UNIVERSITY "VITEZ"
FACULTY OF INFORMATION TECHNOLOGY
BOSNIA AND HERZEGOVINA
AND
POLITEHNICA UNIVERSITY TIMISOARA
FACULTY OF ENGINEERING HUNEDOARA

BOOK OF ABSTRACTS

ICAS 2026 CONFERENCE

www.icas.fih.upt.ro

University “Vitez”
Faculty of Information Technology
Bosnia and Herzegovina
and
Politehnica University Timisoara
Faculty of Engineering Hunedoara
Romania

ICAS 2026 CONFERENCE

BOOK OF ABSTRACTS

Banja Luka 2026

14th INTERNATIONAL CONFERENCE OF APPLIED SCIENCE

https://icas.fih.upt.ro/

Supported by:
DRVO KLASTER, BANJA LUKA
BHAAAS Academy

Organizer
UNIVERSITY VITEZ
FACULTY OF INFORMATION TECHNOLOGY
BOSNIA AND HERZEGOVINA
and
BHAAAS ACADEMY
CHARLOTTE, NORTH CAROLINA, USA

Co-organizer and publisher:
UNIVERSITY OF TIMISOARA
FACULTY OF ENGINEERING HUNEDOARA

Sponsored by:
DRVO KLASTER
Vojo Petkovic, Manager

For publisher:
Lect. Daniela Alic, PhD

Editor-in-chief:
Prof. Tihomir Latinović, PhD

Book of Abstracts (International Conference on Applied Science)

ISSN 3100-4164
ISSN-L 3100-4164

Editura POLITEHNICA

The ICAS Conference was launched in 2013 through a collaborative project organized by the Interdisciplinary Scientific Values for Education and Research Society (SCIVERS), Wuhan University, Huazhong University of Science and Technology of China, and the Politehnica University Timisoara. From the very beginning, the conference had an international character, with papers published in the IOP Conference Series: Materials Science and Engineering, indexed in the Web of Science Core Collection. In 2014, the organizers expanded to include the "Henri Coandă" Air Force Academy from Brașov, Romania, together with several companies such as ArcelorMittal SA and SC Eurosport DHS SA, thereby strengthening the connection between academia and industry.

The Faculty of Mechanical Engineering at the University of Banja Luka joined as a co-organizer in 2017, when the conference was held in Hunedoara, Romania. Prior to that edition, a Memorandum of Understanding and a special agreement were signed between the Faculty of Mechanical Engineering in Banja Luka and the Politehnica University Timisoara, establishing that ICAS would be organized annually, alternating between Romania and Bosnia and Herzegovina. The 2018 edition was therefore hosted in Banja Luka, attracting 125 researchers from seven countries and featuring five plenary lectures and 125 presented papers. The Scientific Committee was composed of senior academics with significant ISI-indexed publications, while each conference section was jointly chaired by professors from Romania and Banja Luka.

The conference continued to grow, adapting to global circumstances through fully online editions in 2020 and 2021, thereby ensuring continuity and maintaining scientific quality. In 2022, ICAS returned to Banja Luka, supported by major companies and institutions from the Republic of Srpska, including the Ministry of Scientific and Technological Development, Higher Education and Information Society, and the City of Banja Luka. With 106 papers from ten countries, ICAS 2022 achieved the milestone of becoming the first international applied sciences conference in the Republic of Srpska, further strengthening connections between the Balkans, the European Union, and global partners in scientific, economic, and cultural collaboration. The 2024 edition was organized in Travnik by University Vitez in cooperation with the Faculty of Engineering in Hunedoara, further broadening regional partnerships. In 2025, the conference was coordinated online by the Faculty of Engineering in Hunedoara and University Vitez, with the proceedings published in the Journal of Physics: Conference Series (JPCS 3153), indexed in Scopus.

The upcoming ICAS 2026 conference, scheduled for May 30 and organized in an online format, is co-organized by the Faculty of Engineering Hunedoara and BHAAAS.
Over more than a decade, ICAS has evolved from a regional initiative into a recognized international academic tradition. Each Proceedings volume has been indexed in Scopus, underscoring its scientific rigor, international visibility, and contribution to the advancement of applied sciences. The conference continues to serve as a bridge between academia, industry, and society, fostering innovation, collaboration, and excellence across borders.

ORGANIZING COMMITTEE

Presidents
Latinovic Tihomir, BHAAAS Academy, University Vitez
Tirian Ovidiu Gelu, Politehnica University Timisoara
Todic Mladen, University of Banja Luka
Ratiu Sorin Aurel, Politehnica University Timisoara

Conference Coordinator
Alic Daniela, Politehnica University Timisoara

Program Coordinator
Ljilja Šikman, University of Banja Luka
Kiss Imre, Politehnica University Timisoara

Video-conference Coordinator
Abrudean Cristian, Politehnica University Timisoara

Organizers of the Plenary Speakers Session
Tihomir Latinovic, University Vitez
Bordeasu Ilare, Politehnica University Timisoara
Organizers of Mechanical Engineering Session
Nedelcu Dorian, BHAAAS Academy, Ex Babes Bolay University, Cluj Napoca
Pinca-Bretotean Camelia, Politehnica University Timisoara
Organizers of Materials Engineering Session
Socalici Ana, Politehnica University Timisoara
Ardelean Erika, Politehnica University Timisoara
Organizers of Computer Engineering Session
Latinovic Tihomir, BHAAAS Academy, University Vitez
Panoiu Manuela, Politehnica University Timisoara
Organizer of Electrical Engineering Session
Popa Gabriel, Politehnica University Timisoara
Iagar Angela, Politehnica University Timisoara

Members
Josan Ana, Politehnica University Timisoara
Stoica Romulus, Politehnica University Timisoara
Armioni Miruna, Politehnica University Timisoara
Gaianu Oana, Politehnica University Timisoara
Popa Mihaela, Politehnica University Timisoara

Honorary Committee:

Dragan Florin, Rector of the University Politehnica Timisoara
Dumitrel Alina, Prorector of the University Politehnica Timisoara
Pacuretu Anton, Ambassador of Romania in Bosnia and Herzegovina
Boboutanu Dan, Mayor of Hunedoara
Mastilovic Draga**,** Minister of Scientific and Technological Development and Higher Education of the Republic of Srpska
Račić Goran, President of the Chamber of Commerce of the Republic of Srpska
Stanivuković Draško, Mayor of Banja Luka
Markovic Savo, Director of Thermal Power Plant Stanari
Marković Dragisa, METAL MAS d.o.o Teslic
Maric Stipo, SIM TECHNIK D.O.O.
Petrovic Željko, Elas Komerc D.O.O.
Jovišević Vladislav, Eko toplane, Banja Luka
Aksamija Zlatan, University of UTAH, President of BHAAAS Academy
Drvo Klaster, Vojo Petkovic

SCIENTIFIC COMMITTEE:

President
Latinovic Tihomir, BHAAAS Academy, former University of Banja Luka
Alic Daniela, Politehnica University Timisoara
Vice-Presidents
Ljilja Šikman, University of Banja Luka
Kiss Imre, Politehnica University Timisoara
Members
Abderafi Souad, Mohammed V University
Alic Carmen Inge, Politehnica University Timisoara
Anghel Drugarin Cornelia, Babes-Bolyai University
Ardelean Erika, Politehnica University Timisoara
Ardelean Marius, Politehnica University Timisoara
Arkhypova Liudmyla, National Technical University of Oil and Gas
Bajramovic Esad, University of Bihac
Banic Milan, University of Nis
Barb Carmen Sorina, “Lucian Blaga” University of Sibiu
Barz Cristian, Technical University of Cluj Napoca
Behrem Sefik, University of Bihac
Beju Livia Dana, Lucian Blaga University of Sibiu
Bikic Sinisa, University of Novi Sad
Birtok-Baneasa Corneliu, Politehnica University Timisoara

Bistrian Diana, Politehnica University Timisoara
Borut Kosec, University of Ljubljana
Brahim Ahmed Ould, Mohammed V University
Budiul Berghian Adina, Politehnica University Timisoara
Ćehić Minka, University of Bihac
Cioata Vasile, Politehnica University Timisoara
Cohodar Maida, University of Sarajevo
Cuntan Corina, Politehnica University Timisoara
Deaconu Sorin, Politehnica University Timisoara
Dedijer Sandra, University of Novi Sad
Delgado Sobrino Rolando Daynier, Slovak University of Technology
Desnica Eleonora, University of Novi Sad
Dezso Gergely, University of Nyíregyháza
Diering Magdalena, Poznan University of Technology
Dinis Corina, Politehnica University Timisoara
Dobras Dragoslav, University of Banja Luka
Dobrnjac Mirko, University of Banja Luka
Dragic Miroslav, University of Banja Luka
Dungan Luisa Izabel, Politehnica University Timisoara
Erdei Zoltan, Technical University of Cluj Napoca
Fras Zemljic Lidija, University of Maribor
Frunzaverde Doina, Babes-Bolyai University
Gierz Lukasz, Poznan University of Technology
Gillich Gilbert-Rainer, Babes-Bolyai University
Greconici Marian, Politehnica University Timisoara
Gvero Petar, University of Banja Luka
Hakli Huseyin, Necmettin Erbakan University
Hanan Annie Yusni, Universiti Teknologi MARA Seremban Campus
Hasnan H. A., Universiti Teknologi MARA Seremban Campus
Hodzic Atif, University of Bihac
Hodžić Damir, University of Bihac
Hodur Cecilia, University of Szeged
Holubek Radovan, Slovak University of Technology in Bratislava
Horga Vasile, Gheorghe Asachi University of Iasi
Hodzic Atif, University of Bihac
Iagar Angela, Politehnica University Timisoara
Isakovic Ines, University VITEZ
Ishak Noor, Universiti Teknologi MARA Seremban Campus
Jakupovic Sanel, Paneuropean university “Apeiron”
Jalba Klaus, Hochschule Neu-Ulm
Josan Ana, Politehnica University Timisoara

Kaouka Alaeddine, Ecole Normale Superieure de Laghouat
Karabegovic Isak, University of Bihac
Kivrak Hasan, Istanbul Technical University
Klimentov Kliment, "Angel Kanchev" University of Ruse
Kopei Volodymyr, Ivano-Frankivsk National Technical University of Oil and Gas
Kosec Borut, University of Ljubljana
Kostal Peter, Slovak University of Technology in Bratislava
Krunislav Miroslavljevic, University of Slavonski Brod
Kruszelnicka Weronika, University of Science and Technology in Bydgoszcz
Kueffmann Karin, Westphalian University of Applied Science
Kulenović Fatka, University of Bihac
Labudzki Remigiusz, University of Poznan
Lazovic Tatjana, University of Belgrade
Lecic Milan, University of Belgrade
Lesya Shkitsa, Ivano-Frankivsk National Technical University of Oil and Gas
Lovasz Erwin Christian, Politehnica University Timisoara
Marinković Aleksandar, University of Belgrade
Marinković Dragan, TU Berlin
Matejic Milos, University of Kragujevac
Mester Gyula, University of Szeged
Mihon Liviu, Politehnica University Timisoara
Miklos Cristina, Politehnica University Timisoara
Miklos Imre, Politehnica University Timisoara
Miltenovic Aleksandar, University of Nis
Miltenovic Vojislav, University of Nis
Minic Sinisa, University of Nis
Moraru Sorin Aurel, Transilvania University of Brasov
Mukli Lindita, Aleksander Moisiu University
Muscalagiu Ionel, Politehnica University Timisoara
Nedelcu Dorian, Babes-Bolyai University
Nemedi Imre, Polytechnical Engineering College of Subotica
Nenad Zrnić, University of Belgrade
Nermin Sarajlic, Univerzitet u Tuzli
Nor Azni Shahari, Universiti Teknologi MARA Seremban Campus
Nur Amira Mat Saffie, Universiti Teknologi MARA Seremban Campus
Oden Muhammed Kamil, Selcuk University
Ohodjas Ibrahim, University VITEZ
Onysko Oleh, Ivano-Frankivsk National Technical University of Oil and Gas
Osaci Mihaela, Politehnica University Timisoara
Panchuk Vitalii, Ivano-Frankivsk National Technical University of Oil and Gas
Panoiu Manuela, Politehnica University Timisoara

Panoiu Caius, Politehnica University Timisoara
Prajova Vanessa, Slovak University of Technology in Bratislava
Paszek Justyna, Silesian University of Technology
Pavlovic Zivko, University of Novi Sad
Pedrali Patricia Carolina, Regional University of Northwestern Rio Grande do Sul
Pelic Marcin, Poznan University of Technology
Petruse Radu Emanuil, Lucian Blaga University of Sibiu
Pinca-Bretotean Camelia, Politehnica University Timisoara
Popa Gabriel Nicolae, Politehnica University Timisoara
Popov Gencho, University of Ruse
Predrag Zivkovic, University of Nis
Putan Vasile, Politehnica University Timisoara
Rackov Milan, University of Novi Sad
Radojcin Milivoj, University of Novi Sad
Ranko Antunovic, University of East Sarajevo
Rasmani Khairul, Universiti Teknologi MARA Seremban Campus
Ratiu Sorin, Politehnica University Timisoara
Rasmani Khairul, Universiti Teknologi MARA Seremban Campus
Razzaghi Mohsen, Mississippi State University
Ribaric Eda, Polytechnic of Rijeka
Rogic Miroslav, University of Banja Luka
Rusu-Anghel Stela, Politehnica University Timisoara
Shahari Nor Azni, Universiti Teknologi MARA Seremban Campus
Simunovic Goran, University of Slavonski Brod
Skurkova Lestyanszka Katarina, Slovak University of Technology in Bratislava
Snezana Petkovic, University of Banja Luka
Socalici Ana, Politehnica University Timisoara
Solvang Bjoern, UiT The Arctic University of Norway
Snežana Ćirić Kostić, University of Kragujevac
Stefanovic Gordana, University of Nis
Stoica Diana, Politehnica University Timisoara
Suman Sabrina, Polytechnic of Rijeka
Szabo Gyla, Obuda University
Szabo Marta, University Szent Istvan
Sziebig Gabor, UiT The Arctic University of Norway
Taubmann Hennry, C3 Prozess und Analysentechnik Gmbh
Tica Milan, University of Banja Luka
Tirian Ovidiu, Politehnica University Timisoara
Todic Mladen, University of Banja Luka
Tomljenovic Ljerka, Polytechnic of Rijeka
Topcic Alan, Univerzitet u Tuzli

Tota Paul, Politehnica University Timisoara
Trisovic Natasa, University of Belgrade
Tujarov Krasimir, University of Ruse
Ungreanu Nicolae, Technical University of Cluj Napoca
Vasiu Teodor, Politehnica University Timisoara
Velisek Karol, Slovak University of Technology in Bratislava
Vicente Raul Zafra, University of Tartu
Vojić Samir, University of Bihac
Vojvodić Biljana, University of Banja Luka
Vranjes Biljana, University of Banja Luka
Zajmovic Mahir, University VITEZ
Zivkovic Aleksandar, University of Novi Sad
Znotka Jürgen, Westphalian University of Applied Science
Zsoter Brigitta, University of Szeged

CONTENTS

KEYNOTE LECTURES

VIRTUAL DESIGN AND VALIDATION OF A CONVEYOR - BASED ROBOTIC DEBURRING WORKSTATION USING ABB ROBOTSTUDIO

RADOVAN HOLUBEK[1], DAYNIER ROLANDO DELGADO SOBRINO[1], PETER KOŠŤÁL[1], MIRIAM MATÚŠOVÁ[1], NIKOLAS BLAHUŠIAK[1]

[1]Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava, Bratislava, Slovak Republic, radovan.holubek@stuba.sk
[2]Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava, Bratislava, Slovak Republic, daynier_sobrino@stuba.sk
[3]Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava, Bratislava, Slovak Republic, peter.kostal@stuba.sk
[4]Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak
[5]University of Technology in Bratislava, Bratislava, Slovak Republic, miriam.matusova@stuba.sk
[6]Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava, Bratislava, Slovak Republic, xblahusiak@stuba.sk

Abstract

This paper presents the virtual design and validation of a robotic workstation intended for automated deburring of aluminum engine block castings. The research focuses on the development of a detailed simulation model in the ABB Robot Studio environment that replicates key operational conditions of an industrial robotic cell. The proposed system utilizes an ABB IRB 2600 industrial robot equipped with a specialized deburring tool and integrated with a conveyor system that transports workpieces through the robot's workspace. A crucial aspect of the developed model is the implementation of conveyor tracking, which enables the robot to perform machining operations on moving parts with high positional accuracy.

The simulation includes the generation of toolpaths based on CAD geometry to remove burrs around multiple cylindrical openings on the casting. In addition to the machining process itself, the virtual workstation incorporates essential safety elements such as protective fencing, interlocked access doors, and signal indicators that emulate real industrial safety behavior. The developed simulation environment enables the verification of robot kinematics, process logic, and interaction between the robot and external equipment before the physical deployment of the system. The results demonstrate that virtual commissioning in Robot Studio can significantly support the design, optimization, and validation of robotic finishing workstations. The presented model also provides a foundation for further research focused on toolpath optimization, advanced robotic control, and integration within hybrid manufacturing systems.

Keywords: mobile phone networks, 5G, standards, misconceptions in social networks, application safety

INTEGRATING EXTENDED REALITY INTO MODERN MANUFACTURING: INDUSTRIAL VALUE, AI CONVERGENCE, AND INDUSTRY 5.0 IMPLICATIONS

RADU EMANUIL PETRUSE[1]
[1] Faculty of Engineering, Lucian Blaga University of Sibiu, Sibiu, Romania, radu.petruse@ulbsibiu.ro

Abstract

Extended reality (XR) is becoming increasingly relevant in manufacturing not as an isolated visualization technology, but as an operational interface layer connecting workers to product data, work instructions, digital twins, machine telemetry, and enterprise knowledge. In modern industrial environments, XR is moving beyond experimentation toward practical use in workflows where contextualized information can directly improve performance, safety, and decision-making. The most credible near-term applications include training, guided assembly, maintenance support, inspection, logistics, and remote expert assistance, where immersive and in-situ access to information can reduce complexity and enhance task execution. At the same time, XR is evolving through its convergence with artificial intelligence. AI-enhanced XR systems are beginning to support scene understanding, hands-free interaction, adaptive guidance, predictive maintenance, and conversational access to industrial knowledge, extending the role of immersive technologies from visualization toward intelligent operational support. This convergence is especially relevant in the context of Industry 5.0, where the focus shifts from automation alone toward human-centricity, sustainability, resilience, and more effective collaboration between people and advanced technologies. Yet the path to wider adoption remains uneven. Much of the publicly available evidence still comes from successful pilot projects rather than long-term, independently validated industrial deployments. Important challenges remain, including ergonomics, cognitive load, cybersecurity, data governance, interoperability, and the risk of treating XR as a standalone device strategy rather than as part of a broader enterprise architecture. These issues are particularly important when immersive systems are integrated with AI, live industrial data, and decision-support functions. The central argument advanced here is that XR has already demonstrated meaningful industrial value, but its lasting impact will depend less on technological novelty than on its responsible integration into enterprise systems, operational workflows, and human-centered innovation strategies. In the transition toward Industry 5.0, XR should be understood not merely as a new visual medium, but as a strategic interface between people, intelligent machines, and the digital thread of modern manufacturing.

Keywords: Extended Reality (XR), Digital twins, AI-enhanced XR, Industry 5.0

ACCURATE ISOLATION OF WINDAGE LOSSES IN HIGH-SPEED ROTATING SYSTEMS: EXPERIMENTAL PROCEDURES AND VALIDATION

CRISTINA NINE (ANTON)[1], ZOLTAN-IOSIF KORKA[2], DORIAN NEDELCU[3], TIBERIU-DANIEL PAU[4]
[1]Doctoral School of Engineering, Babes-Bolyai University, University Centre Resita, Traian Vuia Square, Reșița, Romania, cristina.anton@ubbcluj.ro
[2]Doctoral School of Engineering, Babes-Bolyai University, University Centre Resita, Traian Vuia Square, Reșița, Romania, zoltan.KORKA@ubbcluj.ro
[3]Doctoral School of Engineering, Babes-Bolyai University, University Centre Resita, Traian Vuia Square, Reșița, Romania, dorian.nedelcu@ubbcluj.ro
[4]Doctoral School of Engineering, Babes-Bolyai University, University Centre Resita, Traian Vuia Square, Reșița, Romania, tiberiu.pau@ubbcluj.ro

Abstract

Windage power losses (WPL) represent a major portion of no-load losses in high-speed rotating machinery, yet experimentally separating these losses from bearing friction, seal drag, and other parasitic effects remains challenging. This work presents a validated and repeatable experimental methodology for isolating windage losses in enclosed rotating systems, demonstrated using a helical gear operating between 2000 and 5000 rpm. The approach uses differential power measurements, comparing total input power with the test specimen installed against a baseline configuration that removes the aerodynamic component of interest. A purpose-built test rig minimizes parasitic variability through controlled shaft alignment, thermal stabilization, bearing preload, and seal friction. Multiple measurements at each speed ensure statistical robustness. Validation is performed using CFD simulations, which confirm strong agreement between measured windage losses and predicted aerodynamic drag. Results show that the proposed method isolates windage losses with high repeatability and low uncertainty, enabling accurate characterization of aerodynamic drag in gears, rotors, and other rotating components. The paper also outlines implementation guidelines, error-mitigation strategies, and practical considerations for industrial and research applications. This methodology establishes a standardized framework for windage measurement, supporting future advancements in aerodynamic loss modeling, gearbox efficiency, and high-speed rotating machinery design..

Keywords: Windage Power Losses (WPL), Experimental Methodology, CFD Validation, High-Speed Rotating Machinery

FUNDAMENTAL SCIENCES

IHA-RVA ANALYSIS OF THE IMPACTS OF CLIMATE CHANGE ON THE NATURAL WATER SUPPLY OF THE UKRAINIAN CARPATHIA

ARKHYPOVA LIUDMYLA[1], MATIYIV KHRYSTYNA[1], KORCHEMLYUK MARTA[1], SHEKETA VASYL[1], PIKH MARIIA[1]

[1]Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, Ukraine

Abstract

This study investigates recent transformations of the water supply regime of the Ukrainian Carpathians on the example of the upper reaches of the Prut River of the Danube Basin based on daily observations of water flows from three hydrological water-gauging stations (Vorokhta, Tatariv and Yaremche) during 2015–2024. An integrated methodological framework combining trend analysis, low-level runoff assessment, indicators of hydrological change (IHA) and range of variability approach (RVA) was applied to detect changes in water supply. The results show a statistically significant decrease in annual runoff and low-level runoff, indicating a decrease in water availability and a decrease in base flow support. Seasonal analysis showed a restructuring of water supply formation processes with a significant decrease in spring and summer runoff and a slight increase in winter runoff, indicating a gradual transition from snowmelt-regulated hydrological conditions to precipitation-dominated conditions. The IHA-RVA analysis showed moderate to high hydrological changes across the basin, especially in terms of monthly flow magnitude, annual extremes, and timing of flow events. The combination of decreasing low flows and increasing flood peaks suggests hydrological extremes and broader regime instability. Overall, the water supply of the Ukrainian Carpathians is interpreted as experiencing climate-sensitive hydrological regime change. The results of the study contribute to the understanding of runoff transformation in mountain basins and may contribute to adaptive water resources management and climate resilience planning in the Carpathian region.

Keywords: Water supply regime, Ukrainian Carpathians, Hydrological change, Climate resilience

AN ANALYTICAL FRAMEWORK FOR MONITORING THE ENERGY SECURITY OF UKRAINE'S ECONOMY

ANDRUSIV ULIANA[1], MARYNCHAK LILIYA[1], KNEYSLER OLGA[2], SPASIV NATALIIA[2], NAZARIY POPADYNETS[3]

[1]Ivano-Frankivsk National Technical University of Oil and Gas
[2]Ukrainian National University, Ternopol, Ukraine
[3]Lviv Polytechnic National University, Lviv, Ukraine

Abstract

The article develops and substantiates an analytical framework for monitoring the energy security of Ukraine's national economy based on a resource-functional approach. The proposed four-block architecture comprises a target block, an object-subject structure, an information-methodological base, and an aggregation block, ensuring systematic coverage of hierarchical levels - macro-, meso-, and micro level. An integrated system of five evaluation criteria is justified: energy efficiency, energy protection, energy reliability, energy independence, and economic resilience - across nine resource components normalized to the range [0; 1]. Three alternative functional aggregation models are developed: additive, multiplicative, and power-sum, along with an energy security status scale: critical, dangerous, insufficient, sufficient, secure, and absolute.

The framework is tested on data from Ukraine's national economy under forecast scenarios for 2020-2035. Under the additive model, the integral indicator grows from 0.806 to 1.051, while the multiplicative model records a persistently critical state (0.467-0.504). The analytical advantage of the multiplicative model is demonstrated, as it eliminates the possibility of compensating critical values of individual determinants with higher values of other components. It is established that the greatest threats are concentrated in the areas of thermal energy, secondary fuel and energy resources, and natural gas. Criteria for the rational use of fuel and energy resources and a methodology for assessing energy-saving and resource-substitution potential are defined. The practical application of the proposed framework will contribute to improving the soundness of managerial decisions in the field of energy policy and strengthening Ukraine's energy independence under conditions of geopolitical instability.

Keywords: Energy security, Analytical framework, Resource-functional approach

DFT INVESTIGATION OF REGIOSELECTIVITY IN HETERO DIELS–ALDER CYCLOADDITIONS

DJAMILA HELLEL[1,2], HADJER AOUISSI[3], FOUAD CHAFAA[2,4], LAZHAR BOUGHANI[5], ABDELMALEK KHORIEF NACEREDDINE[2], EMMANUEL VRANCKEN[6]

[1]Laboratory of applied and didactic sciences, Higher Normal School of Laghouat - Laghouat, Algeria.
[2]Laboratory of Physical Chemistry and Biology of Materials, Higher Normal School of Technological Education of Skikda, Algeria.
[3]Laboratory of applied chemical and physical sciences, Higher Normal School of Laghouat - Laghouat, Algeria.
[4]Department of Basic Formation, Faculty of Natural and Life Sciences University of Batna 2, Algeria.
[5]Chemistry Department, Faculty of sciences, University of Souk Ahras, Algeria.
[6]Laboratory of molecular architecture and nanostructured materials, Higher Normal School of Chemistry-Montpellier, France

Abstract

Control of regioselectivity in organic reactions has been one of the oldest problems in modern synthetic organic chemistry. In this work, the regioselectivity in a hetero Diels-Alder reaction between two electronically activated substrates is investigated on a theoretical level by Density Functional Theory (DFT). In particular, the role of electronic factors and the frontier molecular orbital (HOMO-LUMO) interactions in the formation of the main regioisomers is examined. Global and local reactivity descriptors (Fukui functions, electrophilicity indices) allowed for rationalizing the experimentally reported reactivity trends according to the Parr-Domingo approach. These computational results give not only a clear prediction of the preferred regioisomer but also a perception on the electronic factors that support the selectivity of the reaction. This study exemplifies how theoretical chemistry techniques can be employed to predict selectivity trends and design experiments in heterocyclic chemistry.

Keywords: DFT, hetero Diels-Alder reaction, regioselectivity and Parr-Domingo approach.

A QUANTITATIVE FRAMEWORK FOR ASSESSING CO2 TAX ADEQUACY BASED ON MONETIZED CARBON DAMAGE: EVIDENCE FROM UKRAINE

KRYKHIVSKA NATALIIA[1], ROMASHKO OLEKSANDRA[1]

[1]Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, Ukraine

Abstract

This article explores the adequacy of CO2 taxation in Ukraine in relation to the monetized economic damage caused by carbon emissions. It analyzes the dynamics of CO2 emissions, tax revenues, and tax rates in Ukraine between 2018 and 2024, identifying key changes in the national carbon taxation system under the influence of economic, regulatory, and wartime factors. Particular attention is given to the gap between the current level of CO2 taxation and the estimated value of carbon damage based on the Social Cost of Carbon approach. A quantitative framework for assessing CO2 tax adequacy is proposed, comprising three analytical levels: fiscal adequacy of tax revenues, price adequacy of the nominal tax rate, and an integrated carbon tax adequacy index. The model is applied under two carbon damage scenarios: a conservative scenario based on 50 USD/tCO2 and a moderate scenario based on 100 USD/tCO2, with all monetary values converted into Ukrainian hryvnia. The analysis demonstrates that, despite increased CO2 tax rates and revenues, the current Ukrainian carbon tax covers only a negligible share of estimated carbon damage and remains below internationally recognized carbon pricing benchmarks. A structural mechanism for aligning CO2 taxation with monetized carbon damage is developed, combining emissions monitoring, SCC-based damage estimation, tax recalibration, institutional enforcement, behavioral response of emitters, and emission reduction feedback. The findings emphasize the need to transform Ukraine's CO2 tax into a dynamic carbon pricing mechanism that supports decarbonization, strengthens environmental regulation, and aligns climate policy with the real economic cost of emissions.

Keywords: CO2 taxation, Social Cost of Carbon, Carbon tax adequacy

INTEGRATED ECONOMIC-LOGISTICS MODEL FOR OPTIMIZING SMART GRID INFRASTRUCTURE DEPLOYMENT IN URBAN ENERGY SYSTEMS

POLYANSKA ALLA[1], POPOVA TETIANA[1], MYCHAILYSHYN KHRYSTYNA[1]

[1]Ivano-Frankivsk National Technical University of Oil and Gas, Ivano-Frankivsk, Ukraine

Abstract

In the context of the global energy transition and increasing demands for energy efficiency, urban energy systems require transformation toward flexible, decentralized, and digitally managed structures. Smart grids represent a key solution, enabling bidirectional energy flows, integration of renewable energy sources, demand-side management, and improved system reliability. However, their large-scale deployment is constrained by high capital costs, complex infrastructure planning, and the lack of integrated approaches to assess economic and logistical feasibility.

This study aims to develop an integrated economic-logistics model for optimizing smart grid infrastructure deployment in urban energy systems. The proposed methodology is based on a multicriteria decision analysis (MCDA) framework and introduces an integrated indicator of the effectiveness of smart grid implementation – ISESG, combining economic (ECO), logistics (LOG), and energy (EN) subindices.

The economic component evaluates investment feasibility using NPV, IRR, CAPEX, OPEX, and LCOE. The logistics component focuses on network configuration, node placement, and minimization of transmission losses, while the energy component captures energy savings, peak load reduction, renewable integration, and CO_2 emissions reduction. The model applies normalization and weighted aggregation of sub-indices, with weights reflecting decision priorities. Three scenarios-baseline, partial smart grid implementation, and advanced deployment – are analyzed to compare system performance.

Results demonstrate that the integrated approach improves investment efficiency, reduces energy losses, and enhances system flexibility and reliability. The proposed model contributes to both theory and practice by providing a comprehensive decision support tool for policymakers, energy companies, and urban planners, supporting sustainable and economically viable smart grid deployment.

Keywords: Smart grids, Economic-logistics model, Multicriteria decision analysis (MCDA), Urban energy systems

GEODETIC INVENTORY OF AN EXISTING BUILDING AS AN IMPORTANT ELEMENT OF ITS FURTHER EXPANSION

PASZEK KRZYSZTOF[1], PASZEK JUSTYNA[1]

[1]Silesian University of Technology, Gliwice, Poland

Abstract

This paper presents the results of a geodetic survey of the existing educational complex. Measurements were taken prior to its expansion by an additional floor. The resulting expansion design was analyzed, and a control survey of the entire complex was conducted. Differences in the building corner coordinates and frontal measurements between the control measurement and the values obtained from the design were calculated.

Furthermore, discrepancies were identified in the number of building corners and the frontal measurements of its edges, which led to the impossibility of implementing the resulting construction design. The work also revealed errors in the design map prepared by the previous surveyor.

Keywords: Smart grids, Economic-logistics model, Multicriteria decision analysis (MCDA), Urban energy systems

THE SLOPES OF THE MINING AREA AND THE INCLINATIONS OF THE BUILDINGS LOCATED ON IT - AN ATTEMPT TO DETERMINE THE RELATION

PASZEK KRZYSZTOF[1], PASZEK JUSTYNA[1]

[1]Silesian University of Technology, Gliwice, Poland

Abstract

This paper presents the results of multi-year research involving geodetic observation of the variation in the mining terrain slopes and the building inclinations induced by an underground mining exploitation of hard coal deposits. The absolute values of mining terrain slopes and building inclinations were determined from the geodetic measurements.

These values were then compared, and the mathematical relation between them was established. Furthermore, the obtained slopes and inclinations values were normalized using their maximum values, enabling reliable comparison.

Keywords: Mining terrain slopes, Building inclinations, Geodetic measurements, Underground coal exploitation

TOTAL QUALITY MANAGEMENT (TQM): BIBLIOMETRIC AND CITATION ANALYSIS BASED ON WOS AND SCOPUS

SNEŽANA TOPALOVIĆ[1], PREDRAG DAŠIĆ[2], GYULA MESTER[3]

[1]High School for Hospitality and Tourism, Vrnjačka Banja, Serbia, e-mail: topalovicsneza@gmail.com
[2]Engineering Academy of Serbia (IAS), Belgrade, Serbia, e-mail: dasicp58@gmail.com
[3]University of Szeged, Szeged, Hungary, e-mail: drmestergyula@gmail.com

Abstract

Total Quality Management (TQM) is a key management approach that aims to improve the quality of products and services in various industries. TQM is used to manage an organization in which quality, continuous improvement and customer satisfaction are the main goals of all employees and all processes in the organization. Its application in the manufacturing and service sectors enables the improvement of the performance of companies worldwide. And in recent years, company management has been focusing more on TQM, which leads to maximizing customer satisfaction and loyalty. Therefore, the aim of this paper is to comprehensively and systematically analyze the trend of publication of works in WoS (Web of Science) and Scopus citation databases for the period from 1991 to 2025 and to indicate the main research areas and the most prominent topics in TQM. The number of publications as well as their trends, countries, sources, authors, organizations, citations and keywords were used as the primary determinants of this analysis. For the period from 1991 to 2025, a total of 99,555 publications were published in Scopus for ”Total Quality Management” for the option ”Article Title, Abstract, Keywords” or 2,824 for the option ”Article Title” only. The largest number of publications in the first option is in the field of ”Medicine” with 70.6%, and in the second option iy in the field of ”Business, Management and Accounting” with 46.2% of the total number of publications. The largest number of publications in order are: USA, UK (United Kingdom), Canada, Australia, China, Germany, India, etc. And finally, the use of modern versions of hard and soft TQM (HTQM and STQM) for Industry 4.0 and Industry 5.0, as part of the Quality 4.0 and Quality 5.0 models, is described.

MATERIALS ENGINEERING

RECOVERY OF SIDERITIC TAILINGS AS PELLETS IN THE STEEL INDUSTRY

ADRIANA BOBORA[1], ANA SOCALICI[1], CORNELIU BIRTOK BANEASA[1]

[1] Politehnica University of Timișoara, Hunedoara, România

Abstract

This paper presents the experimental results obtained at a laboratory scale regarding the superior recovery of sideritic wastes mixed with various types of powdery wastes. The main objective was to process these materials through pelletizing technology to obtain a Carbofer-type material, intended for use in the steel industry as a slag foaming agent. The investigations involved testing the experimental recipes within a steelmaking process in a pilot-scale induction furnace.

The performed analyses confirm the effectiveness of the resulting pellets for slag foaming, thus validating the technical feasibility of recirculating powdery wastes back into the production cycle. The results demonstrate the potential of this recovery route to generate multiple benefits of an ecological, technological and economic.

Keywords: Sideritic wastes recovery, Pelletizing technology, Slag foaming agent

INFLUENCE OF PROCESS PARAMETERS ON THE TENSILE STRENGTH OF ADDITIVELY MANUFACTURED POLYMER SPECIMENS

DAMIR HODZIC[1], ANES OSMANAGIC[1] AND HASAN TALIC[1]

[1] University of Bihać, Faculty of Technical Engineering, Bihać, Bosnia and Herzegovina

Abstract

The subject of this research involves the investigation of the influence of various process parameters on the mechanical properties of polymer specimens, with particular emphasis on tensile strength. The study employs Fused Deposition Modeling (FDM), currently the most widely used additive manufacturing technology due to its simplicity, accessibility, and cost-effectiveness.

The research focuses on analyzing how variations in parameters such as layer thickness, infill density, printing speed, and filament temperature affect the mechanical resistance of specimens fabricated from PLA material.

For experimental purposes, standardized specimens in accordance with ISO 527-2 Type 1A were produced using a Creality CR-10 SE system. After fabrication, the specimens were subjected to tensile testing using a universal testing machine. The obtained results were used to evaluate the influence of the selected processing parameters on the strength and ductility of the specimens. This research aims to contribute to a better understanding of the relationship between technological parameters and the resulting mechanical performance of additively manufactured components, providing a basis for process optimization in industrial and engineering applications.

Keywords: Fused Deposition Modeling (FDM), PLA specimens, Tensile strength

TECHNIQUES OF MICROSCOPIC AND SURFACE ANALYSIS FOR MONITORING THE BIOLOGICAL DEGRADATION OF WOOD UNDER OUTDOOR CONDITIONS

HASANAGIĆ REDŽO[1], ŠLJIVO UMEJR[1] , MUJANIC SELMA[1]

[1] Department of Wood Science and Technology, Faculty of Technical Engineering, University of Bihac, Bihac, Bosnia and Herzegovina,

Abstract

This paper presents microscopic and surface analysis techniques used to monitor the biological degradation of wood exposed to outdoor conditions. Special emphasis is placed on methods that enable early detection of degradation caused by fungal activity.
The presented methods include microscopic surface analysis, surface roughness measurements, and color change analysis. These techniques allow reliable monitoring of the wood condition and can be used as a basis for preventive protection measures and for extending the service life of wooden elements in outdoor applications.

Keywords: Microscopic analysis, Fungal degradation, Wood protection

THERMAL PROCESSING INFLUENCE ON THE MECHANICAL PERFORMANCE OF AEROSPACE STEELS

GABRIELA MIHUȚ[1], MARIUS ARDELEAN[1], ERIKA POPA[1], EUGEN CRIȘAN[1]

[1] Politehnica University of Timișoara, Hunedoara, România

Abstract

The objective of this research is to characterize the 15VMoCr14X steel (250 mm square bloom), intended to produce the left and right strut fittings for aircraft landing gears. The study presents comprehensive data regarding the chemical composition, segregation pattern (segregation square), grain size, solid-state transformation critical temperatures, and mechanical properties.

These initial evaluations were conducted on samples extracted from the undeformed bloom to determine the degree of isotropic of its mechanical characteristics. Following hot forging—applying a deformation degree equivalent to the closed-die forging process used for the actual finished part—a primary heat treatment and multiple secondary heat treatment variants were performed. The paper analyzes the mechanical properties resulting from each heat treatment cycle, alongside the metallurgical factors influencing these values. Ultimately, the study identifies the optimal heat treatment variant required to achieve the optimal mechanical properties mandated by aerospace (AERO) standards.

Keywords: Microscopic analysis, Fungal degradation, Wood protection

POSSIBILITIES FOR THE VALORIZATION OF STEEL SLAG IN THE STEEL INDUSTRY

RALUCARIF[1], ANA-VIRGINIA SOCALICI [1]

[1] Politehnica University of Timișoara, Faculty of Engineering Hunedoara, România

Abstract

This paper analyzes the possibilities of integrating steel slag into the production flow of the steel industry, within the current paradigms of the circular economy and industrial sustainability. The main objective of the research is the valorization of the ferrous fraction with a particle size below 10 mm, extracted from slag through de-ironing processes, to obtain briquette-type by-products intended for optimizing the metallic charge of steelmaking units.

The proposed methodology focuses on the physicochemical characterization of the recovered fraction and on establishing an optimal briquetting formulation using specific binders capable of ensuring the mechanical strength required for handling and furnace charging. The results highlight that the use of these briquettes not only facilitates the recovery of metallic iron and iron oxides but also contributes to reducing the consumption of virgin raw materials and decreasing the volume of stored waste. The reintroduction of the ferrous fraction in the form of briquettes represents a viable techno-economic solution for increasing metallic yield and reducing the carbon footprint of the steelmaking process.

Keywords: Steel slag, Circular economy, Briquetting

SELECTIVE RECOVERY OF METALS FROM USED PRIMARY BATTERIES THROUGH HYDROMETALLURGICAL PROCESSES

CĂTĂLIN ARDELEAN[1], MARIUS ARDELEAN[1], LAURA STRUGARIU[1], ERIKA ARDELEAN[1]

[1]Politehnica University Timisoara, Hunedoara, Romania

Abstract

The exponential growth in the use of electrical devices generates a significant quantity of waste of used primary batteries, with a major environmental impact due to their high heavy metal content. The management of this type of waste represents a major environmental challenge. This paper presents an experimental study on the selective recovery of zinc and manganese from two categories of used primary batteries: alkaline Zn-MnO_2 batteries and non-alkaline Zn-C batteries.

After manual dismantling and separation of the components, the paste containing ZnO and MnO_2 was subjected to leaching with H_2SO_4 at different molar concentrations and temperatures ranging from 50 to 70°C. The recovery of metals from the solution was carried out using two methods: chemical precipitation and electrolysis. The results confirm the viability of the hydrometallurgical process for the selective recovery of Zn and Mn from used primary batteries, with direct potential for integration into industrial recycling flows compliant with European legislation.

Keywords: Battery waste recycling, Zinc recovery, Manganese recovery

LOW-COST RAPID MANUFACTURING OF ALUMINUM COMPONENTS USING 3D-PRINTED POLYMER MODELS AND SINGLE-USE MOLDS

RAREŞ-ANDREI IVAN[1], MARIUS POP-CĂLIMANU[1], COSMIN CODREAN[1], MARIANA ILIE[1], VIRGIL STOICA[1]

[1]Politehnica University Timisoara, Timisoara, Romania

Abstract

The paper presents a low-cost rapid manufacturing method for aluminum components, combining polymer 3D printing with conventional casting in single-use molds. The approach is demonstrated through the fabrication of an intake manifold for an experimental single-cylinder diesel engine. A 3D-printed polymer model is embedded in a plaster-based refractory mold and subsequently removed by thermal treatment. Molten aluminum is then poured into the resulting cavity, producing a near-net-shape metal component with minimal post-processing.

The proposed method offers an accessible alternative to advanced metal additive manufacturing technologies, enabling the rapid production of one-off part or very small series using equipment commonly available in university laboratories.

Keywords: Aluminum components, 3D printing, Conventional casting

DEVELOPMENT OF BIOACTIVE CARBON AEROGELS FOR ANTIBACTERIAL APPLICATIONS

CRISTINA MOȘOARCĂ[1], RADU BĂNICĂ[1], NICK SAMUEL ȚOLEA[1], MIRELA IORGA[1], FLORINA ȘTEFANIA RUS[1], ALEXANDRA BUCUR[1], GEORGE DIMA[1], NICOLAE BIRSAN[1,2], BOGDAN-OVIDIU ȚĂRANU[1]

[1]National Institute of Research and Development for Electrochemistry and Condensed Matter, Timisoara, Romania
[2]Laboratory of Electrochemistry, Corrosion and Electrochemical Engineering, Faculty of Chemical Engineering, Biotechnologies and Environmental Protection, Politehnica of Timisoara, Timisoara, Romania

Abstract

We report the synthesis and characterization of composite aerogels based on carbonized cellulose fibers containing calcium carbonate, designed as multifunctional materials for potential applications in thermal insulation, gas adsorption and biological water purification. The aerogels were prepared by freeze drying suspensions of cellulose fibers in the presence of CaCl2 and agarose followed by thermal treatment at 300°C and 600°C under inert argon atmosphere. Then it was submitted to a hydrothermal treatment at 180°C in a pressurized CO2/NH3 atmosphere.

The resulting materials are carbonized cellulose fibers, either partially or totally, embedded in amorphous carbon and CaCO3 (calcite), mainly formed by gas-solid reactions during the hydrothermal process. Structural and compositional characterization were performed by XRD, SEM/EDX, TGA/DTA, FTIR and UV–VIS–NIR diffuse reflectance spectroscopy. Selected aerogel samples were further functionalized with Ag, AgCl, and Ag_2CO_3 by ionic exchange reactions with $AgNO_3$ solution, producing nanoparticle coatings with crystallite sizes of 9–11 nm for Ag and 46–230 nm for AgCl, according to the Debye–Scherrer equation. The antibacterial activity of decorated and undecorated aerogels against Pseudomonas aeruginosa ATCC 27853 biofilms was evaluated for five days. Ag/AgCl-modified aerogels showed complete bacterial elimination (>log 5 reduction), while undecorated aerogels acted as a substrate for biofilm growth (log 2.477 reduction). The opaque porous structure restricts the photoreduction of AgCl for the sustained release of Ag+ ions and long-term antibacterial performance.

Keywords: Composite aerogels, Carbonized cellulose fibers, Antibacterial activity

ANTIBACTERIAL BEHAVIOUR OF PR^{3+}-DOPED RARE-EARTH COMPOUNDS Y_2SIO_5 AND $LA(PO_3)_3$ TOWARD ESCHERICHIA COLI

CRISTINA MOȘOARCĂ[1], RADU BĂNICĂ[1], MIROSLAV DRAMICANIN[1,2], ZELJKA ANTIC[1,2], MIRELA IORGA[1], FLORINA ȘTEFANIA RUS[1], ALEXANDRA BUCUR[1], RAUL BUCUR[1], ANDREI RACU[1], BOGDAN-OVIDIU ȚĂRANU[1], GEORGE DIMA[1], RAMONA VETESI[3]

[1]National Institute of Research and Development for Electrochemistry and Condensed Matter, Timisoara, Romania
[2]Centre of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences—National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia;
[3]Aquatim S.A., Water Quality Control Laboratory, Timisoara, Romania, Romania

Abstract

Ultraviolet C (UVC) radiation is widely used in antimicrobial technologies because it can damage the genetic material of microorganisms, leading to the inactivation of bacteria, viruses, and other pathogens. Nevertheless, the application of conventional UVC light sources may be limited by a series of drawbacks, such as high operational expenses, high power consumption, and technological difficulties associated with the materials used. A promising alternative method involves the blue-to-UVC UC process, whereby blue photons of lower energy can be converted into UVC photons of higher energy via a particular luminescent material. Blue-to-UVC UC provides an opportunity to use cost-effective blue-light sources, whereas UVC photons can be generated locally.

Such an advantage makes the development of novel UVC light sources possible. Rare-earth-doped inorganic phosphors are appropriate for UC-based germicidal applications due to their unique optical properties and chemical stability. The current study investigates the antibacterial effectiveness of $Y_2SiO_5:Pr^{3+}$ and $La(PO_3)_3:Pr^{3+}$ powders against E. coli ATCC 8739 through two types of experiments. Based on the analysis, the less toxic substance is applied as a component in composite membranes composed of $Y_2SiO_5:Pr^{3+}$ and PDMS, whose germicidal performance is assessed under blue-light exposure. The results indicate that $La(PO_3)_3:Pr^{3+}$ shows higher toxicity toward E. coli than $Y_2SiO_5:Pr^{3+}$, while PDMS membranes containing $Y_2SiO_5:Pr^{3+}$ exhibit moderate antibacterial activity attributed to UVC emission generated through the upconversion process. Acknowledgments: This study was supported by Romania's National Recovery and Resilience Plan, PNRR [project grant number C9-I8-28/FC 760107/2023].

Keywords: Composite aerogels, Carbonized cellulose fibers, Antibacterial activity

UV-C LUMINESCENT MATERIALS BASED ON PR3+ UPCONVERSION: EXPERIMENTAL AND DATA-DRIVEN PREDICTION OF 5D ENERGY LEVELS

A. V. RACU[1], G-D. DIMA[1], A. I. BUCUR[1], B. ȚĂRANU[1], R. A. BUCUR[1], C. MOȘOARCĂ[1], F. Ș. RUS[1], M. IORGA[1], Ž. ANTIĆ[1,2], M.D. DRAMIĆANIN[2], M. G. BRIK[1,2,3,4]

[1]National Institute of R&D for Electrochemistry and Condensed Matter, INCEMC Timisoara, Romania.
[2]Centre of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Serbia.
[3]School of Integrated Circuits, Chongqing University of Posts and Telecommunications, Chongqing, China
[4]Institute of Physics, University of Tartu, Estonia.

Abstract

UV-C luminescent materials are gaining significant attention for their effectiveness in virus neutralization and disinfection [Ref. Cates]. In this study, we explore the optical properties of a series of Pr3+doped host materials, with a particular focus on 4f–5d transitions and their contributions to UV-C emission. Luminescence spectroscopy was used to identify excitation and emission processes, including upconversion mechanisms that produce UV-C output.

Special emphasis was placed on the position and bandwidth of the 5d levels, as these are highly sensitive to the host crystal field environment. To complement the experimental investigation, we developed a machine learning (ML) model trained on literature-reported 5d energy levels and relevant structural descriptors. This model enables the prediction of 5d absorption and emission energies across a diverse range of compounds, for UV-C spectral range. By integrating experimental data, literature reports, and ML-based predictions, our study identifies key factors governing Pr3+ 5d-level energetics and emission performance. This combined experimental and data-driven approach advances our understanding of UV-C luminescence mechanisms and supports the rational design of efficient materials for disinfection applications.

Acknowledgments: This study was supported by Romania's National Recovery and Resilience Plan, PNRR, Project C9-I8-28, 760107/2023.

Keywords: UV-C luminescence, Machine learning model

OPTIMIZATION OF $Y_2SIO_5:PR^{3+}$/PDMS COMPOSITE MEMBRANES FOR GERMICIDAL PERFORMANCE

RADU BĂNICĂ[1], CRISTINA MOȘOARCĂ[1], ZELJKA ANTIC[1,3], MIROSLAV DRAMICANIN[1,3], MIRELA IORGA[1], MIHAI MARGHITAS[1,2], FLORINA STEFANIA RUS[1], ALEXANDRA BUCUR[1], ALEXANDRA ANA MEDRUȚ[2], DANIEL URSU[1], CRISTIAN CASUT[1], BOGDAN-OVIDIU TARANU[1], DAN ROSU[1], GEORGE DIMA[1,2]

[1]National Institute of Research and Development for Electrochemistry and Condensed Matter, Timisoara, Romania
[2]Department of Mechanics and Strength of Materials, Department of Applied Chemistry and Engineering of Inorganic Compounds and Environment, Politehnica University Timisoara,
[3]Centre of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences—National Institute of the Republic of Serbia, University of Belgrade, Serbia.

Abstract

The increasing prevalence of methicillin-resistant Methicillin-resistant Staphylococcus aureus has intensified the demand for materials capable of maintaining aseptic surfaces. A promising approach involves materials that generate germicidal ultraviolet C (UVC) radiation through photon up-conversion processes. In this study, $Y_2SiO_5:Pr^{3+}$ up-conversion phosphor was synthesized and embedded into a polydimethylsiloxane (PDMS) matrix to obtain inorganic–organic composite membranes and coatings. PDMS was selected due to its elasticity, biocompatibility, chemical resistance, and high transparency in the UVC range, which is essential given the low efficiency of up-conversion emission. The study focused on optimizing PDMS polymerization conditions and evaluating the thermal stability of the membranes under accelerated aging between 40 and 200 °C, simulating heating induced by laser or intense light irradiation. To reduce production costs while maintaining optical performance, silicone oil was incorporated into the polymer matrix. The materials were characterized using UV–Vis spectroscopy, FT-IR spectroscopy, X-ray diffraction, and photoluminescence measurements. Mechanical compression tests were also performed to assess the stability and applicability of composites containing silicone oil. The obtained materials exhibit good transparency in the germicidal spectral range, along with chemical resistance and strong adhesion, indicating their potential use as antimicrobial coatings or membranes for passive sunlight-driven disinfection of surfaces. Acknowledgments: This study was supported by Romania's National Recovery and Resilience Plan, PNRR [project grant number C9-I8-28/FC 760107/2023].

Keywords: PDMS composites, Antimicrobial coatings

COMPARATIVE ANALYSIS OF THEORETICAL GRAVIMETRIC HYDROGEN STORAGE CAPACITIES IN METALLIC, INTERMETALLIC, AND COMPLEX HYDRIDES

O. EDDAHMANI[1], M. HADHOUD[1], A. TAHIRI[2], A. SALI1 AND R. TOUTI[1]

[1]Sidi Mohamed Ben Abdellah University, Fez, Morocco
[2]Chouaïb Doukkali University, El Jadida, Morocco

Abstract

Achieving effective hydrogen storage remains a major challenge, but compounds rich in hydrogen are seen as strong candidates for high-capacity gravimetric storage. This research evaluates the hydrogen storage performance of metallic, intermetallic, and complex hydrides. It highlights which types and specific compounds within these groups are most effective for practical hydrogen storage. Additionally, a short comparison was conducted to examine how hydrogen storage capacities vary with molar mass.

Metallic and intermetallic hydrides typically have limited hydrogen storage due to their higher molar masses and strong metal hydrogen bonds. In contrast, complex hydrides tend to offer much higher storage capacities than elemental or intermetallic counterparts, making them especially attractive for applications that require substantial hydrogen content. Additionally, a comparison underlines how molar mass, chemical composition, and structural features collectively affect hydrogen storage performance. Overall, the review outlines the strengths and limitations of each hydride category and suggests potential strategies for developing lightweight, high-capacity hydrogen storage materials.

Keywords: Metallic hydrides, Intermetallic hydrides, Complex hydrides

RANDOM FOREST MODEL FOR THE PREDICTION OF OPTICAL PROPERTIES OF PR^{3+}-DOPED LUMINESCENT MATERIALS FOR BACTERICIDAL APPLICATIONS

GEORGE-DANIEL DIMA[1,2], ANDREI V. RACU[1], FLORINA ŞTEFANIA RUS[1], ALEXANDRA IOANA BUCUR[1], BOGDAN TARANU[1], RAUL ALIN BUCUR[1], CRISTINA MOSOARCA[1], MIRELA IORGA[1], ZELJKA ANTIC[1,3], MIROSLAV DRAMICANIN[1,3], MIKHAIL G. BRIK[1,3,4]

[1]National Institute of R&D for Electrochemistry and Condensed Matter, INCEMC Timisoara, Romania
[2]Politehnica University Timişoara, Faculty of Chemical Engineering, Biotechnologies and Environment Protection, Timisoara, Romania
[3]Centre of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Serbia
[4]Institute of Physics, University of Tartu, Estonia

Abstract

The present paper aimed to develop and study a machine learning algorithm to estimate the Pr3+dopant 5d-levels absorption and emission wavelength in a set of 12500 potential promising inorganic compounds. To build the descriptors for predictions, CIF files and structural data from Material Project database were used through the MPRester library. The resulting database included 22 descriptors for all 12500 hosts, and for consistency, at the preliminary prediction stage, the DB was exposed to the elimination of redundancies. In the final step, the Random Forest model identified several descriptors of high importance, namely the energy of the band-gap, the coordination number, the distance (X-F), and the angle < F-X-F. The sum of the importance of these descriptors accounted for more than 75% of the total importance of all descriptors.

From the point of view of accuracy, it was assessed by the absolute mean error of the MAE, which for both absorption and emission data was close to 5 nm. For explainability, the SHAP analysis was used, obtaining the impact of each descriptor on the general and individual predictions, and based on its values, the compounds were ordered according to their predictive potential, which allows the selection of candidates for further development and investigations. The approach could further contribute to the development of luminescent materials doped with Pr3+ for bactericidal applications.
Acknowledgments: This study was supported by Romania's National Recovery and Resilience Plan, PNRR, project grant number C9-I8-28/FC 760107/2023.

Keywords: Random Forest model, Hydrogen storage materials

RAPID SYNTHESIS OF YBO_3 HOST MATERIALS FOR PR^{3+} DOPING

RADU BĂNICĂ[1], GEORGE DIMA[1,2], CRISTINA MOȘOARCĂ[1], ZELJKA ANTIC[1,3], MIROSLAV DRAMICANIN[1,3], MIRELA IORGA[1], MIHAI MARGHITAS[1,2], FLORINA ȘTEFANIA RUS[1], ALEXANDRA BUCUR[1], RAUL BUCUR[1], DANIEL URSU[1], CRISTIAN CASUT[1], NICOLAE BIRSAN[1], BOGDAN-OVIDIU ȚĂRANU[1]

[1]National Institute of Research and Development for Electrochemistry and Condensed Matter, Str. Dr. A. Păunescu Podeanu nr.144, 300569 Timisoara, Romania
[2]Department of Mechanics and Strength of Materials, Department of Applied Chemistry and Engineering of Inorganic Compounds and Environment, Politehnica University Timisoara, Timisoara, Romania
[3]Centre of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences—National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia.

Abstract

The rapid emergence of antibiotic-resistant microorganisms has intensified the search for alternative strategies for water and surface disinfection. Since natural sunlight reaching the Earth's surface contains only negligible ultraviolet C (UVC) radiation, most bacteria have not developed resistance to this spectral range, making UVC highly efficient for microbial inactivation in medical and water-treatment applications. Materials capable of converting incident light into UVC photons through photonic up-conversion are therefore promising candidates for sunlight-driven germicidal systems. In addition, yttrium-based compounds may display intrinsic antibacterial activity through ion release or surface interactions with microbial cell walls. In this work, YBO_3 was synthesized and investigated as a host matrix for future Pr^{3+} doping, with the aim of combining UVC up-conversion emission and possible non-radiative antibacterial effects. The material was prepared by a solid-state route using two yttrium precursors: commercial Y_2O_3 and low-temperature polyol-derived Y_2O_3 nanoparticles. Structural and physicochemical characterization was carried out by X-ray diffraction, scanning electron microscopy, Fourier transform infrared spectroscopy, UV–Vis–NIR spectrophotometry, dynamic light scattering, and thermogravimetric analysis. The results demonstrate that the yttrium precursor strongly affects reaction kinetics and thermal requirements. Polyol-derived Y_2O_3 nanoparticles enabled the formation of pure YBO_3 at 800 °C in less than 10 minutes, whereas the commercial precursor produced residual Y_2O_3 even after higher temperatures and longer reaction times. This approach reduces calcination energy consumption and yields smaller YBO_3 particles than conventional methods.

Acknowledgments: This study was supported by Romania's National Recovery and Resilience Plan, PNRR [project grant number C9-I8-28/FC 760107/2023].

Keywords: Random Forest model, Hydrogen storage materials

THERMAL MODIFICATION OF MARINE SHELL WASTE: A PATHWAY TO FUNCTIONAL CALCIUM-BASED PRODUCTS

ALEXANDRA IOANA BUCUR[1], ANDREI RACU[1], RADU BĂNICĂ[1], CRISTINA MOȘOARCĂ[1], FLORINA ȘTEFANIA RUS[1], GEORGE DIMA[1], BOGDAN-OVIDIU ȚĂRANU[1], RAUL ALIN BUCUR[1]

[1]National Institute of R&D for Electrochemistry and Condensed Matter, Timisoara, Romania

Abstract

Marine shells exoskeletons, generated in significant amounts by the food industry and naturally occurring along shorelines, represent a substantial waste provocation. Their decomposition leads to malodorous emissions and poses public health risks. Consequently, research has pivoted towards upcycling these residues into high-value products, leveraging their cost-effectiveness, abundance, and structural versatility. Current literature offers extensive insights into repurposing these materials for sustainable applications. Among the strategies to enhance their performance, surface modification stands out as a key approach for optimizing efficiency. Thermal treatment is often the preferred route for surface tailoring, as it effectively eliminates the organic fraction—thereby neutralizing odours and pathogens—while simultaneously enhancing the material's porosity for improved functional performance.

This study explores the thermal processing impact on shell-derived materials, demonstrating how controlled heat application can refine their properties for advanced functional uses. The thermal decomposition analysis reveals a strategic pathway for converting raw shell waste into reactive calcium oxide, which, upon hydration, yields calcium hydroxide. This approach effectively transforms an environmental burden into two high-value products: functionalized shell fragments with many potential applications, such as Pr-doping hosts for UV-C upconversion, and calcium hydroxide solution – an extremely useful agent in many areas due to its high alkalinity.

Acknowledgements: This work was carried out through the Nucleu Program within the National Research Development and Innovation Plan 2022–2027, carried out with the support of MCID, project no PN 23 27 02 01, contract no. 29N/2023, and by Romania's National Recovery and Resilience Plan, PNRR [project grant number C9-I8-28/FC 760107/2023]

Keywords: Marine shell waste, Thermal treatment, Calcium hydroxide

THE ELECTROSYNTHESIS OF HYDROXYAPATITE COATINGS ON TI SUPPORTS USING DIFFERENT VERSIONS OF THE ELECTROCHEMICAL DEPOSITION METHOD

ALEXANDRA IOANA BUCUR[1], BOGDAN-OVIDIU ȚĂRANU[1], RAUL ALIN BUCUR[1], FLORINA ȘTEFANIA RUS, RADU BĂNICĂ[1], CRISTINA MOȘOARCĂ[1], ANDREI RACU[1], GEORGE DIMA[1]

[1]National Institute of R&D for Electrochemistry and Condensed Matter, Timisoara, Romania

Abstract

The electrochemical deposition method is one of several methods used to synthesize hydroxyapatite as a coating on the surfaces of metal supports. This method has a standard version that requires an experimental configuration consisting of several elements: a potentiostat or power supply, a working electrode consisting of the metal on the surface of which the hydroxyapatite coating will be electrosynthesized, a counter electrode, an electrolysis cell with a heating mantle, and an electrolyte solution containing the two precursors essential for electrosynthesizing the hydroxyapatite coating. The procedure requires applying an electrochemical potential for a specified duration, while the heating mantle ensures the experiment proceeds at a particular temperature.

The present study compares the standard version of the electrochemical deposition method with an alternative version, according to which the solution containing one of the two precursors (either the calcium precursor or the phosphate precursor) is placed in the electrolysis cell before the electrochemical experiment, while the solution containing the other precursor is gradually added to the initial solution throughout the experiment, using a burette. The results show that the hydroxyapatite samples obtained with the alternative version had a higher degree of crystallinity and should be more resilient in a corrosive environment, such as the one to which dental implants are exposed. Future studies will focus on fundamental research, including the obtaining of Pr-doped hydroxyapatite samples for UV-C upconversion experiments. Acknowledgements: This study was supported by Romania's National Recovery and Resilience Plan, PNRR, project grant number C9-I8-28/FC 760107/2023.

Keywords: Marine shell waste, Thermal treatment, Calcium hydroxide

ULTRAFINE-GRAINED ALUMINIUM ALLOY SHEETS FABRICATED BY ACCUMULATIVE ROLL-BONDING TECHNIQUE

STEFAN STEFANOV[1]

[1] University of Ruse, Department of Material Science & Technology, Ruse, Bulgaria

Abstract

The article touches on the accumulative roll-bonding method used for the fabrication of ultrafine-grained metal sheets and their subsequent metallographic analysis and select mechanical testing methods.

Keywords: Ultrafine-grained aluminum alloy sheets, Accumulative roll-bonding, Mechanical testing

TESTING THE MECHANICAL PROPERTIES OF FDM-PRINTED PARTS

SZONYA ERDÉLYI[1], IMRE NÉMEDI[2], IGOR FÜRSTNER[3], TAMÁS TORNAI[4]

[1]Subotica Tech – College of Applied Sciences, Subotica, Serbia
[2]Bánki Donát Faculty of Mechanical and Safety Engineering, Obuda University, Hungary
[3]Subotica Tech – College of Applied Sciences, Subotica 24000, Serbia
[4]Doctoral School on Safety and Security Sciences, Obuda University, Budapest, Hungary

Abstract

3D printing, particularly FDM technology, is increasingly being used to produce parts, prototypes, and small-batch products. Despite the technology's advantages, the mechanical properties of printed parts depend significantly on the manufacturing parameters used; therefore, testing these properties is of paramount importance for reliable and reproducible manufacturing. The aim of the research is to analyze the mechanical properties of 3D-printed materials based on measurement data, with particular emphasis on tensile strength, modulus of elasticity, and elongation at break. During the tests, we analyze the effects of technological parameters such as layer thickness and infill density.

The experiments are conducted on test specimens prepared under controlled laboratory conditions, using standardized measurement procedures. The obtained results provide a basis for comparing different parameter combinations and identifying settings that improve the mechanical performance of FDM-printed parts. The research contributes to a more accurate understanding of the mechanical behavior of 3D-printed parts and to more informed parameterization of the manufacturing process.

Keywords: 3D printing, FDM technology, Mechanical properties

PR^{3+} ACTIVATED $NAY_9SI_6O_{26}$ NANOPHOSPHORS WITH TUNABLE VISIBLE EMISSION AND HIGH THERMAL STABILITY FOR SOLID-STATE LIGHTNING

ŽELJKA ANTIĆ[1,2,*], JOVANA PERIŠA[2], SANJA KUZMAN[2], ZORAN RISTIĆ[2], VLADIMIR PANKRATOV[3], TATJANA DRAMIĆANIN[2], MIROSLAV D. DRAMIĆANIN[1,2]

[1]National Institute of Research and Development for Electrochemistry and Condensed Matter, INCEMC, Timisoara, Romania
[2]Centre of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia
[3]Laboratory of Spectroscopy, Institute of Solid-State Physics, University of Latvia, 8 Kengaraga Street, Riga, Latvia
*Corresponding author e-mail: zeljkaa@gmail.com

Abstract

$NaY_9Si_6O_{26}$ nanoparticles with varying Pr^{3+} concentrations were synthesized by an alkaline hydrothermal process, yielding agglomerated spherical particles ~55 nm in diameter with a hexagonal crystal structure. Emission spectra show that the intensity of UV $4f^15d^1 \rightarrow 4f^2$ emissions is partially suppressed by efficient nonradiative relaxation, resulting in sharp visible emissions from intraconfigurational Pr^{3+} $4f^2$ transitions. The photoluminescence intensity increases with Pr^{3+} concentration up to 0.2 mol%, where the strongest emission is observed, and then decreases at higher concentrations. Increasing the Pr^{3+} concentration also decreases the emission decay constant for both the $4f^15d^1$ and $4f^2$ levels. These materials exhibit excellent thermal and temporal stability, retaining ~95% of their room-temperature emission up to 150°C and showing no degradation over 400 min of continuous operation, underscoring their robustness. Prototype LED demonstrators fabricated with these phosphors show efficient color-tunable orange, yellow, and green emission, confirming strong compatibility with commercial LED platforms and potential for solid-state lighting.

Keywords:

CARBON–CALCITE COMPOSITE FOAM WITH ENHANCED STRUCTURAL AND FUNCTIONAL PERFORMANCE

FLORINA STEFANIA RUS[1], CRISTINA MOȘOARCĂ[1], ALEXANDRA BUCUR[1], ANDREI RACU[1], BOGDAN TARANU[1], GEORGE DIMA[1], NICOLAE BIRSAN[1], RADU BANICA[1]

[1]National Institute of Research and Development for Electrochemistry and Condensed Matter, INCEMC, Dr. A. Paunescu Podeanu Street, No. 144, 300569 Timisoara, Romania

Abstract

Porous carbon-based foams have become an increasingly relevant class of materials thanks to their low density, adaptable architecture, and the ease with which they can incorporate multiple functional phases. Their behavior is strongly shaped by features such as pore connectivity, wall chemistry, and the distribution of inorganic domains, all of which influence how these foams interact with their environment. Developing materials that combine structural stability with well-controlled interfacial properties remains an important goal in materials engineering. In this study, we examine a carbon–calcite composite foam obtained from glucose and $CaCl_2$ precursors through hydrothermal processing followed by thermal treatment. The resulting material forms a lightweight, hydrophilic carbon matrix reinforced with in situ-generated calcite. Microscopy reveals a hierarchical, interconnected pore network, while the hybrid carbon–mineral walls provide both mechanical robustness and enhanced surface functionality. To explore how this architecture behaves when exposed to small polar molecules, the foam was placed in a controlled acetic acid atmosphere. The material produced a rapid and steady decrease in vapor concentration, suggesting that its open porosity supports fast molecular diffusion, while the composite walls enable stable retention. Overall, the results show how hybrid carbon–mineral foams can be designed to couple structural control with interfacial reactivity, offering a versatile platform for applications requiring predictable molecular interactions.

Acknowledgments: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CCCDI - UEFISCDI, project number PN-IV-P8-8.3-PM-RO-BE-2024-0004, within PNCDI IV.

Keywords:

PROTOTYPE THERMAL ENERGY STORAGE SYSTEM BASED ON PHASE-CHANGE MATERIALS

RADU BANICA[1], MIHAI PETRU MARGHITAS[1,2], DAN ROSU[1], CRISTINA MOȘOARCĂ[1], DANIEL URSU[1], STEFANIA RUS[1], NICK SAMUEL TOLEA[1], ALEXANDRA IOANA BUCUR[1], BOGDAN TARANU[1], NICOLAE BIRSAN[1]

[1]National Institute of Research and Development for Electrochemistry and Condensed Matter, Str. Dr. A. Păunescu Podeanu nr.144, 300569 Timisoara, Romania
[2]Department of Mechanics and Strength of Materials, Department of Applied Chemistry and Engineering of Inorganic Compounds and Environment, Politehnica University Timisoara, 1 Mihai Viteazu Blvd., 300222 Timisoara, Romania

Abstract

This study investigates the technological and economic performance of phase-change material (PCM)-based thermal energy storage systems for domestic hot-water applications. A 1:2 scale thermal battery prototype was designed based on average household consumption in Romania, with an effective storage capacity of approximately 1239 kJ. The system consists of a 32 L plexiglass tank containing aluminium tubes filled with paraffin (melting range 53–57 °C) as PCM, immersed in a heat-transfer fluid. To improve flow distribution and reduce channeling, plexiglass diffusers were installed at the inlet and outlet of the tube bundle, ensuring more uniform fluid circulation.
Thermal behaviour was analysed using Reynolds, Nusselt, and Prandtl correlations. Heat-transfer enhancement was achieved by inserting steel and copper wire structures into selected tubes to increase the effective thermal conductivity of the PCM. Thermal imaging and experiments revealed strong axial temperature gradients, with a warmer lower region and a cooler upper region of the bundle. A temperature inversion phenomenon was observed in PCM-filled tubes, attributed to combined conduction, natural convection, and internal air circulation effects. Tubes with copper-enhanced PCM reached higher temperatures and showed greater temperature variation along their height, confirming the superior performance of copper compared to steel and pure paraffin. Transient charging and discharging tests highlighted the strong limitation imposed by the low thermal conductivity of paraffin on heat propagation within the system.
Acknowledgment: This work was supported by a project financed by the Ministry of Research, Innovation and Digitization through PN 19 22 01 03 - Innovative technologies for the development of integrated devices for the generation and storage of electrical energy.

Keywords:

MECHANICAL ENGINEERING

FEM-BASED ANALYSIS OF THE STRESS–STRAIN STATE OF A PRESSURE VESSEL WITH AN INTEGRATED SPIRAL HEATING AND COOLING SYSTEM

ERMIN BAJRAMOVIĆ[1], FADIL ISLAMOVIĆ[1], BELMA ISLAMOVIĆ ČAVKIĆ[1]

[1]Technical faculty Bihac, University of Bihac, Bosnia and Herzegovina

Abstract

Pressure vessels with integrated spiral heating and cooling systems represent structures of complex geometry, in which additional components can significantly influence the distribution of stresses and deformations. In this study, an analytical and numerical (FEM) analysis of the stress–strain state of a vertical cylindrical pressure vessel with an integrated spiral system for heating and cooling the working medium is presented. The calculation of the basic dimensions was carried out in accordance with the EN 13445-3 standard, while the numerical analysis was conducted using the Autodesk Inventor software package.

The analyzed load cases included internal vessel pressure (3 bar and −1 bar) and spiral pressure (4 bar and −1 bar). The results show that the maximum von Mises stresses occur in the toroidal region of the upper torispherical head and reach approximately 63 MPa, which is significantly below the allowable stress of 136.7 MPa according to EN 13445-3. It was also determined that the spiral has a beneficial local stiffening effect on the cylindrical shell, reducing stresses in that region. The results obtained confirm the safety and structural integrity of the vessel under the prescribed operating conditions.

Keywords: Pressure vessel, Spiral heating–cooling system, Stress–strain analysis

DEVELOPMENT AND VALIDATION OF A CUSTOM POSTPROCESSOR FOR SIEMENS NX CAM TARGETING MACH3-BASED CNC MILLING MACHINES

NIKOLAS BLAHUŠIAK[1], RADOVAN HOLUBEK[1], PETER KOŠŤÁL[1], DAYNIER ROLANDO DELGADO SOBRINO[1]

[1]Institute of Production Technologies, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava, Bratislava, Slovak Republic

Abstract

Computer-aided manufacturing (CAM) systems such as Siemens NX generate machine-independent tool data that must be translated into controller-specific G-code via a postprocessor. While industrial controllers such as Fanuc or Siemens Sinumerik are broadly supported, low-cost PC-based controllers such as Mach3 lack dedicated, validated postprocessor solutions for professional CAM environments. This paper presents the development and validation of a custom postprocessor for Siemens NX CAM targeting Mach3-based three-axis CNC milling machines.

The methodology employs NX Post Builder to define machine kinematics, G/M-code output formatting, and program event sequencing. The proposed postprocessor addresses the lack of similarity between Fanuc-based templates through custom event and operation handlers. Validation is performed by comparing simulated toolpaths with physically machined test specimens, evaluating dimensional accuracy against a tolerance of ±0.1 mm. Results demonstrate that a professional NX CAM workflow can be successfully extended to non-standard CNC hardware, reducing setup complexity and improving NC code reliability for custom milling applications.

Keywords: Siemens NX CAM, Mach3 controller, Custom postprocessor

DESIGN AND EXPERIMENTAL VALIDATION OF INNOVATIVE LIFTING LUGS FOR DOCK LEVELER HANDLING

BOGDAN-DOREL CIOROAGĂ[1], ADRIAN-AMADEUS OPREA[1], ANDREI-EMANUEL ANCUȚA[1], MARIUS ARDELEAN[1], SORIN-IONEL OLIERIU[1], VASILE GEORGE CIOATĂ[1]

[1]Engineering and Management Departament, Faculty Engineering of Hunedoara, Politehnica University Timisoara, Hunedoara, Romania

Abstract

This paper presents the design and experimental validation of innovative lifting lugs intended for the safe handling of dock levelers. Initially, commonly used lifting lug configurations in current industrial practice were analyzed, with the objective of increasing their load-bearing capacity and improving overall safety. Based on this assessment, a new design was developed and optimized. The proposed solution was evaluated through finite element analysis (FEA) to assess stress distribution and structural performance under loading conditions.

Experimental validation was subsequently carried out through tensile loading tests in order to confirm the numerical results. The lifting lugs were manufactured from two structural steels, S235 and S355, using flat and checkered plates with thicknesses ranging from 6 mm to 12 mm. The components forming the lifting lug body were produced by CNC laser cutting, ensuring high precision and repeatability. The results demonstrate the effectiveness of the new design in enhancing lifting capacity while maintaining structural integrity and safety requirements.

Keywords: Lifting lugs, Finite element analysis, Structural safety

CFD-BASED AERODYNAMIC PERFORMANCE EVALUATION OF THE AIRBUS A300 AIRCRAFT

ELIZA CSOMOS[1], DANIELA DELIA ALIC[1]

[1]Politehnica University Timisoara, Faculty of Engineering Hunedoara, Romania

Abstract

This paper presents a computational fluid dynamics (CFD) study of the aerodynamic performance of a scaled geometric model of the Airbus A300 aircraft using steady-state simulations at a freestream Mach number of 0.8. The Airbus A300 was selected as the research subject due to its role as a foundational landmark in modern aviation, having established key design standards for contemporary commercial twin-engine aircraft. The numerical analysis is performed by solving the Reynolds-Averaged Navier–Stokes equations in conjunction with the k–ω Shear Stress Transport (SST) turbulence model. Simulations are conducted at angles of attack of −4°, 0°, and +4° to investigate the sensitivity of aerodynamic characteristics to changes in incidence.

The analysis focuses on the evaluation of static pressure distribution, velocity field, turbulent kinetic energy, and airflow behavior in the wing-tip region. Lift and drag coefficients are computed for each angle of attack to assess aerodynamic efficiency under cruise-like conditions. The objective of this study is to evaluate the aerodynamic performance of the Airbus A300 over a range of angles of attack using CFD simulations and to validate the numerical results against available reference data, thereby assessing the reliability of CFD methods for the aerodynamic analysis of commercial transport aircraft. In addition, the study aims to establish a validated CFD framework and to provide reference aerodynamic data that can support future numerical and experimental investigations, as well as aerodynamic optimization and performance assessment studies of commercial transport aircraft.

Keywords: Airbus A300, Computational fluid dynamics, Aerodynamic performance

ANALYSIS OF DIFFERENCES BETWEEN THE RESISTANCES OF SOME ALUMINUM ALLOYS TO CAVITATION EROSION

LAVINIA-MADALINA MICU[1], ILARE BORDEASU[2,3*], CLAUDIA-AMALIA CIUREL[2], CRISTIAN GHERA[2], CORNELIA-LAURA SALCIANU[4], ALEXANDRU-NICOLAE LUCA[2], MARIA-ALEXANDRA PASCA[2], DANIEL-CATALIN STROITA[2], DORIN BORDEASU[5]

[1]Department of Agricultural Technologies-Department I, King Mihai I University of Life Sciences, Timisoara, Romania
[2]Department of Mechanical Machines Equipment and Transportation, Politehnica University Timisoara, Romania
[3]Romanian Academy of Scientists, Timisoara branch, Romania
[4]Department of Mechatronics and Robotics, Politehnica University Timisoara, Romania
[5]Department of Automation and Applied Informatics, Politehnica University Timisoara, Romania

Abstract

The evaluation of the resistance to cavitation erosion, of the surface structure of any material, usually, is carried out based on the evolutionary form of the specific curves recommended by the international standards ASTM G32, or on that of the values of the specific parameters, defined by these curves.

The evaluation is of a comparative type, in which the reference is made to a standard material, or to a material of the same type, but whose application to parts stressed by cavitation is very well known. The present paper aims to justify the influence of mechanical properties on the resistance to vibratory cavitation erosion on the structure of aluminum alloys 7075, 5083, 6082 and 2017A. Comparative histograms, constructed with the values of the parameters mean depth of erosion (MDEmax) and the resistance of the structure to cavitation erosion (Rcav), justify the differences in resistance and degree of degradation, due to the individual and summed influences of the mechanical properties: mechanical strength at break, yield strength, elongation at break, surface hardness and resilience.

Keywords: Cavitation erosion, Aluminum alloys, Mechanical properties

DIGITAL TRANSFORMATION IN ROMANIAN COMPANIES: EMPLOYEES' PERCEPTION AND IMPLEMENTATION LEVEL

MIRELA SIMIJDEAN[1], ELENA-BIANCA NEGOMIREANU[1], MIHAI DRAGOMIR[1]

[1]Department of Design Engineering and Robotics, Technical University of Cluj-Napoca, 400641 Cluj-Napoca, Romania

Abstract

Digital transformation is an issue that concerns most organizations today, especially industrial ones. One cannot talk about progress and profitability without considering the resources that the fourth industrial revolution brought about - digital tools. The level of embracing this digital transformation differs between countries and industries. In Romania, digital transformation is still far from being completely implemented. There are factories that have started to use digital tools, but to a lesser extent than the European average, mostly regarding connectivity, human capital, and the use of digital services. There are a lot of opportunities, but also threats like human resistance, lack of training, and differences between industries. This study aims to evaluate the perception of Romanian employees regarding digital transformation, to identify the real level of implementation of digital tools in companies, to emphasize the differences between industries and the maturity of the companies, and ultimately to analyze the relationship between logistics and the qualification of human resources regarding digitalization. For this purpose, the study proposes a conceptual framework aimed at improving human adaptability to digital transformation and supporting organizations in reducing resistance to change.

To identify all these aspects, an extended questionnaire that covers several industries has been used. To make a descriptive analysis of the level of digitalization in Romanian companies, and to identify the digital tools required by employees. Results show significant differences based on company maturity and sector, with older and production-oriented companies showing higher levels of digital implementation. Furthermore, correlations indicate that firms prepared logistically for digital transformation tend also to invest in employee digital training. These findings offer valuable insights for industrial managers and contribute to the broader effort of integrating digital technologies into manufacturing systems, in line with Industry 4.0 and smart factory paradigms.

Keywords: Digital transformation, Industry 4.0, Employee perception

COMPARATIVE ANALYSIS OF CAM STRATEGIES FOR CNC MACHINING OF A COMPLEX MECHANICAL PART

ALEXANDRU-MIHAI PINCA-BRETOTEAN[1], ADRIAN BUT[2], COSMIN PREDA[3]

[1]Department of Engineering and Management, University Politehnica Timișoara
[2]Department of Materials Engineering and Manufacturing, University Politehnica Timișoara
[3]Department of Industrial Machines and Equipment, University "Lucian Blaga" Sibiu, Sibiu, Romania,

Abstract

This paper presents the development and validation of a CAM-based technology for the CNC machining of a complex aluminum part in two setups. The part being a component of a mechanical motion transmission subassembly. The part has a complex geometry defined by profiled inner and outer surfaces, radial ribs, cut out areas, and mounting features, which require careful planning of the machining sequence and milling strategies. The first part of the study analyses the machining technology for both setups, including the cutting tools, cutting parameters, and machining times. Setup 1 is treated as a reference technological stage, while for setup 2 a comparative analysis is carried out for two CAM strategies applied to the critical operations of rib gap cutting and rough machining of the flat surfaces between ribs.

The comparison is performed under identical cutting tools and cutting parameters, so that the observed differences in machining time can be attributed exclusively to the milling strategy. The results show that the pocketing strategy leads to significant reductions in machining time compared to contour milling, confirming the major influence of toolpath generation on process efficiency.

Keywords: CAM technology, CNC machining, Milling strategies

ASSESSMENT OF ENVIRONMENTAL IMPACT OF PV INSTALLATION CONSIDERING DIFFERENT END-OF-LIFE SCENARIO

ADRIAN MARSZAŁKOWSKI[1]

[1]Bydgoszcz university of science and technology, Poland

Abstract

This study examines the environmental impact of a photovoltaic (PV) power plant within the framework of Life Cycle Assessment (LCA), with a particular focus on the role of recycling in a circular economy. As the deployment of renewable energy technologies increases, so does the volume of end-of-life components, highlighting the importance of efficient resource recovery and waste management. The analysis covers the full life cycle of a PV installation, including material extraction, production, operation, and end-of-life treatment. Special attention is given to key materials such as glass, aluminum, silicon, and metals like silver and copper, which constitute a significant share of the system and offer high recycling potential. Two end-of-life scenarios landfilling and recycling are compared to assess their environmental implications. The study employs the ReCiPe impact assessment method within the SimaPro software to evaluate environmental burdens across multiple categories. Results are analyzed at both midpoint (specific impact categories such as climate change and toxicity) and endpoint levels (human health, ecosystem quality, and resource depletion). This approach enables the identification of environmental “hot spots” across the system.

Keywords — ***Photovoltaic (PV) power plant, Life Cycle Assessment (LCA), Circular economy, Recycling, Renewable energy technologies***

AXIBLADE A PYTHON APPLICATION TO DESIGN AXIAL HYDRAULIC TURBINE BLADES

DORIAN NEDELCU[1], TIHOMIR LATINOVIC[2]

[1]"Babes-Bolyai" University of Cluj-Napoca, Romania
[2]University VITEZ, Faculty of Information Technology, Travnik, Bosnia and Herzegovina

Abstract

The AxiBlade application is created in Python language to design axial turbine blades. After reading the input data, the application calculates: asymptotic elements, coordinates of the unfolded profiles, tangential velocities and pressure coefficients, position of the rotation axis, spatial coordinates, the blade volume and the intersection of the blade with level planes. All numerical results are exported to Excel, where specific charts are generated. Also, the 3D profile coordinates are saved into files and can be imported into SolidWorks to generate the 3D blade geometry. Reducing the axially symmetrical 3D flow in Kaplan and bulb turbines to 2D flow, the method of conformal representations O. Popa allows the dimensioning of the planar networks of profiles that will be the basis of the construction of the axial blade in the hypothesis of potential flow through the turbine runner. The AxiBlade application is created based on the following references:

• Dorian Nedelcu - PhD thesis: "Mathematical modelling of hydrodynamic phenomena with application to computer-aided design of axial turbines and radial-axial pumps", Polytechnic Institute Timisoara, 1986.

• Viorel Constantin Campian – PhD thesis: "Contributions to the study and design of axial hydraulic machine runners", Polytechnic Institute Timisoara, 1978.

• Octavian Popa – Article: "The determination of a general relation properties of a single airfoil and those of the same airfoil arranged in an arbitrary cascade", Proc. of the Fourth Conf. on Fluid Machinery, Budapest, 1972.

Affiliation of authors: Dorian NEDELCU: "Babes-Bolyai" University of Cluj-Napoca, Romania

Keywords — ***AxiBlade application, Axial turbine blades, Python programming, Conformal representations***

THE PROTOTYPE OF A CALORIMETER DESIGNED TO MEASURE THE SPECIFIC HEAT CAPACITY OF SMALL LIQUID SAMPLES

MARIO-ROBERT ROMCEA[1], VIRGIL STOICA[1], FLORIANA D. STOIAN[1]

[1]Politehnica University Timisoara, Timisoara, Romania

Abstract

This work presents the stages of design, manufacturing, and validation of the operation of a calorimeter dedicated to measuring the specific heat capacity of liquid samples, including magnetic nanofluids. The working principle of this calorimeter is the electric heating method. Its construction was realised such that it can be integrated with a magnetic field generating system to determine the influence of an applied magnetic field on the sample specific heat capacity value for the case of magnetic nanofluids. The calorimeter has a data acquisition system, which uses an Arduino Nano V3 microcontroller.
This system also includes two IRF 520 MOSFET driver modules, a current and voltage measuring module, type INA 219, and a convertor module ADS1115, all connected by an I2C. Measurements are stored in an Excel file using the PLX-DAQ V2 tool, synchronised with the Arduino IDE programme. The accuracy and the precision of the measurements were verified using a liquid of known specific heat capacity (water).

Keywords — ***Calorimeter design, Specific heat capacity, Magnetic nanofluids, Arduino Nano***

DESIGN AND STRUCTURAL ANALYSIS OF A NEW GREEN MASS SPREADER WITH A DIVIDED WORKING UNIT

Ł. GIERZ[1*], B. ROTNICKI[1], D. DOLIŃSKI[2], V. ZUBKO[3]

[1]Poznan University of Technology, Institute of Machine Design, Faculty of Mechanical Engineering, Poznań, Poland
[2]Rzeczoznawcy UNIVERSUM BV6 D. Kraków, Poland
[3]Department of Mechanical and Electrical Engineering, Poltava State Agrarian University, Poltava, Ukraine

Abstract

Most ruminant farms use the ensiling process to preserve feed, which requires anaerobic conditions in the windrows. Many mechanical devices are available to spread green manure on the market, but solutions that would enable the spreading of the mass in two directions while simultaneously reducing operating resistance are still lacking. The aim of this work was to develop a conceptual design for an innovative spreader with a divided working unit and a strength analysis of its main frame.
The project involved the development of a 3D CAD model and detailed finite element calculations (FEM). Modeling was performed in Autodesk Inventor and comparative analysis was performed in the Ansys and Autodesk Inventor environments. The designed frame did not contain nodes where stresses exceeded 57% of the allowable stress values for the material used (S355 steel). The new design with a divided working unit meets the intended functional requirements and has great potential for agricultural applications.

Keywords — ***Innovative spreader design, Finite Element Method (FEM), Autodesk Inventor, Agricultural applications***

DESIGN OF AN IN-FURROW INOCULATION MODULE FOR ROW CROP PLANTERS– CASE STUDY: ELVORTI VEGA 8 PROFI ROW SEEDER

Ł. GIERZ[1], M. SHELEST[2], V. ZUBKO[3], O. BILOVOD[3], T. KHVOROST[2], O. PANKOVA[4], O. SUKHANOV[2]

[1]Poznan University of Technology, Institute of Machine Design, Faculty of Mechanical Engineering, Poznań, Poland
[2]Sumy National Agrarian University, Ukraine
[3]Poltava State Agrarian University, Ukraine
[4]Kharkiv National Automobile and Highway University, Ukraine

Abstract

The transition of domestic agricultural machinery manufacturing to the Agriculture 4.0 concept requires the development of equipment capable of implementing resource-saving and environmentally friendly technologies. The use of biological agents is a key factor in reducing the chemical burden on soils; however, traditional methods of pre-sowing seed treatment in hoppers or stationary mixers lead to mechanical micro-damage to the seed material and the loss of bacterial viability due to abiotic factors. The aim of this study was the development and engineering substantiation of an in-furrow inoculation module for domestically produced row crop planters, using the Elvorti Vega 8 Profi as a case study.

The technical solution is based on the spatial integration of a spray nozzle directly into the seed tube of the double-disc opener. It has been substantiated that the application of the biological agent occurs within a confined aerodynamic space during the free fall of the seed. It is proven that with such a configuration, the kinematics of the machine do not affect the residence time of the seed in the treatment zone, as it is governed exclusively by the laws of free fall.

This guarantees high coverage uniformity and dosage stability without the risk of material sticking to the working components. To verify the proposed concept, 3D CFD modeling of a multiphase aerosol flow was performed in the Ansys software suite. The analysis of fluid dynamic processes allowed for the visualization of the intersection zone between the spray cone and the ballistic trajectory of the seed. The computer simulation results confirmed the key kinematic condition of the system: the settling time of fine droplets on the walls significantly exceeds the seed's transit time through the treatment zone. This ensures effective coating of the seed material while in suspension and minimizes the loss of the working fluid.

Keywords — ***Agriculture 4.0, In-furrow inoculation module, CFD modeling (Ansys), Row crop planters (Elvorti Vega 8 Profi)***

PROFILING OF PRECISION CUTTERS FOR THE MANUFACTURE OF SCREW PARTS WITH A LARGE PITCH

VOLODYMYR KOPEI[1], OLEH ONYSKO[1], LIUBOMYR BORUSHCHAK[1], ANATOLII VERKALETS[1], TARAS HOLYK[1]

[1]Ivano Frankivsk National Technical University of Oil andGas, Ivano Rfankivsk, Ukraine

Abstract

Threads and other screw parts with a large pitch and a small diameter usually have a large helix angle. Therefore, cutters that manufacture such screws, for high wear resistance, must be equipped with shims that provide a cutting-edge angle rounded to the value of this helix angle. In addition, the requirement of high wear resistance requires the use of non-zero cutter rake angles. All this leads to the need to adjust the profile of the cutting edge of the tool. In addition, for small thread diameters, the cutting-edge profile is significantly affected by the magnitude of the tangential displacement of the cutter tip relative to the axis of the part. In this study, an algorithm for profiling thread cutters is based on the use of the specified three geometric parameters of the tool and geometric parameters of the thread (diameter, pitch, profile angle). The algorithm is based on analytical studies of the specified functional dependence using symbolic mathematics in the SymPy environment. The results obtained prove that the calculated cutter profile has significant curvature but can be approximated by a straight line with a high level of accuracy.

Keywords — Thread cutters, Helix angle, Cutter profiling algorithm

ARTIFICIAL INTELLIGENCE AND THE SAFETY OF USING LPG FROM SMALL BOTTLES

MLADEN TODIC[1], TIHOMIR LATINOVIC[2], BILJANA VRANJES[1], ALEKSANDAR MAJSTOROVIC[3]

[1] University of Banja Luka, Facuty of Mechanical Engineering, Banja Luka, Republic of Srpska, Bosnia and Herzegovina
[2]University VITEZ, Faculty of Information Technology, Travnik, Bosnia and Herzegovina
[3]Banja Luka, City of Banja Luka, City Administration, Department for Common Affairs, Republic of Srpska, Bosnia and Herzegovina

Abstract

Liquefied petroleum gas is widely used as an energy source used in households, agriculture, construction, etc. In areas where there is no pipeline system or large investments would be required in the construction of pipelines to transport gas to consumers, mobile gas cylinders are used. Usually, it is LPG in a combination of propane-butane. Most often, bottles with a volume of 25 l are used, with LPG in the amount of 10 kg. Cylinders are made of steel, aluminum and composite material, depending on the legal regulations in various countries. When using gas, in most cases, a pressure regulator, composite hose and consumer are included. Gas is a good servant but a bad master. Fires and explosions quite often occur as a result of improper use of gas and damaged elements in the system from the cylinder to the consumer of LPG from these cylinders. The question arises, can unwanted phenomena be reduced or, in the final analysis, brought to zero? To achieve this, many scientific, research and development centers are considering the introduction of AI in this segment of gas use.

A major problem is the financial costs of future users to accept an AI system that can safely reduce potential consequences to close to zero or significantly reduce the impact of technical malfunctions in the system that lead to accidents. Also, the problem is filling gas bottles because in many countries, bottles are replaced and not directly filled on site in a defined area. The reason is the location of the implementation of multi-sensors and supporting equipment required by a modern AI system. The AI system can predicatively warn of the deterioration of some sensors and, in the extreme case, block the gas leak. As part of the AI system, machine and deep learning must be implemented, IoT technologies that must react predicatively to prevent unwanted effects. Each system has its advantages and disadvantages. Thus, the AI system has its disadvantages that will only be noticed in the future.

Keywords — AI, gas, accidents, mobile bottles

DESIGN AND NUMERICAL ANALYSIS OF A TEST STAND FOR DETERMINING FRICTION COEFFICIENTS OF GRANULAR MATERIALS USING FEA SIMULATIONS.

WIKTOR ŁYKOWSKI[1], ŁUKASZ GIERZ[1]

[1] Poznan University of Technology, Faculty of Mechanical Engineering, Poznan, Poland

Abstract

Determining the precise physical and mechanical properties of granular mineral fertilizers, such as static and kinetic friction coefficients, is crucial for optimizing their transport, storage, and distribution processes. While scientific literature provides friction coefficients for selected bulk materials, there is a lack of precise data for specific mineral fertilizers, such as urea. Previous numerical simulations using the Discrete Element Method (DEM) in Ansys Rocky – conducted with friction coefficients sourced from literature – demonstrated that the resulting trend line aligns well with experimental data, yet it remains shifted by a certain constant correction factor.

The objective of this study was to develop a conceptual design of a new test stand to determine the static and kinetic friction coefficients between the structural components of mechanical seed drills and granular material. The conceptual design involved analyzing existing structural solutions, developing a three-dimensional CAD model, and conducting a finite element analysis (FEA) of the load-bearing structure. Modeling and stress simulations were carried out within the SolidWorks environment. The developed test stand enables precise measurement of motion resistance using the torsional method.

The actual friction parameters obtained from physical testing will allow for the calibration and significant improvement in the accuracy of numerical DEM analyses of metering and sowing systems.

Keywords — Static friction coefficient, Kinetic friction coefficient, Discrete Element Method (DEM)

MECHANICAL INVESTIGATION OF SELECTED TRADITIONAL TIMBER ROOF SYSTEMS FROM BANAT

ROBERTA RĂDUCA[1], ZENO-IOSIF PRAISACH[1], MIHAELA MOLNAR[1], CORNEL HAȚIEGAN[1]

[1] Babeș-Bolyai University of Cluj-Napoca – Faculty of Engineering – CUUBB Reșița

Abstract

Structural behaviour of traditional timber roof structures represents an important aspect in the conservation and rehabilitation of built heritage. In the Banat region, many historic buildings preserve traditional double-pitched timber roof systems that reflect local construction techniques, material availability, and empirical structural knowledge developed over time. Despite their cultural and architectural value, these structures are often insufficiently studied from an engineering perspective. This paper investigates several traditional timber roof trusses from the Banat region, focusing on their structural configuration and mechanical behaviour under gravitational loads. The study analyzes the manner in which forces are transferred and distributed through the structural elements of the roof systems, with particular attention to the load path from the roof covering to the supporting walls. The research combines field documentation, geometric analysis, and simplified structural calculations in order to better understand the efficiency and stability of these traditional systems. The paper aims to highlight the relationship between traditional carpentry techniques and structural performance, emphasizing the constructive logic behind vernacular roof structures. Furthermore, the research contributes to the documentation and understanding of historic timber systems, providing useful information for future conservation, restoration, and rehabilitation interventions on heritage buildings in the Banat region.

Keywords — Traditional timber roof structures, Structural behaviour and load path, Banat region heritage, Conservation and rehabilitation

MODELING OF THERMOMECHANICAL STRESSES IN THE MAIN SPINDLE ASSEMBLY OF HIGH-SPEED MACHINE TOOLS

BILJANA PROCHASKA[1], MILAN ZELJKOVIĆ[2], SANEL GREDELJ[3]

[1]Rudarski fakultet, University of Banja Luka, BiH, biljana.prochaska@mf.unibl.org
[2]FTN Novi Sad, University of Novi Sad, Novi Sad, Republika Srbija, milanz@uns.ac.rs
[3]Tehnički fakultet, University of Bihać, Bihać, BiH, sanel.gredelj@unbi.ba

Abstract

This paper presents a preliminary numerical modeling of complex thermomechanical processes in high-speed machine tools (HSM) using the finite element method (FEM) within general-purpose software systems. The objective of the research is to identify the locations of critical thermal stresses in structures subjected to thermal loads. As a critical subassembly regarding the geometric accuracy of the machine tool, the main spindle assembly is analyzed in detail. The developed model considers bearing friction as the primary and most influential heat source, which directly causes a temperature rise in the front bearing and subsequent thermal expansion of the main spindle. The obtained results enable accurate localization of thermal stresses and provide a foundation for quantitative analysis, which will be the subject of further research. Keywords: High-speed machine tools, main spindle assembly, thermomechanical modeling, finite element method (FEM), bearing friction, thermal stress localization

Keywords — High-speed machine tools, main spindle assembly, thermomechanical modeling, finite element method (FEM), bearing friction, thermal stress localization

ELECTRICAL ENGINEERING

THE FUTURE PERSPECTIVES OF RENEWABLES ENERGY SECTOR IN ROMANIA

CORNELIA-VICTORIA ANGHEL-DRUGĂRIN[1], CRISTIAN PAUL CHIONCEL [1]

[1] Babes-Bolyai University Cluj-Napoca, România

Abstract

The Romanian energy sector has experienced considerable impacts associated with the pandemic and current geopolitical issues. Thus, both at national and European level, strategies have been developed that foresee accelerated decarbonization through the transition to renewable energy. A scenario-based analysis is essential to highlight the perspective of the Romanian energy sector, contrasting existing national strategies with an optimal trajectory that would guarantee the fulfilment of EU objectives and obligations. It is absolutely necessary for the EU to reduce its dependence on energy imports.

Consequently, the EU Commission introduced the REPowerEU initiative, which aims to reduce net greenhouse gas emissions by at least 55% by 2030, aiming to accelerate the pace of the EU's decarbonization efforts, relying on local green energy sources.

Keywords — Romanian energy sector, Renewable energy transition, REPowerEU initiative

COMPARATIVE ANALYSIS OF SERVO CONTROL SYSTEMS USING ETHERCAT AND SERIAL COMMUNICATION

TAMÁS TORNAI[1], LÁSZLÓ GOGOLÁK[2], IGOR FÜRSTNER[3]

[1] Doctoral School on Safety and Security Sciences, Obuda University, Budapest, Hungary,
[2]Department of Mechatronics and Automation, Faculty of Engineering, University of Szeged,
[3]Bánki Donát Faculty of Mechanical and Safety Engineering, Obuda University Budapest, Hungary,

Abstract

The paper presents an original electronically controlled pneumatic (ECP) braking system for freight trains, incorporating an advanced fuzzy algorithm which determines the pressure required to break the wheels of each vehicle by analyzing both the wheel slip and the actual mass of the vehicle as well as the train speed and the braking regime imposed by the driver. Fuzzy logic was used to obtain a optimal control of the braking of each vehicle and to eliminate some mechanical components from classic schemes (for example the triple valve), which are prone to failure (mechanical wear, blockages, leaks etc.).

The proposed system offers the major advantage of inter-system compatibility, allowing vehicles equipped with this technology to be coupled in the same consist with electro-pneumatic-braked units (preferably immediately after the locomotive). Other significant benefits are due to the electronic control of pneumatic braking, such as reducing break times and eliminating the disadvantages generated by transmitting the pneumatic signal along the brake pipe.

The validity of the proposed system is demonstrated by off-line methods, with simulation results showing that the fuzzy algorithm contributes at both the avoidance of wheel lock-up and the subsequent release of the wheels if locking occurs.

Keywords — Electronically controlled pneumatic braking, Fuzzy logic control, Freight trains

NONLINEAR MODELING OF THE DEPENDENCE OF INSTANTANEOUS WIND TURBINE POWER ON WIND SPEED BY APPLYING QUADRATIC REGRESSION ON SCADA DATA

GOJKO KRUNIĆ[1], SRĐAN VASKOVIĆ[2]

[1]University of East Sarajevo, Faculty of Production and Management Trebinje, Trebinje, Bosnia and Herzegovina, gojko.krunic@fpm.ues.rs.ba
[2]University of East Sarajevo, Faculty of Mechanical Engineering, East Sarajevo, Bosnia and Herzegovina, srdjan.vaskovic@ues.rs.ba

Abstract

This paper analyzes the nonlinear dependence of the instantaneous wind turbine power on wind speed using a quadratic regression model on one-year SCADA (Supervisory Control and Data Acquisition) data. The aim of the research is to quantitatively model the relationship between wind speed and output power and to assess the accuracy of the model in real exploitation conditions. The obtained results show that the quadratic regression model well approximates the basic nonlinear trend of the dependence of power on wind speed, with a determination coefficient value of $R^2 \approx 0.83$. The accuracy of the model was additionally assessed using RMSE and MAE, with deviations observed, especially in extreme operating modes. Residual analysis shows that the model is most accurate in the middle range of wind speeds, while systematic deviations occur at very low and high speeds. In conclusion, the quadratic regression model represents a simple and efficient approach for analyzing wind turbine performance and estimating wind energy potential based on SCADA data, with limited accuracy in extreme operating conditions.

Keywords — wind turbine, wind speed, SCADA systems, instantaneous power, nonlinear regression.

FUZZY LOGIC CONTROL SYSTEM FOR IMPROVING THE BRAKING OF FREIGHT RAILWAY VEHICLES.

STELA RUSU-ANGHEL[1], ALEXANDRU-NICOLAE RUSU[1], CLAUDIU PAUL SAFTA[1], ARIS-CIPRIAN BISTRIAN[1]

[1] Politehnica University Timisoara, Faculty of Engineering Hunedoara, România

Abstract

The paper presents an original electronically controlled pneumatic (ECP) braking system for freight trains, incorporating an advanced fuzzy algorithm which determines the pressure required to break the wheels of each vehicle by analyzing both the wheel slip and the actual mass of the vehicle as well as the train speed and the braking regime imposed by the driver. Fuzzy logic was used to obtain a optimal control of the braking of each vehicle and to eliminate some mechanical components from classic schemes (for example the triple valve), which are prone to failure (mechanical wear, blockages, leaks etc.).

The proposed system offers the major advantage of inter-system compatibility, allowing vehicles equipped with this technology to be coupled in the same consist with electro-pneumatic-braked units (preferably immediately after the locomotive). Other significant benefits are due to the electronic control of pneumatic braking, such as reducing break times and eliminating the disadvantages generated by transmitting the pneumatic signal along the brake pipe.

The validity of the proposed system is demonstrated by off-line methods, with simulation results showing that the fuzzy algorithm contributes at both the avoidance of wheel lock-up and the subsequent release of the wheels if locking occurs.

Keywords — Electronically controlled pneumatic braking, Fuzzy algorithm, Wheel slip control

COMPUTER ENGINEERING

APPLICATION OF ARTIFICIAL INTELLIGENCE IN CONTEMPORARY AUDIO PRODUCTION: TECHNICAL AND MEDIA-THEORETICAL ASPECTS

SINIŠA TOMIĆ[1], DALIBOR DRLJAČA[1] , OLJA KRČADINAC[2]

[1]Pan European University APEIRON, Banja Luka, Republic of Srpska, Bosnia and Herzegovina
[2]University of "Union-Nikola Tesla", Belgrade, Serbia

Abstract

This paper analyzes the application of artificial intelligence (AI) in contemporary digital audio production, with the aim of examining its impact on both the technical and aesthetic aspects of the production process. A comparative analysis was conducted between manual and AI-assisted processing modes across several multitrack projects of different genres and production characteristics.

The analysis was carried out within the workflow environment of Steinberg Cubase 12 and included dynamic stability, spectral energy distribution, signal-to-noise ratio, and the mixing phase. The results indicate that AI assistance reduces inter-project variability and systematically introduces technical standardization into the production process, particularly in the domains of dynamic processing and tonal balance.

The study shows that AI tools do not replace the role of the audio producer or sound engineer; rather, they assume routine technical tasks, thereby reshaping the production workflow and allowing the human factor to focus more on aesthetic and creative decision-making.

The paper contributes to a better understanding of the relationship between algorithmic optimization, platform standardization, and professional transformation in contemporary audio production.

Keywords — Artificial intelligence, Digital audio production, Workflow optimization

REDEFINING VALUE: THE IMPACT OF AI AND MACHINE LEARNING ON THE FUTURE OF FINANCE AND ACCOUNTING

DENIJAL IMAMOVIC[1], TIHOMIR LATINOVIC[1], MUZAFER SARAČEVIC[1], MAHIR ZAJMOVIC[1]

[1]University VITEZ, Faculty of Information Technology, Bosnia and Herzegovina

Abstract

This paper examines the profound paradigm shift in the global financial and accounting sectors as they transition from traditional, rule-based systems to Artificial Intelligence (AI) and Machine Learning (ML) frameworks. The central thesis explores how these technologies are redefining value by shifting the industry's focus from manual data processing to high-value strategic intelligence and professional judgment. In the realm of global finance, the research highlights how ML algorithms are revolutionizing risk management and credit scoring.

By integrating alternative data sources—such as social media activity and real-time payment transactions, AI models achieve superior predictive accuracy, thereby fostering financial inclusion for underserved populations. Furthermore, the study explores the impact of real-time analytics in fraud detection, where systems like Mastercard's Decision Intelligence analyze billions of transactions in milliseconds, preventing over $35 billion in losses. In accounting, the paper analyzes the "stunning" efficiency gains brought by Robotic

Process Automation (RPA). Top firms report processing time improvements of 70% to 80% and the saving of millions of human work hours annually. This automation of "soul-crushing" mundane tasks is effectively "melting" the middle office, allowing professionals to reallocate their expertise toward strategic analysis and advisory roles. Despite these advancements, the transition faces significant legal and ethical hurdles, including algorithmic bias, the opacity of "black-box" models, and strict compliance with the GDPR. The research emphasizes that the development of Explainable AI (XAI) is critical for building stakeholder trust and ensuring accountability in autonomous decision-making. In conclusion, the integration of AI and ML is not merely a technical upgrade but a structural transformation that can improve a bank's efficiency ratio by up to 15 percentage points and deliver an ROI between 20% and 50%. The future of the industry lies in human-AI collaboration, where automated precision enhances the resilience and adaptive capacity of global financial systems

Keywords — Artificial intelligence, Machine learning, Financial transformation

DEVELOPMENT OF AN APPLICATION FOR DATA COLLECTION AND ANALYSIS FOR EMERGENCY RESPONSE IN ECOLOGICAL CRISIS AREAS OF BOSNIA AND HERZEGOVINA

ISHAK KAZIC[1], BECIR ISAKOVIC[2]

[1] International Burch University, Sarajevo 71000 Bosnia and Herzegovina, ishak.kazic@gmail.com
[2] International Burch University, Sarajevo 71000 Bosnia and Herzegovina, becir.isakovic@ibu.edu.ba

Abstract

Environmental pollution and illegal waste disposal remain significant ecological challenges in Bosnia and Herzegovina, particularly due to limited monitoring infrastructure and delayed reporting mechanisms. This paper presents a data-driven system for automated detection and analysis of urban waste incidents using computer vision and geospatial data integration. Images captured by mobile devices are processed using a YOLOv8 object detection model trained to recognize waste-related objects. Detection results are combined with geolocation data to perform distance-aware analysis relative to known container locations, enabling more reliable classification of incident severity. A streaming data pipeline based on Apache Kafka supports real-time ingestion and processing of user-generated reports, while processed results are stored and analyzed using Python and Pandas. The system also includes an interactive geospatial visualization component implemented with GeoJSON and Leaflet, enabling spatial exploration of detected incidents and identification of environmental hotspots. Experimental evaluation demonstrates reliable detection performance and confirms the feasibility of integrating computer vision, streaming data processing, and geospatial analysis for ecological monitoring. The proposed

framework provides a scalable approach for supporting environmental monitoring and improving response to waste-related incidents in urban areas.

Keywords — Computer vision, Geospatial analysis, Environmental monitoring

DATA-DRIVEN ANALYSIS OF STUDENT ENROLLMENT TRENDS USING MACHINE LEARNING ALGORITHMS: A CASE STUDY OF THE UNIVERSITY OF TETOVA

REMZIJE SULEJMANOSKA[1], FESTIM HALILI[1], MERIKA K. HALILI[1]

[1] University of Tetovo, Tetovo, North Macedonia

Abstract

The increasing role of data analytics and machine learning in educational management has opened new possi- bilities for understanding student behaviors and institutional performance. This paper presents a data-driven study applying computational methods to analyze enrollment trends across the faculties of the University of Tetova from 2021 to 2024. Utilizing Python-based data preprocessing, exploratory data analysis, K- Means clustering, and decision tree classification, we identify en- rollment patterns and forecast future trends, with a special focus on the predominance of the Faculty of Medical Sciences.

The study demonstrates how machine learning models can classify faculty trends and predict future enrollment, providing actionable insights for higher education strategic planning. The presented methodology contributes to the multidisciplinary application of data science in educational institutions, showcasing the impact of computational algorithms in decision-making processes beyond traditional industrial and commercial domains. Index Terms—data science; machine learning; higher educa- tion analytics; computational methods

Keywords — data science; machine learning; higher education analytics; computational methods

RESEARCH ON THE DEVELOPMENT OF A PLATFORM FOR EVALUATING THE EFFECTS OF DRUG ADMINISTRATION

DIANA-MARIA THOLVAY[1]

[1] Universitatea Politehnica Timişoara, Timişoara, România

Abstract

Digitalization of clinical workflows has accelerated the emergence of clinical decision support systems (CDSS), especially in scenarios where treatment selection requires balancing expected efficacy against patient-specific risks and formal constraints from official drug documentation. This paper presents the design and implementation of a research-level decision support platform obtained by extending an existing monolithic medical application developed with Spring Boot, JHipster, and an Angular frontend.

The platform transforms a conventional CRUD-oriented system into an auditable, explainable, end-to-end clinical pipeline that integrates internal patient data with external evidence sources and supports post-decision surveillance. The primary objective is to implement a complete clinical workflow in which the physician remains the initiating decision-maker (proposing a treatment), while the system plays a dual role: (i) validating the physician's proposal against official contraindications, interactions, and warnings; and (ii) independently producing a comparative A/B recommendation via an explainable decision engine.

A central requirement is reproducibility and auditability: every evaluation persists not only the selected option but also the justification, triggered rules, and external evidence used, enabling later reconstruction and review of the decision context. Beyond the initial decision, the platform introduces a supervision loop that collects real-world data after therapy initiation through patient monitoring, adverse reaction reporting, and outcome feedback contributed by both patients and pharmacists. These signals enable structured re-evaluation when risk indicators emerge, closing the loop between decision, observation, and governance.

Keywords — Clinical decision support systems, Explainable AI, Workflow digitalization

COMPARATIVE ANALYSIS OF SERVERLESS AND VPS ARCHITECTURES IN AI-POWERED WEB APPLICATIONS: AN END-TO-END PERFORMANCE EVALUATION

JASNA HAMZABEGOVIC[1], KENAN DURAKOVIC[1], AMEL DZANIC[1]

[1] Faculty of Technical Engineering, University of Bihać, Bosnia and Herzegovina

Abstract

This paper presents a comparative empirical evaluation of serverless and Virtual Private Server (VPS) architectures in the context of AI-powered web applications that rely on Large Language Models (LLMs) as external services. While serverless computing is often assumed to provide superior scalability, performance, and cost efficiency, such assumptions are rarely validated through controlled, application-level experiments in realistic AI workloads. To address this gap, two production-equivalent implementations of the same web application were deployed: a serverless version on a cloud platform and a traditional VPS-based backend.

The experimental design includes both full-stack scenarios, incorporating LLM API calls, and infrastructure-only scenarios, where the model layer is excluded to isolate infrastructural effects. Performance was evaluated using standardized benchmarking techniques under cold, warm, and load conditions.

The results indicate that in full-stack scenarios, overall latency is dominated by the external LLM service, making infrastructural differences between serverless and VPS approaches relatively insignificant. However, in infrastructure-only scenarios, VPS consistently demonstrates lower latency and more stable performance, particularly due to the absence of cold-start overhead. Furthermore, no significant scalability advantage of serverless was observed under the tested workload. The findings suggest that the effectiveness of serverless architectures in AI applications is highly dependent on workload characteristics, and that end-to-end system analysis is essential for accurate performance evaluation. This study contributes empirical evidence to the ongoing discussion on infrastructure selection for modern AI-driven web systems.

Keywords — Serverless computing, Virtual Private Server (VPS), AI web applications

ACCEPTANCE OF SELF-DRIVING ROBOTIC CARS

DALMA ZILAHY[1], GYULA MESTER[2], ZARAND MESTER ZILAHY[1]

[1] Obuda University, Budapest, Hungary
[2] University of Szeged, Faculty of Engineering, Szeged, Hungary

Abstract

The technology behind Self-Driving Robotic Cars (Autonomous Vehicles) has undergone significant development over the past decade; however, their acceptance and social integration face numerous psychological, cultural, and technological challenges. The aim of this study is to provide a comprehensive overview of the factors influencing the acceptance of Self-Driving Robotic Cars, related research findings, and future development and communication strategies. The psychological effects of autonomous driving must be measured in real or simulated situations, as paper-and-pencil-based questionnaires do not fully reflect actual usage intentions. Experience in Europe is limited, and the media and fiction may distort public opinion. Emphasizing safety on social media, standardizing safety metrics, and increasing support from transportation policy and society are essential. It is important to inform consumers about the benefits and operation of the technology, as well as to launch simulation training and test programs (based on examples from Waymo, Tesla, Aurora, and Cruise)..

Keywords — Self-Driving Robotic Cars, Acceptance challenges, Psychological and cultural factors, Safety communication strategies

2026 RANKING OF ARTIFICIAL INTELLIGENCE RESEARCHERS IN SERBIA

GYULA MESTER[1]

[1] University of Szeged, Faculty of Engineering, Szeged, Hungary

Abstract

The study presents the 2026 ranking list of Artificial Intelligence researchers in Serbia. Scientific indicators are essential for measuring the quantity and quality of scientific output. Scientific indicators measure the following: the volume of scientific publications - the number of publications and their quality, citations, h-index. The ranking list is primarily based on the researchers' h-index. Researchers with the same h-index were ranked based on their number of citations. The h-index, also known as the Hirsch index, is based on citations. The h-index was introduced by physicist Jorge E. Hirsch (University of California, San Diego) in 2005: "A scientist has an h-index if, out of N articles, at least h articles have at least h citations, and the remaining (N-h) articles have at most <=h citations". Thus, the h-index is the highest number h that indicates that h publications have at least h citations, and by definition, all other scientific publications have fewer than h citations. According to Hirsch, the h-index was originally intended only for comparing individual performance, but it can also be used to determine the h-index of the following research groups, journals, disciplines, institutions, and countries. The original h-index does not distinguish between dependent and independent citations; that is, it also takes self-citations into account. We also present the researchers Orcid ID.

Keywords — 2026 ranking list, Artificial Intelligence researchers in Serbia, publications, number of citations, h-index, Hirsch-index, Orcid ID

IMPROVING SIX SIGMA METHODOLOGY WITH ARTIFICIAL INTELLIGENCE

JANOS SANTA[1]

[1] EURGAI, Budapest, Imerys, Szeged, Hungary

Abstract

This paper details the initial findings from a partial application of the Six Sigma Methodology, leveraging Artificial Intelligence (AI), on real production data. While process improvement using Six Sigma and statistical analysis of indicator variations is standard and supported by various digital tools, this research supports the idea that even highly optimized systems can be further enhanced by integrating AI.

Skepticism towards AI-driven analysis, stemming from past issues with 'hallucinated' results, is acknowledged. However, the reliability and sophistication of modern AI have vastly improved. Integrating AI into process improvement methodologies like Six Sigma has the potential to elevate the overall results significantly.

The acknowledged and historical skepticism towards AI-driven analysis, particularly in industrial and academic circles, stemming from well-documented past issues with unreliable, or 'hallucinated,' results, is fully recognized. This hesitation is a valid consequence of earlier technological limitations. However, a critical distinction must be made: the reliability, computational power, and analytical sophistication of modern, foundation-level AI models have vastly improved. Integrating this advanced AI capability directly into robust, established process improvement frameworks like Six Sigma does not merely replace existing tools; it possesses the transformative potential to significantly elevate the speed, depth, and overall quality of the resultant improvements.

Crucially, while the speed and comprehensive nature of real-time AI responses are undeniably compelling, we strongly recommend—and our methodology mandates—that a crucial step of manual cross-checking and expert validation of all AI-provided results remains a necessary and permanent component of the process. This safeguards against potential residual errors and, more importantly, avoids the premature and dangerous conclusion that human intervention, domain expertise, or critical oversight is obsolete. The true power lies in the partnership.

Keywords — Six Sigma Methodology, Artificial Intelligence integration, Process improvement, Expert validation

14th International Conference on Applied Sciences

Banja Luka, 30-31.05.2026

Book of Abstracts (International Conference on Applied Science)

ISSN 3100-4164

ISSN-L 3100-4164

Editura POLITEHNICA