doba tehnokulture. Preoblikovanje digitalnog svijeta, koji je zahvatio sve oblasti života, traži da razumijemo medij tehnologije, kao najprepoznatljivijeg i najprisutnijeg medija, a koji postavlja mnogobrojne izazove pred savremeno društvo. Kako se mijenja naše iskustvo života, na svim nivoima, kroz nove prizme iznova nastajuće i nepresušne rijeke inovacija - kojom se pokazuje stvaralačka moć kreativnog djelovanja i modaliteta istraživanja u novoj arhitekturi doba u kojem živimo.

Cljučne riječi: tehnologija, tehnosfera, tehnokultura, transformacija, društveni rizik, digitalizacija.

INNOVATIVE SOLUTIONS IN SHAPING THE ORGANISATIONAL STRUCTURE OF ENTERPRISE MANAGEMENT IN THE CONTEXT OF DIGITALISATION

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Liubov Niekrasova Kateryna Zaichenko Tetiana Nosova Dmytro Ivashkin

ABSTRACT:

The article is devoted to the development of innovative solutions for forming the organisational structure of enterprise management in the context of digitalisation through the integration of virtual elements. A conceptual model for forming the organisational structure of enterprise management in the context of digitalisation has been developed, consisting of six main stages: auditing the existing organisational management structure, identifying and classifying key business processes, designing and integrating virtual management blocks, evaluating the effectiveness of the management structure after the implementation of virtual blocks, analysing the results obtained, and adjusting changes. The influence of a group of factors at each stage of its implementation has been determined. As part of one of the stages, a formalised methodology based on a system of interrelated indicators is proposed: the virtualisation coefficient of the organisational management structure, the resource virtualisation coefficient, the fixed cost level index, the coefficient of structural shifts in fixed costs, the virtualisation growth indicator, and the integral index of the level of virtualisation of the organisational management structure. The proposed measures were tested at three Ukrainian enterprises with a project-functional organisational management structure, a network structure, and a linear-functional structure with project elements. The developed assessment methodology ensures the correct comparability of enterprises with different types of organisational structures. It can be used as an analytical tool to determine the stage of organisational transformation and justify management decisions regarding the development of hybrid and network management models in the context of digital transformation.

Keywords: *virtualisation, digitalisation, innovation, enterprise, organisational management structure, model, process.*

ENTROPY ANALYSIS OF POLITICAL SYSTEMS IN AN EXPONENTIAL SOCIETY: A SOCIOLOGICAL-THERMODYNAMICAL APPROACH TO ASSESSING THE STABILITY OF PUBLIC ADMINISTRATION AND THE EFFICIENCY OF POLITICAL LEADERSHIP

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Oksana Shelomovska



Ruslan Voloshin



Marina Stanojevic

ABSTRACT:

The article provides an interdisciplinary sociological and thermodynamic analysis of the political systems of an exponential society functioning in conditions of accelerated growth of information flows, digital oversaturation, and increased nonlinearity of socio-political processes. It substantiates the thesis about the limitations of traditional linear and classical institutional approaches to the analysis of political stability and the effectiveness of public administration in conditions of high complexity and turbulence. As an alternative, it proposes an entropic approach that combines sociological theory of complex systems with the conceptual apparatus of thermodynamics and information theory. The aim of the study is to develop and substantiate an entropy model for analyzing political systems, which integrates sociological approaches to the study of political stability with the conceptual apparatus of thermodynamics and information theory. Political entropy is operationalised using Shannon's information entropy, adapted through the indicators of the Fragile States Index (FSI). The proposed procedure for normalizing indicators allows calculating both absolute and normalized entropy values, which makes it possible to assess not only the overall level of political instability, but also the internal structural configuration of political risks and the degree of their concentration or diffusion. The methodology was tested within the framework of a comparative empirical analysis of the political systems of five European countries — Ukraine, Serbia, Germany, the Czech Republic, and Latvia — during the period 2015–2024. The entropy indicators obtained are compared with the aggregated FSI scores, which makes it possible to identify latent differences in the nature of instability that remain invisible within traditional index assessments. The results demonstrate that states with similar levels of fragility may exhibit substantially different entropic configurations. High values of normalised entropy indicate a diffuse risk structure, which reduces the effectiveness of targeted governance interventions. The proposed entropic approach expands the analytical capabilities of political sociology, offering a more differentiated and structurally sensitive understanding of political stability, and serves as an additional tool for assessing institutional adaptability, the sustainability of public administration, and the effectiveness of political leadership in conditions of growing socio-political turbulence.

Keywords: political entropy, exponential society, Fragile States Index, information entropy, political stability, public administration, nonlinear dynamic, political systems, sociological-thermodynamical approach, Shannon's theory.

ETHICS BY DESIGN: EMBEDDING MORAL RISK ASSESSMENT INTO MANAGEMENT PRODUCT ROADMAPS

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Aelita Mani



Arbi Agalliu

ABSTRACT:

The swift progress of technology has introduced a new class of risks that are not purely technical, though deeply ethical. This paper argues for a preemptive approach to integrity-based risk management through "Ethics by Design," a framework that embeds moral considerations into the entire technology development lifecycle. We propose a practical methodology for integrating Moral Risk Assessment (MRA) into product roadmaps, a keystone of strategic product management. By doing so, we deliver a structured process for identifying, analyzing, and mitigating ethical risks before they cause social harm. This integrated approach transforms the product roadmap from a purely feature-driven plan into an effective tool for responsible innovation. The paper reviews existing literature on Ethics by Design, moral risk assessment, and product roadmapping, and synthesizes these concepts within a novel, actionable framework for technology companies. We conclude by discussing the practical implementation of the outlined framework, drawing on case studies of leading technology firms, and outlining directions for future research.

Keywords: *Ethics by Design, Moral Risk Assessment, Product Roadmap, Responsible Innovation, Technology Governance, Value Sensitive Design*

THE METHODS OF USER JOURNEY MAP DEVELOPMENT AND DEPLOYMENT WITH COST-BENEFIT EVALUATION

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ABSTRACT:

The article outlines the methods of creating and developing User Journey Maps (UJM, CJM) as a tool for forming an effective user experience in digital products. A brand-new hybrid approach to CJM building was introduced, combining graph models and Markov chains to map customers' behavior on the web. Special attention was paid to UX/UI design principles integration, accessibility, and customer testing tools. The algorithm of prioritizing interface design changes based on a multi-criteria quality function was presented. The multi-criteria quality function addresses rejection factors, levels of user satisfaction, and compliance with WCAG standards indicators. An experimental approbation of the approach based on the web-platform prototype with relevant users' interaction data was held. The obtained results show a decrease in rejection probability along with upscaling usability and accessibility levels. The suggested method is recommended for implementation in website development, mobile app development, and interactive service development to enhance business process efficiency and user experience quality.

Keywords: UX design, UI design, web design, user journey map, accessibility. user testing, Markov chains, computer science.

IMPACT OF GREEN FINANCE ON THE FOREIGN DIRECT INVESTMENTS IN THE EUROPEAN UNION

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ABSTRACT:

This study examines the impact of green finance on foreign direct investment (FDI) inflows in EU countries over the period 2000–2023. Using a balanced panel of 26 EU economies, the analysis combines a public green finance proxy based on government renewable energy investments with conventional macroeconomic controls. Fixed effects and dynamic system Generalized Method of Moments (System GMM) estimators are employed to address unobserved heterogeneity, FDI persistence, and potential endogeneity. The results confirm strong persistence in FDI inflows find no statistically significant short-run effect of green finance on FDI. Renewable energy consumption and market size are also not robust determinants, while trade openness shows a weak negative association with FDI. Overall, the findings suggest that in mature and highly integrated EU economies, green finance does not act as an immediate pull factor for foreign investors but rather influences investment dynamics through indirect or longer-term channels.

Keywords: Green Finance, FDI, EU, System GMM

RECONCEPTUALIZING SERVICE QUALITY IN RESOURCE-CONSTRAINED PUBLIC HEALTHCARE: A SERVQUAL PERSPECTIVE ON MALAYSIA

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ABSTRACT:

Patient satisfaction serves as a vital indicator of healthcare performance and institutional trust. This conceptual paper explores the relationship between service quality and patient satisfaction within the public healthcare sector of Malaysia. By utilizing the SERVQUAL dimensions of tangibility, reliability, responsiveness, assurance, and empathy, the study situates these factors within a unique sociocultural landscape. The paper argues that within a high volume and subsidized environment where financial costs are absent, the quality of service delivery becomes the primary determinant of satisfaction. This work provides a theoretical foundation for policymakers to design patient centered reforms and offers a conceptual roadmap for future empirical validation.

Keywords: Service Quality; Patient Satisfaction; Public Healthcare; SERVQUAL; Malaysia

BASIC PRINCIPLES OF MOTIVATION AS AN OBJECT OF MANAGEMENT INFLUENCE ON THE INNOVATIVE ACTIVITIES OF BUSINESS ENTITIES

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ABSTRACT:

The article focuses on the need to determine the basic principles of motivation as an incentive to increase the economic potential of business entities. The assessment of the impact of the motivation system on the innovative activity of business entities as a component of the system of enterprise tools is presented and determined. The components of the motivational mechanism of innovative activity of business entities and the impact of the motivation system on expanding innovative opportunities and strengthening the competitiveness of enterprises are considered. The complex of motivation-forming factors that can cause changes in the motivational structure of the entity, such as positive and negative, is considered.

Keywords: innovative activity, motivation, business entities, motivation-forming factors, motivation system.

OPPORTUNITIES AND CHALLENGES FOR BOSNIAN START-UPS IN THE GLOBAL CARBON OFFSET MARKET

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ABSTRACT:

This research analyzes the opportunities and challenges for start-up companies in Bosnia and Herzegovina to build a competitive position in the global carbon offset market. The aim of the paper is to assess whether the natural resources, institutional readiness and entrepreneurial capacity of Bosnia and Herzegovina provide a sufficient basis for developing a competitive role in the global carbon offset market. The analysis was conducted through a review of relevant literature, mapping of existing policies in the field of climate change and energy, and a SWOT approach that assesses the key strengths, weaknesses, opportunities and threats for Bosnian-herzegovina start-up companies. The results indicate that Bosnia and Herzegovina, thanks to its rich forest ecosystems and significant hydropower potential, has a realistic basis for the development of emission reduction and carbon sequestration projects. At the same time, the research shows that the lack of a clear regulatory framework, insufficient market infrastructure and a complex institutional system seriously limit young professionals in the fields of forestry, economics and energy from starting companies or consulting firms that would participate in the emissions compensation market. The paper concludes with recommendations for improving the conditions for the inclusion of Bosnia and Herzegovina and private start-ups in the global market. Particular emphasis is placed on the need for regulatory reforms, the establishment of verification and monitoring mechanisms, the development of financial instruments to support start-ups, and the creation of incubation programs that would strengthen the capacities of young professionals and enable more competitive access to the market.

Keywords: Carbon offset market, Bosnia and Herzegovina, private start-up companies, forest ecosystems, institutional framework.

MEASURING PUBLIC ATTITUDES TOWARD PLANTING DROUGHT-RESISTANT LINDEN TREES: A LOCAL CLIMATE CHANGE INITIATIVE IN BOSNIA AND HERZEGOVINA

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ABSTRACT:

Oxygen production, preservation of a pleasant urban microclimate and cultivation of quality wood are becoming increasingly important in conditions of accelerated climate change. In Bosnia and Herzegovina, there is a real potential for planting tree species resistant to long-term droughts and extreme temperatures, as previous research indicates the possibility of mass clonal production of certain species and the establishment of plantations on private and state forest areas. Local communities in Bosnia and Herzegovina often await systemic solutions from state institutions, although more intensive local initiatives to plant highly resilient species could have a significant impact on climate change mitigation at the micro-local level. Despite the potential, there is insufficient research on how citizens of different regions perceive the use of such species, especially linden (*Tilia* sp.), as a model for local climate adaptation. The aim of this research is to examine the attitudes of local communities towards planting linden as a drought and heatwave resistant species, and to analyze how these attitudes are linked to other environmental and social variables. As part of the study, a structured questionnaire was developed and administered to residents of different geographical areas of Bosnia and Herzegovina, with the aim of measuring their perceptions of climate risks and potential solutions. The research results contribute to understanding how local communities perceive the role of highly resilient species in urban and rural areas, and how increased linden planting can impact local development, stabilize the wood products market, and improve beekeeping. The developed questionnaire represents the basis for further empirical research on public attitudes in the context of climate change in Bosnia and Herzegovina.

Keywords: innovations, local market, Bosnia and Herzegovina, attitude towards linden, private ownership.

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ROBOTICS SOCIETY OF BOSNIA AND HERZEGOVINA



The Robotics Society of Bosnia and Herzegovina is dedicated to long-term work in the fields of education, professional development, and technological advancement in the domain of automation and robotic systems. The primary mission of the Society is reflected in strengthening the role of science and applied knowledge, with the aim of positioning Bosnia and Herzegovina as a competitive actor on the European and global innovation stage. Through the promotion of scientific and technological progress and the implementation of modern technical solutions, the Society actively contributes to the transformation of the domestic economy and educational system into a modern knowledge-based society. In order to achieve these goals, the Society's activities include the organization of scientific and professional conferences, congresses, and symposiums, support for innovators, as well as the establishment of specialized laboratories and robotics centers at universities and secondary schools. As a central platform, the Society brings together scientists, engineers, professors, and students, encouraging publishing activities, fostering international cooperation with related institutions, and promoting the integration of advanced technologies into the real industrial sector.

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***DRUŠTVO ZA ROBOTIKU
U BOSNI I HERCEGOVINI***



Društvo za robotiku u Bosni i Hercegovini posvećeno je višegodišnjem radu na polju edukacije, stručnog usavršavanja i tehnološkog razvoja u domenu automatizacije i robotskih sistema. Primarna misija Društva ogleda se u jačanju uloge nauke i primijenjenog znanja, s ciljem pozicioniranja Bosne i Hercegovine kao konkurentnog aktera na evropskoj i globalnoj inovativnoj skali. Kroz poticanje naučno-tehnološkog napretka i implementaciju savremenih tehničkih rješenja, Društvo aktivno učestvuje u transformaciji domaće privrede i obrazovnog sistema u moderno društvo utemeljeno na znanju. U svrhu ostvarivanja ovih ciljeva, djelovanje Društva obuhvata organizaciju naučno-stručnih skupova, kongresa i simpozijuma, podršku inovatorima, te formiranje specijalizovanih laboratorija i centara za robotiku na univerzitetima i srednjim školama. Kao centralna platforma, Društvo okuplja naučnike, inženjere, profesore i studente, podstičući izdavačku djelatnost, međunarodnu saradnju sa srodnim institucijama, te integraciju naprednih tehnologija u realni industrijski sektor.

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 Nacionalni park Una bosanskohercegovačka i svjetska prirodna vrijednost



Štrbački buk, najviši vodopad na rijeci Uni i najposjećenija atrakcija u Parku



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VISION OF THE FOUNDATION ‘OLYMPIAD OF KNOWLEDGE’ (‘OLIMPIJADA ZNANJA’)

Core Values

- We consider knowledge to be the greatest value of any society.
- We encourage and seek creativity and innovation in knowledge building and sharing.
- We promote and support knowledge competitions with the best.
- We nurture honesty and integrity.
- Our service is dedicated to children and society, wholeheartedly

Core Purpose

The purpose is to enhance children's competencies by elevating the status of teachers and strengthening functional knowledge.

Envisioned Future (BHAG)

Our imperative is to ensure that by 2028, every child in Bosnia and Herzegovina experiences a brilliant childhood in excellent kindergartens. Simultaneously, we strive for every student to shine with functional literacy by 2040, and for our country to secure a place among the top 20 according to relevant international standards of functional knowledge, such as the PISA tests.

Vivid Descriptions

Setting the goal for all high school students in Bosnia and Herzegovina to achieve functional literacy by 2040 represents an ambitious plan with a key focus on education as the foundation for societal development. This objective not only promotes individual student success but also enhances the overall competitiveness of the country on the international stage. Developing functional literacy entails creating a generation of young individuals capable of applying their knowledge in real-life situations, solving complex problems, and contributing to societal innovations.

The indicators that will track progress toward achieving this goal include:

- **Availability of Excellent Kindergartens:** Monitoring the number and distribution of high-quality kindergartens across the country to ensure that every child, regardless of location, has access to top-notch preschool education;
- **Child Participation in Preschool Education:** Tracking the percentage of children actively participating in preschool education programs up to the age of six, with a special emphasis on inclusivity and equal opportunities for all;
- **Program Quality Excellence:** Monitoring quality standards in preschool institutions, including not only educational methods and teacher expertise but also infrastructure conditions that support holistic child development in line with global best practices;
- **Social Inclusion:** Monitoring progress in achieving inclusive approaches to preschool education, ensuring that children, teachers, parents, and society as a whole are fully integrated into the educational environment;
- **Parent Collaboration:** Developing programs and practices that encourage collaboration between kindergartens, parents, and local communities, ensuring continuous parental support in their children's education and development;
- **PISA Tests:** Monitoring students' performance on PISA tests with the aim of gaining an objective insight into their abilities in reading, mathematics, and science. Additionally, tracking Bosnia and Herzegovina's position on the global education scale, which includes criteria such as teaching quality, educational access, and student outcomes, provides a comprehensive overview of the educational system's success;
- **Student Success in Continuing Education:** Monitoring the percentage of students who successfully complete high school education and continue further studies or secure successful employment in relevant sectors;
- **Innovations in Teaching:** Supporting and monitoring the development of innovative teaching methods, introducing new technologies, and adapting the curriculum to make all of the above possible. This goal is set with the intention of creating an educated society that will be a cornerstone for Bosnia and Herzegovina's economic and social development.



FOUNDATION ‘OLYMPIAD OF KNOWLEDGE’

<https://olimpijadaznanja.ba/>

VIZIJA FONDACIJE „OLIMPIJADA ZNANJA“

Ključne vrijednosti

Znanje držimo za najveću vrijednost jednog društva. Podstičemo i tragamo za kreativnošću i inovacijama u izgradnji i dijeljenju znanja. Promoviramo i podržavamo natečanje u znanju s najboljima. Njeguemo poštenje i integritet. Služimo djeci i društvu sa srcem

Svrha

Unapređivanje kompetencija djece kroz podizanje statusa učitelja i jačanje funkcionalnog znanja.

Strateški izazov

Naš imperativ je do 2028. osigurati svakom djetetu u Bosni i Hercegovini blistavo djetinjstvo u izvrsnim vrtićima, istovremeno težeći da do 2040. svaki učenik svijetli funkcionalnom pismenošću, a naša zemlja zauzme mjesto među 20 najboljih prema relevantnim međunarodnim standardima funkcionalnog znanja, poput PISA testova.

Živopisni prikaz – šta to zapravo znači

Postavljanje cilja da svi srednjoškolci u Bosni i Hercegovini postignu funkcionalnu pismenost do 2040. godine predstavlja ambiciozan plan s ključnim fokusom na obrazovanje kao temelju razvoja društva. Ovaj cilj ne samo da promovira pojedinačni uspjeh učenika, već i ukupnu konkurentnost zemlje na međunarodnoj razini. Razvijanje funkcionalne pismenosti podrazumijeva stvaranje generacije mladih koji su sposobni primijeniti svoje znanje u stvarnom životu, rješavati kompleksne probleme i pridonositi inovacijama u društvu.

Indikatori kroz koje će se pratiti napredak prema postizanju ovog cilja uključuju:

- **dostupnost izvrsnih vrtića:** praćenje broja i rasprostranjenosti visokokvalitetnih vrtića diljem zemlje kako bi se osiguralo da svako dijete, neovisno o lokaciji, ima pristup vrhunskom predškolskom obrazovanju;
- **participacija djece u predškolskom obrazovanju:** praćenje postotka djece koja aktivno sudjeluju u programima predškolskog obrazovanja do dobi od šest godina, s posebnim naglaskom na inkluzivnosti i osiguravanju jednakih prilika za sve;
- **vrhunska kvaliteta programa:** praćenje standarda kvalitete u predškolskim ustanovama, uključujući ne samo edukativne metode i stručnost odgajatelja, već i infrastrukturne uslove koji podržavaju holistički razvoj djece u skladu sa najboljim svjetskim praksama;
- **socijalna inkluzija:** praćenje napretka u ostvaranju inkluzivnih pristupa predškolskom obrazovanju, osiguravajući da su djeca, učitelji, roditelji, i društvo u cjelini, u potpunosti integrirani u obrazovno okruženje;
- **saradnja s roditeljima:** razvoj programa i praksi koji potiču saradnju između vrtića, roditelja i lokalne zajednice, osiguravajući kontinuiranu podršku roditelja u obrazovanju i razvoju svoje djece;
- **PISA testovi:** praćenje rezultata učenika na PISA testovima s ciljem sticanja objektivnog uvida u njihove sposobnosti u čitanju, matematici i nauci, i praćenja pozicije Bosne i Hercegovine na globalnoj ljestvici obrazovanja, koja uključuje kriterije kao što su kvaliteta nastave, pristup obrazovanju i rezultate učenika, te pruža cjelovit pregled uspješnosti obrazovnog sistema.
- **uspješnost učenika u nastavku školovanja:** praćenje postotka učenika koji uspješno završavaju srednjoškolsko obrazovanje i nastavljaju dalje školovanje ili se uspješno zapošljavaju u relevantnim sektorima;
- **inovacije u nastavi:** podupiranje i praćenje razvoja inovativnih metoda podučavanja, uvođenje novih tehnologija i prilagodbe nastavnog plana i programa kako bi sve gore navedeno bilo moguće. Ovaj cilj postavljen je s namjerom stvaranja obrazovanog društva koje će biti oslonac za ekonomski i društveni razvoj Bosne i Hercegovine



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