POLITEHNICA UNIVERSITY OF TIMIȘOARA
FACULTY OF ENGINEERING HUNEDOARA
AND
UNIVERSITY „VITEZ"

BOOK OF ABSTRACTS

INTERNATIONAL CONFERENCE ON APPLIED SCIENCES ICAS 2025

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Faculty of Engineering
Hunedoara, Romania

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and

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ICAS 2025 CONFERENCE

BOOK OF ABSTRACTS

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PREFACE

The ICAS Conference was first launched in 2013 as part of a collaborative project between the Interdisciplinary Scientific Values for Education and Research Society (SCIVERS), Wuhan University (China), Huazhong University of Science and Technology (China), and Politehnica University of Timisoara (Romania), Faculty of Engineering Hunedoara. In 2017, the Faculty of Mechanical Engineering at the University of Banja Luka, followed in 2023 by the University "VITEZ", joined the list of organizers for the ICAS Conference and took an active role in its proceedings.

The ICAS 2025 Conference, marking the 13th edition of the International Conference of Applied Sciences, will be held in Hunedoara, Romania. The event will cover a broad spectrum of topics in applied science, engineering, and technology. Plenary contributions focus on immersive reality technologies in modern manufacturing processes as part of the transition toward Industry 5.0, as well as on artificial intelligence and machine learning. Meanwhile, the abstracts submitted to the conference cover topics such as:

- Fundamental Sciences – interdisciplinary research at the crossroads of analytical chemistry, environmental modeling, and applied mathematics. Topics include spectrophotometric analysis of complex mixtures, photogrammetric accuracy in terrain mapping and structural analysis of discontinuous deformations. Mathematical models and economic evaluations address the effects of atmospheric pollution and promote sustainable financial strategies in enterprise planning.
- Electrical Engineering – contemporary challenges in energy efficiency, electrical safety, and renewable energy integration. Research highlights include software-assisted photovoltaic system design, power factor optimization in industrial settings, and current asymmetry protection strategies for induction motors. Case-specific analyses, such as the electromechanical safety of mining systems and national trends in renewable energy capacity, underscore the sector's shift toward sustainability and operational resilience.
- Computer Engineering – transformative impact of digital technologies on assessment algorithms, smart automation, and intelligent systems. Research covers innovative methods for student performance evaluation via text similarity metrics, the strategic role of IT in business, and IoT-based renewable energy solutions for smart cities. Applications of AI in food classification and offline programming for robotic systems emphasize the growing relevance of automation and machine learning in real-world contexts.
- Mechanical Engineering – advancements in simulation-driven design, performance optimization, tribology, fluid dynamics, and additive manufacturing. Contributions explore topics such as mechanical efficiency in 3D printed parts, gearbox loss optimization, cavitation resistance in aluminum alloys, CFD studies on vehicle

aerodynamics, autonomous ships, safety and sustainability of naval operations. Complementary themes include simulation-driven and interactive learning methods, ergonomic monitoring, acoustic comfort in heavy trucks, sustainable waste practices in rail transport, biochar treatment of used engine oil, and the digital transformation of SMEs and industrial systems.

- Materials Engineering – investigations into advanced materials, resource recovery, and thermophysical innovations. Highlights include experimental studies on fiber-reinforced composites, nanofluid properties, and plasmonic sensor applications. Also included are recycling-based solutions, advanced steel degassing methods, and the reuse of plastic waste and sideritic residues in construction and metallurgy.

Participants represent over 45 universities, research centers, and companies from countries including the United States, China, Iraq, Turkey, Greece, Bosnia and Herzegovina, Serbia, Montenegro, Slovakia, Austria, Poland, Ukraine, Estonia and Romania. These institutions are actively engaged in research and academic activities across a wide range of disciplines.

The ICAS Conference has already attained international standards and recognition. We are confident that hosting such an event can help strengthen connections among Balkan countries, the European Union, and nations worldwide—not only in scientific collaboration, but also in economic and cultural exchange.

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CONTENTS

KEYNOTE LECTURES

FROM DATA TO INSIGHT: A PRIMER ON AI AND MACHINE LEARNING

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ABSTRACT

Artificial intelligence and machine learning offer powerful methods for transforming raw observations into reliable predictions—but navigating from noisy measurements to actionable results requires a clear roadmap. In this talk we will walk through the journey from raw data to actionable insight: collecting and cleaning data, choosing and training models, evaluating performance, and deploying results. Along the way we will give an intuitive understanding of the three types of machine learning methods: supervised, unsupervised and reinforcement learning. Finally, we will also cover the increasingly important field of explainable AI. These are techniques that aim to turn opaque predictions into transparent, trustworthy insights — so you understand not just what the model says, but why. Explainable AI is nowadays an essential component of AI. These interpretability techniques help surface hidden biases, support ethical auditing, and are increasingly mandated under regulations like the European Union's AI Act, which requires transparency and accountability in high-risk AI applications.

INTEGRATING IMMERSIVE REALITY TECHNOLOGIES IN MODERN MANUFACTURING PROCESSES – TRANSITION TOWARDS INDUSTRY 5.0

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ABSTRACT

Immersive reality technologies, including Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), are rapidly reshaping modern manufacturing by enhancing efficiency, accuracy, ergonomics, and collaboration. As industries transition from the technology-driven paradigm of Industry 4.0 to the human-centric, sustainable, and resilient vision of Industry 5.0, immersive technologies become critical enablers for bridging this evolution. This presentation explores the practical integration of immersive reality in manufacturing processes, focusing on computer-aided design optimization, augmented reality-supported assembly and maintenance, and ergonomic improvements through human-robot collaborative systems. Drawing from recent research and real-world implementations, case studies highlight how immersive technologies not only advance industrial productivity but also prioritize human wellbeing and environmental sustainability. The discussion also addresses current challenges and opportunities associated with this technological transition, outlining pathways for future innovation in manufacturing. The insights provided aim to equip industry professionals and researchers with the knowledge to effectively leverage immersive technologies in pursuit of Industry 5.0 objectives

FUNDAMENTAL SCIENCES

SPECTROPHOTOMETRIC DETERMINATION OF THE CONCENTRATIONS OF PYRANINE COMPONENTS IN A TERNARY MIXTURE

ADRIAN WEISZ[1], SORINA GABRIELA ȘERBAN[2], MARIA LAURA STRUGARIU[3], SIMION JITIAN[4]

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ABSTRACT

The purpose of this study was to determine the concentrations of components in a ternary mixture of pyrene dyes. Pyranine (D&C Green No. 8) is a mixture of three pyrene dyes consisting of the main dye trisodium 8-hydroxypyrene-1,3,6-trisulfonate and contaminants formed during its synthesis: trisodium pyrene-1,3,6-trisulfonate and tetrasodium pyrene-1,3,6,8-tetrasulfonate. The zero-order UV-vis spectra of these dyes were used in the spectral range of 190-500 nm. An original spectrophotometric method was used to determine the concentrations of the components of the ternary mixture of pyrene dyes. This is based on the observation that there is a spectral region in which only the main component has a significant absorption compared to the absorptions of the contaminants. Thus, the concentration of the main component can be determined independently of the presence of the other two dyes in the ternary mixture. The impurities in the mixture have a very low absorption at 404 nm compared to that of the main dye. The concentration of the main dye trisodium 8-hydroxypyrene-1,3,6-trisulfonate was determined using the direct absorbance method using the slope and intercept of the linear calibration curve of the standard solution at 404 nm. Subsequently, the concentrations of trisodium pyrene-1,3,6-trisulfonate and tetrasodium pyrene-1,3,6,8-tetrasulfonate were determined using the bivariate spectral calibration method. The novelty of our work lies in finding a method for determining the concentrations of components in a ternary mixture for which there is a high degree of overlap of UV-vis absorption bands.

TECHNOLOGICAL ARCHITECTURE AND MATHEMATICAL MODELING OF DIGITAL SOLUTIONS FOR GREEN FINANCIAL PRODUCTS

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ABSTRACT

This article explores the role of digital technologies in enhancing the accessibility, transparency, and efficiency of green financial products. It analyzes the dynamics of green bond issuance in emerging markets between 2014 and 2023, identifies key development stages, and highlights barriers that hinder the expansion of green finance. Particular attention is given to the potential of blockchain technologies, eco-tokens, and green cryptocurrencies to overcome these barriers by introducing innovative investment mechanisms and improving verification and liquidity processes. A specialized blockchain-based technological architecture for green financial instruments is proposed, comprising infrastructure, protocol, application and integration layers tailored to environmental objectives. A mathematical modeling framework is developed to quantify the efficiency improvements achieved through digitalization, focusing on accessibility, verification efficiency, liquidity enhancement, and environmental-financial alignment. The conducted analysis demonstrates that digital solutions can significantly improve the ecological and financial performance of green financial instruments, especially in emerging economies. Technical recommendations are provided for building energy-optimized infrastructures, standardizing environmental verification protocols, integrating blockchain platforms with monitoring systems, and implementing regulatory technology solutions. The findings emphasize the critical importance of digital innovation in accelerating the green transition, expanding access to sustainable financial resources, and achieving sustainable development goals in the global economy.

ACCURACY OF TERRAIN DETAIL LOCATION IN LOW-ALTITUDE PHOTOGRAMMETRY

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ABSTRACT

Article describes the geodetic post-construction inventory of building structures on the example of expanding the building with an additional floor. The received design for the addition of a floor for the educational complex was analyzed and a control measurement of the entire teaching building was made. Differences in the corners coordinates and the frontal measures between the real and projected data were calculated. They were also presented the encountered problems related to the correct delineation of the axis of the third floor if the building. Geodetic determining the storey axis and columns corners is described. Discrepancies were found in the number of building corners and the values of the frontal measures of building edges. It was found that it was impossible to implement the received construction project and that the map for design purposes was incorrectly prepared by the previous surveying service.

LINEAR DISCONTINUOUS DEFORMATIONS AND BUILDING DAMAGES

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ABSTRACT

The subject of the article is related to the observation and analysis of changes in the values of building deformations (horizontal deviations) due to the occurrence of linear discontinuous deformations of the ground surface (ground steps and thresholds) near and under the buildings. The paper analyzes research material from 9 residential buildings, 43 measurement points and 11 linear deformations. The aim of the research is to attempt to determine the relationship between the geometric parameters of linear discontinuous surface deformation (length and height and the angle of the fault/slip plane) and the values of the building deviations observed along its horizontal, transverse and longitudinal axes. Studies have shown that the greatest influence on the values of the building's deviations is the height of the ground step, followed by its angle of inclination.

ECONOMIC ASSESSMENT OF POLLUTION IMPACT ON FORMATION OF SUSTAINABLE FINANCING STRATEGIES FOR ENTERPRISES

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ABSTRACT

The article addresses the pressing issue of determining the economic impact of environmental pollution on the formation of sustainable financing strategies for enterprises. The paper develops a methodological approach to quantitative assessment of the relationship between environmental risks and financial indicators of business entities. An integrated assessment model is proposed that combines environmental-economic parameters of pollution with key financial indicators. Traditional financial models (DCF, WACC) have been modified by incorporating environmental factors, enabling more accurate forecasting of financial results under intensifying environmental challenges. Based on empirical research of 45 enterprises across various economic sectors for 2019-2023, the impact of pollution on return on assets, cost of capital, and investment attractiveness has been quantitatively assessed. A statistically significant relationship between emission levels and financial indicators has been identified: a 10% increase in emissions leads to an average 0.15 decline in ROA. A typology of sustainable financing strategies (environmental transformation, gradual ecologization, environmental improvement, and environmental leadership) has been developed, and mechanisms for their implementation have been defined. A set of sector-specific recommendations for implementing sustainable financing strategies has been proposed, with effectiveness confirmed by pilot implementation results at enterprises in various sectors (15-22% reduction in environmental payments, increased investment attractiveness, reduced cost of capital). The obtained results create a methodological foundation for integrating environmental parameters into enterprises' financial strategies and contribute to achieving sustainable development goals.

BUILDING A MODEL OF THE DEPENDENCE OF THE LEVEL OF ATMOSPHERIC AIR POLLUTION BY DUST ON WEATHER FACTORS

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ABSTRACT

The article is devoted to building a model of the dependence of the pollution level on weather factors based on a database of constant observations of the state of atmospheric air within the Ivano-Frankivsk region of Ukraine. To obtain representative data for the model, we compared the results of the analysis of atmospheric air quality from different posts located in a clean recreational area, in the urbanized area of the city, within the zone of influence of a large thermal power plant and within the zone of influence of a woodworking enterprise. A trend of PM10 and PM2.5 concentrations was obtained for different posts within the same type of territory. In particular, in the city for two posts parallel dynamics are observed, but with different intensity, which allows developing a model for assessing the anthropogenic component of dust pollution. Based on the data obtained for the territory, it was proven that the natural component of PM10 content is greater than the anthropogenic one. A generalized mathematical model of air quality forecasting was developed in a normalized form, which takes into account the influence of meteorological parameters on changes in dust particles in atmospheric air. It was found that an increase in temperature and atmospheric pressure is associated with an increase in the concentration of dust particles. Humidity also has a positive effect, but much weaker. These results can be useful for modeling air quality forecasting taking into account meteo-corrected pollution indicators.

ELECTRICAL ENGINEERING

USE OF PHOTOVOLTAIC SYSTEM DESIGN SOFTWARE

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ABSTRACT

The need to reduce electricity consumption, combined with the financial support provided by the governments of various European states in the installation of electricity production systems from renewable sources has led to an increase in the number of prosumers. In the case of household consumers, photovoltaic systems located in different spaces or on the ground have been widely implemented. The paper presents a case study in which, for the design of photovoltaic systems, four dedicated software were used: PVGIS, K2 System, Sunny Design and SmartDesign. It was decided to design a photovoltaic system that will be located on the roof of a building facing south. The results obtained prove the efficiency of the design and simulation applications in estimating energy production and the need to combine those software's for the design of the PV system as well as the mounting structure. From the analysis carried out, the PV design software tools showed that the implementation of such a system would pay for itself in 6.5 years.

ELECTROMECHANICAL SAFETY ASSESSMENT OF NATIONAL MINING SYSTEM – LUPENI MINE CASE STUDY

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ABSTRACT

Electromechanical safety assessment at underground mines is essential for preventing work accidents and ensuring the efficient operation of electromechanical equipment. It involves several aspects: National and international regulations and standards (norms, safety and anti-explosion standards and directives), Electromechanical risk factors (hazard of explosion, electromechanical failures and insufficient ventilation), Electromechanical safety measures (safe electromechanical equipment, preventive maintenance and protection and monitoring systems), Safety assessment and auditing (periodic assessments and audits testing and simulations and training of mining personnel). The implementation of an efficient electromechanical safety system can prevent work accidents and ensure the continuous operation of underground mines. The methods of extraction of coal very old, corroborated with the non-compliant electromechanical mining infrastructures and installations, with high risk of injury and professional illness from Lupeni Mine, it can endanger the proper functioning of the mine and implicitly the life of underground personnel in every working day. Poor working conditions, lack of non-compliant materials or materials do not agree with safety and security at work, and the carelessness of the decision-makers makes this mining operation a major factor of insecurity and accidents at work. In this paper, the authors assessed the risk of injury and professional illness in Lupeni Mine and proposed recommendations on stopping, mitigating or eliminating electrical risks.

ON THE USE OF LOW VOLTAGE POWER FACTOR CONTROLLER IN TEXTILE INDUSTRY

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ABSTRACT

Paper presents a practical solution to improve power factor in a textile plant substation using a power factor controller with six capacitors banks. A wireless signaling installation was developed to display the capacitor banks connection to the substation's grid. The power factor controller was implemented into practice. Experimental measurements were made with a power quality analyzer operating in three cases: one case without regulator and other two cases with regulator (one with an unexpected fault in the system and one without fault). It was found that the use of six capacitors banks with the same large value, is not the right solution to obtain a fine adjustment of reactive power in low voltage electric grid.

ON CURRENTS ASYMMETRY PROTECTION FOR THREE-PHASE LOW VOLTAGE INDUCTION MOTORS

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ABSTRACT

The article presents an analysis of asymmetric currents protections for general-purpose three-phase low voltage induction motors. Dedicated electronic protection is provided to detect currents asymmetry on the motor phases. An electronic asymmetry protection with Hall transducers, AC current to DC voltage electronic module, low capacity PLC, and motor's power contactor has been developed. Experiments with industrial electronic asymmetry protection, an electronic module and FBD program for PLC of the proposed protection that are used for currents asymmetric protection are presented.

TRENDS IN RENEWABLE ENERGY GENERATION CAPACITY: A COMPREHENSIVE ANALYSIS OF THE ROMANIAN

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ABSTRACT

This article provides an in-depth examination of the recent developments in renewable energy generation capacity in Romania, specifically during the period from 2020 to 2024. Utilizing the most recent data from national energy reports, Eurostat, and the International Energy Agency, the research assesses advancements in the wind, solar, hydro, and biomass sectors. A mixed-method approach, which integrates statistical time-series analysis with policy evaluation, is employed to investigate the effects of the European Green Deal objectives, funding for post-pandemic recovery, and the evolving national energy strategies. The findings reveal a significant increase in solar photovoltaic installations and a revival of wind energy projects, driven by enhanced investment conditions and revised regulatory frameworks. Nevertheless, obstacles persist regarding grid capacity, permitting processes, and the stability of long-term policies. The study underscores the necessity for strategic upgrades to infrastructure and consistent policy support to ensure that Romania's energy transition aligns with the EU's decarbonization goals.

COMPUTER ENGINEERING

STUDENT ASSESSMENT USING EDITING DISTANCE AND KEYWORDS MATCHING

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ABSTRACT

This paper presents an automated assessment model that is based on assessment tests formed of Short-Answer Items (SAQ). This type consists in a textual answer with a given maximum length. In order to compare the correct answer with the one given by the student, an algorithm that computes the editing distance (also known as Levenshtein distance) between the two answers and the existence of given keywords (semantic tags) is used. Within the model, an item is considered to be answered correctly if the obtained editing distance is inferior to a threshold and the answer contains a set proportion or specific semantic tags. The model will also include the analysis of the optimal way of inputting the needed data by a user by introducing descriptive non-technical requirements. In this matter, the threshold for the editing distance and the usage of semantic tags will be established using natural language-based descriptors (e.g., scales, fuzzy, proportions), offering an intuitive non-technical modality of inputting data that is later mapped to the edit distance and required keywords. In order to implement the described model, a web application can be created. This web application extracts the items and the values needed in the assessment process from a database and computes the result automatically. The obtained data is then stored to be further analyzed by an assessor or using an automated learning method.

IMPORTANCE AND APPLICATION OF INFORMATION TECHNOLOGIES IN COMPANY BUSINESS

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ABSTRACT

The paper analyzes and investigates important aspects of the use and importance of information systems in companies in Bosnia and Herzegovina. Information systems play a key role in all aspects of business, from data and information management to process automation, communication and decision support. Information systems play an important strategic role in the business of an organization. Research on the use of information systems in Bosnia and Herzegovina companies can be of great importance for improving the quality of customer service, increasing efficiency, productivity, improving the competitiveness of the organization, the quality of decision-making and data analysis for the purpose of improving business, implementing new information systems in organizations, etc. The aim of the paper is to analyze, investigate and determine how often information systems are used in Bosnian and Herzegovina companies and present the level of use of information systems in use, their advantages and other things. For the purposes of this research, a survey was conducted for 81 companies in Bosnia and Herzegovina.

SMART CITIES AND IOT: REVOLUTIONIZING WIRELESS SENSOR NETWORKS THROUGH RENEWABLE ENERGY HARVESTING

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ABSTRACT

Smart cities leverage Internet of Things (IoT) technology to enhance urban management, including reducing pollution, improving public safety, and streamlining infrastructure management such as roads and bridges. This integration of IoT solutions is making smart cities a reality as they grow and evolve. A potentially inexpensive source of power, the environment wastes a lot of energy that could be turned into electricity to power the numerous circuits. In the environment, there is a lot of wasted energy that can be converted into electricity to power the various circuits and represents a potentially cheap source of power. Energy harvesting is significant because it provides an alternate power source for electronic equipment in situations where traditional energy sources are unavailable. When used in a wireless sensor network (WSN) and Internet of Things (IoT) device, this technology will reduce maintenance costs, do away with cables and batteries, and be environmentally friendly. It will also do away with the need for network-based energy and traditional batteries. It offers the same benefit in applications from far-off regions, underwater, and other challenging-to-reach areas where traditional energy sources and batteries are ineffective. Energy harvesting is a crucial technique for creating sustainable societies and smart cities of the future since it will encourage eco-friendly technologies that save energy and lower CO2 emissions. In response to the energy issues, we go over the fundamentals of energy harvesting in this article and talk about the different uses of this technology in situations where conventional batteries aren't an option.

ADVANCED MACHINE LEARNING MODELS FOR BANANA SWEETNESS CLASSIFICATION

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ABSTRACT

It takes a lot of time to classify the banana slices by sweetness level using traditional methods. By assessing the quality of fruits more focus is placed on its sweetness as well as the color since they affect the taste. The reason for sorting banana slices by their sweetness is to estimate the ripeness of bananas using the sweetness and color values of the slices. This classifying system assists in establishing the degree of ripeness of bananas needed for processing and consumption. The purpose of this article is to compare the efficiency of the SVM-linear, SVM-polynomial, and LDA classification of the sweetness of banana slices by their LRV level. The result of the experiment showed that the highest accuracy of 96.66% was achieved by the SVM-polynomial algorithm, while the lowest 86.66% by LDA algorithm. The SVM-linear also has an accuracy of 90%. The study showed how machine learning algorithms can be used to classify banana slices according to their sweetness.

OFFLINE ROBOT PROGRAMMING - A TOOL FOR EFFICIENT ROBOT IMPLEMENTATION IN INDUSTRIAL PRACTICE

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ABSTRACT

The utilization of a robot with six degrees of freedom in kinematic applications poses significant challenges, primarily attributable to its intricate kinematic structure and extensive range of potential applications. The trajectory of the robot, delineated by predetermined points, is contingent upon the coordinate systems of the machine, the tool, and the user. The execution of movements is predicated on a priori motion typologies, including linear, arc, and articulated motion. Each robot manufacturer utilizes a distinct programming algorithm, which necessitates a high degree of adaptability. For users lacking experience with industrial robots, this implies substantial variability not only between brands and applications but also among robot types within the same brand. Offline programming facilitates the design of robot trajectories on a computer without compromising the continuity of the production process. This approach enables the proactive development of robot programs, thereby enhancing overall productivity. In addition to enhanced time management and robot availability, offline programming plays a substantial role in ensuring operational safety by mitigating the risk of accidents in a virtual environment. The implementation of programming and testing in a virtual space eliminates the requirement for comprehensive hardware configurations and circumvents the necessity to suspend production operations for the purpose of software uploads. However, offline programs must undergo verification and debugging using data from the robot's actual working environment to ensure operational safety. In essence, the implementation of offline programming enhances the efficiency and flexibility of robotic systems in industrial applications, thereby reducing the time required for implementation.

MECHANICAL ENGINEERING

KINEMATIC ANALYSIS OF SLIDER-CRANK MECHANISM IN SOLIDWORKS

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ABSTRACT

The slider-crank mechanism converts the circular motion of the leading element into a translation of the driven element. It has numerous applications, including the actuation of structural analysis. The position parameters represent the linear displacements of the specific points of the component. The kinematic parameters of the mechanism are the linear velocities and accelerations calculated by analytical equations and generated by SolidWorks Motion software.

SIMULATION OF LOSSES IN A GEARBOX WITH AND WITHOUT ANTI-FOAMING PROTECTION

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ABSTRACT

The anti-foaming protection is designed to prevent the oil from overheating due to intense oil churning and to reduce torque losses. The simulation will be performed on gearbox housing in the SolidWorks Flow module in two variants: without anti-foaming protection and with anti-foaming protection, both for 3 values of the speed: 1000, 1200, 1400 rpm and 3 values of the oil height: 70, 100, 126 mm. The aim of the paper is to quantify the losses in the gearbox housing for different values of speed and oil level.

ON THE INFLUENCE OF MECHANICAL PROPERTIES OF ALUMINUM ALLOYS ON THEIR RESISTANCE TO CAVITATION EROSION

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ABSTRACT

In this paper, the trends of individual influence of the main mechanical properties (mechanical tensile strength, yield strength, surface hardness, elongation at break and resilience) on the cavitation resistance parameter (Rcav) are analyzed, using correlation diagrams of the two. These diagrams are constructed based on the results of behavior and resistance to cavitation erosion, obtained on four categories of aluminum alloys (7075, 5083, 6082, 2017A) in the framework of research carried out on the standard vibratory apparatus. The averaging curves of the correlated values, in these diagrams, show the trend of the individual influence of each of these properties and can serve for more detailed fracture analyses, carried out based on microscopic images (SEM), regarding the causes that determine the resistance of the structure to cavitation erosion and the mechanisms of deformation and rupture at the macro and microstructural level.

BRIDGING ENGINEERING MECHANICS THEORY AND MECHANICAL ENGINEERING PRACTICE: A SIMULATION-DRIVEN AND INTERACTIVE LEARNING APPROACH

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ABSTRACT

The continuous advancement of digital technologies has created new opportunities to enhance engineering education, particularly in bridging the gap between theoretical concepts and practical applications. This paper presents a simulation-driven and interactive learning approach aimed at enhancing the teaching of Engineering Mechanics in Mechanical Engineering education. Emphasis is placed on the integration of Open Educational Resources (OER) and academic free-access versions of specialized Engineering Software as key tools in bridging theoretical understanding with practical skills. Interactive learning software, educational games, animated learning tools, and simulation environments—are explored for their potential to promote engagement and conceptual clarity. The study also focus educational application of tools like Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD), and structural or modal analysis software, which enable students to visualize mechanical behavior and conduct virtual experiments. Examples of best practices highlight how these accessible resources support active learning and strengthen students' readiness for real-world engineering tasks. The findings underline not only the pedagogical value but also the sustainability and scalability of integrating OER and academic free-access digital tools into modern Mechanical Engineering curricula.

CFD STUDY ON THE AERODYNAMIC INTERACTIONS OF A TRUCK IN HIGHWAY TRAFFIC CONDITIONS

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ABSTRACT

This study presents a computational fluid dynamics (CFD) investigation into the aerodynamic drag variations experienced by a truck during highway overtaking maneuvers, using ANSYS Fluent as the simulation platform. Two overtaking scenarios are analyzed: a truck being overtaken by a passenger car, and by an identical truck. Unsteady Reynolds-Averaged Navier–Stokes (RANS) simulations are employed to capture the transient aerodynamic interactions between the vehicles. The focus is placed on the time-resolved drag coefficient of the overtaken truck throughout the overtaking sequence. Results reveal significant fluctuations in aerodynamic drag, influenced by the relative position and geometry of the overtaking vehicle. The truck–truck interaction leads to more pronounced aerodynamic interference and larger drag variations compared to the car–truck case. These findings underscore the importance of accounting for transient aerodynamic effects in the design and operation of heavy vehicles. The study contributes to improved understanding of drag behavior in realistic highway scenarios, with implications for fuel efficiency, vehicle performance, and road safety.

OFF-LINE MONITORING AND MEASUREMENTS OF TOOL WEAR WITH SINGLE POINT CUTTING EDGE

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ABSTRACT

Turning is one of the most common machining operations in the production of new components. This operation was performed with single-edged cutting tools called turning tools. During a machining operation using a single-point cutting tool, the main cutting edge of the cutting tool performs most of the cutting, being susceptible to the following types of wear: corner wear, flank wear, and notch wear. Flank wear is of greatest interest because it is the most widely used criterion in determining cutting tool durability. The objective of the work is to monitoring and evaluation the flank wear by performing measurements based on off-line methods using different parameters for the turning regime. The experimental strategy consists of orthogonal turning by changing the cutting speed, the feed and cutting depth being constant. In each experiment, the flank wear of the tool is determined using optical microscopy, measurement and control instruments. The thermal regime in the cutting zone was also monitored using a thermal imaging camera and the resulting chips were collected, photographed and stored for further analysis. The conclusions obtained showed that flank wear is a consequence of thermo-mechanical effects in the cutting zone.

DIGITAL MATURITY OF SMEs

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ABSTRACT

Small and medium-sized enterprises, particularly, are slowly moving forward with digitalization. Surveys reveal that Just over a quarter of businesses (27%} are digitizing. Although the proportion of businesses digitizing is growing slowly, there are positive movements in enterprises. Companies are gathering information, building implementation teams, and preparing digitization strategies. To assess the digital maturity of enterprises and their processes, a detailed methodology is needed to collect specific data in relevant areas and evaluate the data itself. The method for assessing digital maturity concerns enterprises belonging to the category of small and medium-sized enterprises operating in the industrial sector. The assessment includes the different categories of processes whose level is assessed. Such process categories include the pre-production stages, such as customer communication, enquiry; bidding, ordering, product design, production technology development, and warehousing. Among the production stages are production planning, production control, the actual production processes, quality, maintenance, logistics and dispatch. Then, there are the economic processes, workflow, and project management The output of such an assessment is a graphical evaluation of digitization in the form of a process map from which the level of digitization of the main business processes can be read. The assessment results can serve as a basis for management to develop strategies, identify strengths and weaknesses and give a comprehensive view of the business processes.

IMPLEMENTATION OF INFORMATION SYSTEMS IN THE MANAGEMENT OF SMALL AND MEDIUM-SIZED ENTERPRISES

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ABSTRACT

In today's dynamically changing business environment, information systems are integral to effective, business management. Their importance is growing, especially in the context of small and medium sized industrial enterprises that face specific challenges. They are exposed to intense competition in domestic and international markets, face pressure to innovate their products and services continuously and must adapt quickly to constantly changing market conditions. The implementation of appropriate information systems is crucial for these enterprises. These systems enable managers and employees to process and analyse large amounts of data efficiently, leading to better decision-making at all levels of management. Through information systems, enterprises can optimize their production processes, which include production planning, inventory management, quality control and logistics. This reduces costs, minimizes errors and increases the overall efficiency of the business.

INFLUENCE OF THE VOLUME FILLING STRUCTURE OF 3D PRINTED PARTS ON THEIR STRENGTH

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ABSTRACT

This study presents an experimental analysis of the impact of infill structure on the mechanical properties of 3D-printed components. Test specimens with selected infill patterns were fabricated using FDM technology and subjected to tensile, compressive, and shear tests. A functional part used for ball distribution was chosen to simulate real operational loading conditions. The results demonstrate a significant influence of infill geometry on the strength and deformability of printed parts. Optimized infill structures can substantially improve mechanical performance with minimal increase in material consumption. The findings offer a basis for more efficient design of 3D-printed components, balancing functional requirements with economic manufacturing considerations.

APPLICATIONS OF BIOCHAR IN THE TREATMENT OF USED ENGINE OIL. CASE STUDY: IMPACT ON THE OIL VISCOSITY

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ABSTRACT

This article focuses on the potential of biochar as a treatment for used engine oil, specifically examining its impact on oil viscosity. Used engine oil poses significant environmental risks due to its toxic components. Biochar, a carbon-rich material with high surface area and versatile surface chemistry, has shown promise in various environmental remediation applications. The study investigates how biochar interacts with used engine oil, particularly in altering its viscosity by adsorbing contaminants and improving oil-water separation. By exploring the physicochemical properties of biochar and its potential to support bioremediation and catalysis, this review highlights its role in modifying the viscosity of used engine oil. The findings suggest that biochar may offer a sustainable and effective solution for improving oil properties, thereby providing environmental and economic benefits. Further experimental studies are needed to validate these findings and optimize biochar-based treatments for real-world applications.

DEVELOPMENT OF THE ROLLFORMING PROCESS FOR STORAGE RACK LEGS

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ABSTRACT

Storage rack legs are made of various materials and using various technologies. The selection of the appropriate material and technology depends on many factors such as: production volume, storage rack load capacity, purpose, etc. In the case of using steel legs, their production technologies may also be different. In the case of storage racks with a high load-bearing capacity, mainly cold-bent profiles (usually angle bars) are used. In the case of medium and lower load capacities, attempts are made to additionally shape the storage rack leg in order to obtain greater stiffness with the lowest possible weight. In this paper an attempt was made to develop a rollforming process for storage rack legs characterized by variable thickness and panel construction. For each profiling section, roll shapes were proposed and the profiling process was simulated using the Simufact Forming program. As part of the simulation, the forces acting on individual sections of the profiling roller sets and the shape of the storage rack legs were obtained similar to the previously assumed shape. The research results were obtained as part of the project titled: Opracowanie procesu produkcji i konstrukcji regału z panelowymi półkami metalowymi" implemented by Metalkas S.A. based on contract number POIR.01.01.01-00-0502/18. The project was co-financed by the Europejski Fundusz Rozwoju Regionalnego, w ramach Działania 1.1 Projekty B+R przedsiębiorstw. Poddziałanie 1.1.1 Badania przemysłowe i prace rozwojowe realizowane przez przedsiębiorstwa Programu Operacyjnego Inteligentny Rozwój 2014-2020.

DRIVER POSTURE ANALYSIS USING CAPTIV T-SENS MOTION SENSORS

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ABSTRACT

Proper driving posture is essential for ensuring both the health and safety of drivers. However, many drivers underestimate its importance, which can lead to long-term health issues such as back pain, muscle stiffness, and other musculoskeletal disorders. Beyond health implications, poor posture can impair concentration and reaction time in critical situations, directly affecting road safety. Promoting and understanding correct posture is therefore vital to mitigating these risks. This paper explores the use of TEA motion sensors and CAPTIV software to analyze driver posture and movement with high precision, offering valuable data for the development of effective ergonomic interventions. This advanced technological approach marks a significant improvement over traditional posture assessment methods.

ACOUSTIC COMFORT ASSESSMENT IN DIFFERENT HEAVY TRUCKS

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ABSTRACT

This paper presents an experimental investigation into the acoustic comfort of heavy trucks, both inside the cab and in the external environment, under various operating conditions. The study begins with measurements taken using a calibrated sound level meter, followed by comparative data collected via an Android application. In the initial phase, sound levels are recorded while the trucks are idling, followed by a second phase of measurements conducted under load conditions. Measurement devices are positioned sequentially—first inside the cab at the operator's ear level, then externally. Analysis of the results indicates that the trucks' equipment significantly influences sound generation and propagation, affecting both external noise emissions and in-cab acoustic comfort.

EXPERIMENTAL STUDY ON CO_2 DETECTION IN INDOOR ENVIRONMENTS

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ABSTRACT

Indoor air quality monitoring, essential for maintaining healthy environments and for setting appropriate corrective measures, can be carried out using dedicated sensors or laboratory testing to detect pollutants such as CO_2 . This paper presents experimental results on CO_2 concentration in various indoor settings. The environmental measurements support efforts to position high-performance CO_2 sensors on the European market and align with current trends in sensor development. Sensor performance and inter-device consistency were evaluated using three devices: Sensors Europe GmbH – AGM50, Greisinger EBG-CO2-1R, and the experimental Nattive-Senz INO-SEN CO2.

SUSTAINABLE WASTE MANAGEMENT PRACTICES IN RAIL TRANSPORT

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ABSTRACT

Waste management in the railway sector is a critical component for ensuring the sustainability and operational efficiency of rail transport. This study investigates contemporary methods and practices for handling waste generated by railway operations, including collection, sorting, recycling, and environmentally responsible disposal. Implementing comprehensive waste strategies reduces environmental impact and enhances passenger safety and comfort. The research emphasizes the need for coordinated efforts among railway authorities, transport operators, and environmental agencies to develop an integrated system capable of addressing current challenges and advancing sustainable practices in the sector.

JUSTIFICATION OF THE USE OF UNIVERSAL HOUSING IN THE MANUFACTURING OF SINGLE-, TWO-, AND THREE-STAGE UNIVERSAL GEARED MOTOR REDUCERS WITH EXTERNAL HELICAL GEARS

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ABSTRACT

This paper discusses the potential application of a universal housing for the production of single-, two- and three-stage motor reducers, along with the possible advantages and disadvantages of using the same load capacity across all these reducer variants. Utilizing a uniform load capacity undoubtedly expands the range of motor sizes that can be coupled with a single reducer, which in turn requires the production of motors with a greater number of different flanges, or the use of adapters for IEC motors with similarly varied flanges. Naturally, within the scope of small reducer sizes, it is unnecessary to use multiple motor sizes, as the reducers become oversized at higher transmission ratios. The same applies to larger reducer sizes, where single-stage reducers are not manufactured since large motors typically cannot be supported by the reducer housing to which they would need to be attached.

ADVANTAGES OF USING UNIVERSAL GEARED MOTOR REDUCERS WITH EXTERNAL HELICAL GEARS

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ABSTRACT

It is undeniable that in large-scale production, special-purpose reducers are increasingly being used instead of universal ones, which is certainly a cause for concern among manufacturers of universal reducers. However, in many applications, universal reducers are practically irreplaceable, as their various configurations - adapted for different mounting forms and positions - can meet nearly all customer requirements at an acceptable cost. This paper highlights the main advantages of using universal geared reducers with external helical gears.

APPLICATION OF INTRPRETATIVE STRUCTURAL MODELLING FOR INDETIFING CRITICAL FACTORS IN SUSTAINABLE ENERGY PLANNING HYDROPOWER PROJECTS

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ABSTRACT

The paper presents the analysis of interrelationship among criteria for sustainable planning project solutions in construction of small hydropower plants (SHP). In the literature we can often find an approaches which include only technical, economic or environmental aspects. In order to ensure sustainable decision-making process in selecting the most acceptable SHP projects the criteria of all approaches must be identified and the analysis must include all these aspects.

Criteria in the paper were identified through a review of the literature, as well as through the advice of experts in the access areas. Contextual relationships among these criteria have been identified and Interpretative Structural Modelling (ISM) technique and the MICMAC analysis has been developed. ISM was used to identify hierarchy structure of all factors while MICMAC analysis has been used for classification criteria based on dependence and driving power.

In this regard, the main goal of this study is to establish a theoretical and methodological approach for decision makers to investigate influencing factors and major insights into relationship between analyzed factors. The analysis showed that the criteria Flow pattern and amount of flow, Annual flow and Installed capacity, have the greatest driving force.

M4.0 TO ENHANCE THE SAFETY AND SUSTAINABILITY OF NAVAL OPERATIONS IN THE BLACK SEA BASIN

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ABSTRACT

Global economic growth is triggering the expansion of the world fleet, raising legitimate concerns about the sustainability of this transportation, which is responsible for conveying around 90 percent of global trade.

Maritime 4.0 (M4.0) has its roots in the Industry 4.0 concept and is responsible for implementing and integrating digital operations and automation in shipping.

The paper focuses on how innovative technologies can improve safety and environmentally friendly naval operations in a sea basin like the Blake Sea, which is fragile due to pollution from ships and has a complicated security picture.

The article investigates specific components of M4.0, such as smart ports, digital shipyards, or Shipyard 4.0, the employment of IoT—Internet of Things, AR—augmented reality technologies, unmanned vehicles, or sensors, highlighting their contribution to enhancing safety and green operation in the context of the actual security climate of the Black Sea and the international regulations in the field. The paper also underlines the possibility of integrating innovative technologies in shipping decision-making. It identifies some of the current gaps in its implementation within the aforementioned sea basin.

A TECHNICAL ANALYSIS REGARDING THE USE OF AUTONOMOUS SHIPS IN THE BLACK SEA BASIN

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ABSTRACT

The latest developments in the maritime industry, encompassing AI—Artificial Intelligence and autonomy in ships' operations area, have sparked the interest of ship owners and shipbuilders in innovation and competitiveness.

For a surface ship, autonomy is not merely using an uncrewed sea vehicle; the vessel's autonomy implies more systems and functions, like collision avoidance, workload management, or remote monitoring functions, meant to enhance safety and shipboard efficiency.

The article is focused on the gains of using autonomous ships in the Black Sea basin, a body of water with a military conflict, sea-deriving mines, pollution constraints, and international regulations concerning the ship's emissions cap or other related MARPOL's convention provisions.

The paper analyses the energetic aspects of autonomous ship operation and its contribution to sustainable and safe operation but sheds some light on the drawbacks regarding the resilience of the operators, the lack of required port and sea infrastructure to facilitate such operations, and the actual regulatory framework in the field.

The concluding part draws attention to the future developments necessary to allow the safe and sustainable operation of autonomous surface ships in the Black Sea basin.

COMMON ACCURACY PROBLEMS WHEN TURNING LARGE-PITCH THREADS

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ABSTRACT

In reality, the most widely used large-pitch threads are in lead screws and in the joints of drill and casing pipes in oil and gas wells. The common profile of such threads is trapezoidal with a profile angle of 60 deg. and straight sides. In the process of turning such threads that have a fairly large pitch - from 4 to 10 mm, there is a need to use a special angle of inclination of the cutting edge of the thread cutter. This need has a purely technological basis - compliance with the suitability of the tool to be sharp. However, in this case, deviations occur in the manufactured thread, sometimes so significant that they can cause inaccuracy of the profile angle and reach half the tolerance, i.e. 0.25 deg. The second half of the tolerance will remain due to other factors of deviations: vibration, inaccuracy of the workpiece installation, inaccuracies of the machine itself, tool wear, etc. To prevent such inaccuracy, a detailed analytical approach was carried out to obtain the functional dependence of the lateral profile of the trapezoidal thread on the thread elevation angle (i.e., the angle of the cutting edge of the tool) and the thread diameter. The applied software application, which is based on the analytical approach, makes it possible to predict the magnitude of the deviation of the thread produced by turning and thus avoid substandard products. In the case of too large deviations of the thread profile, the article presents a developed algorithm that determines the cutter profile, which is not equal to the thread profile, but allows increasing its accuracy.

HIGH CAPACITY INTERCOOLER'S MODELING FOR OPTIMIZATION AND IMPROVING PERFORMANCES

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ABSTRACT

The high capacity intercooler of an ALCO V16 Marine Diesel Engine is modelled based on the original design in order to validate the working parameters and further, to improve the performances through an extended and complete CFD analysis, with ANSYS Fluent software. The new design and optimisation results will replace the old equipment, in order to increase the engine power and lower the polutants.

MATERIALS ENGINEERING

EXPERIMENTAL DETERMINATION OF THE MECHANICAL CHARACTERISTICS OF MICRO-REINFORCED CONCRETE

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ABSTRACT

The factors representing the physical, mechanical, and structural characteristics of micro-reinforced concrete, which influence its resistance to pressure, bending, tension, or dynamic impact loading, have not been sufficiently investigated. The resistance of micro-reinforced concrete has been partially addressed by the global research community, yet there remains significant potential for further investigation. This paper explores the possibilities of achieving improved physical and mechanical characteristics of micro-reinforced concrete through variations in the amount of steel fibers used in the concrete mix. The physical and mechanical properties of the resulting micro-reinforced concrete, in both fresh and hardened states, were compared to those of concrete made without the addition of microfibers, while maintaining the same basic recipe for both traditional and micro-reinforced concrete. For research purposes, a type of concrete with a consistent matrix was prepared for all samples (aggregate, cement, water, and additives), and three different quantities of steel fibers were incorporated at 0.3%, 0.5%, and 1% of the total concrete mass. The selected amounts of fibers significantly influenced the quality of the physical and mechanical characteristics of micro-reinforced concrete.

EXPERIMENTAL RESEARCH OF THE TENSILE PROPERTIES OF FRP REINFORCEMENT PRODUCED WITH E-GLASS FIBERS

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ABSTRACT

Reinforced concrete is still the most common material for construction. However, RC structures have disadvantages such as high self-weight and corrosion of steel reinforcement, especially if the construction is in an aggressive environment. In this regard, this research is a contribution to the application of non-metallic materials such as FRP (Fiber Reinforced Polymer) for reinforcing concrete structures. The aim of this research is to determine and analyze the influence of E-Glass fibers on the mechanical properties of FRP bars with a nominal diameter of 8 mm based on experimental testing, as well as to explore the potential for their application in concrete structures.

SURFACTANT INFLUENCE ON HIGH LOADED NANOFLUIDS: A STUDY ON THERMAL EFFUSIVITY

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ABSTRACT

Nanofluids are at the forefront of many industries with relevant applications in heating and cooling processes. As was noticed from the state of the art, one of the main drawbacks of nanofluids is their stability and the sedimentation phenomenon that occurs in the majority of cases. Even if at low loaded suspensions, this drawback can be controlled by intense sonication, at higher loaded suspensions, this influences the performance of these new fluids, as well as the properties. In this regard, this article tends to shed some light on the advantages and disadvantages of adding surfactants to high loaded suspensions.

Several results are available on SDBS, SDS, as well as few polymers, nevertheless the use of surfactants is rather incidental and their ratio is not fully explained, varying from 1:1 to 1:10. On the other hand, a manufacturing procedure is not clearly outlined in the open literature. So, we considered one of the most common surfactants, SDBS, and we used several concentrations and collected data for thermal effusivity. Results are discussed in terms of SDBS influence on effusivity of two high loaded suspensions of PEG with MgO. The suspensions were manufactured in two steps and the ratio of SDBS was as low as possible.

This experimental study is serving as a reference for stability issues on nanofluids.

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AMORPHOUS AS2S3 CHALCOGENIDE FILMS APPLICATIONS FOR SURFACE PLASMON RESONANCE OPTICAL SENSORS

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ABSTRACT

Three layers surface plasmon resonance (SPR) constitute a well-developed method for applications as optical chemical/biological sensors. In the report four layers structure for coupling of light with surface plasmons has been developed. The proposed structure contains additional amorphous As2S3 thin film deposited over the metal film. As the chalcogenide materials have high refractive index value of the (2.45-2.30), these films constitute a planar waveguide. The resonance mode spectrum and changes due to film refractive index modification were studied numerically. Two different thicknesses for As2S3 layer were considered: d = 50 nm and d = 250 nm. The sensitive characteristics of such SPR sensor and resonance angle values have been analyzed.

TESTING OF FRICTION COEFFICIENT FOR M16 BOLTS CONNECTION FOR ALUMINUM STRUCTURES

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ABSTRACT

Slip resistant bolted connections are often used in metal structures. Their application is of particular interest in aluminum structures when there is need to avoid heat affected zone (HAZ). Behavior of slip-resistant connections is highly dependent on the coefficient of friction between surfaces and preloading force in bolts. The paper presents the investigation of the behavior of the joint made of aluminum AW-6060-T66, which is available on the domestic market and connected with high strength M 16 bolts, and determination of the coefficient of friction for three different treatments of friction surfaces, namely elements with untreated surfaces, elements with surfaces treated with a steel brush and elements with plastic-coated surfaces. Sliding forces of three samples for each surface treatment were experimentally tested and compared to the theoretical values according to Eurocode 9. Based upon the test results, characteristic values of slip factor were statistically determined for each of three different treatments of friction surfaces.

SIMULATION OF THE AIR INTAKE PROCESS THROUGH THE DYNAMIC TRANSFER SYSTEM FOR LARGE-DISPLACEMENT ENGINES

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ABSTRACT

Large-displacement engines (typically above 4.0 liters) require substantial air volumes for efficient combustion. To optimize this process, dynamic air transfer systems are employed to enhance the airflow characteristics, reduce pressure losses, and maximize volumetric efficiency. This paper presents a detailed 3D modeling and computational fluid dynamics (CFD) simulation of an aerodynamic air intake system for large-displacement bus engines. Using SolidWorks Flow Simulation, various design iterations were analyzed to identify the most effective intake system configuration. The results demonstrate significant improvements in air intake performance, suggesting that this simulation approach can be used for enhancing engine efficiency in commercial vehicles.

BRIQUETTES WITH INCREASED REACTION SURFACE AREA

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ABSTRACT

In the reduction process of ores, agglomerates, pellets, and briquettes, besides the mineralogical structure, chemical composition, porosity, working temperature, and composition of the gas phase, the specific surface area of the reaction front (cm^2 surface area per briquette or cm^3 briquette volume) also plays a particularly important role.

Considering the stresses that briquettes are subjected to during handling, transport, and storage, the most suitable shapes are spherical or ovoid. However, these shapes have the disadvantage of low specific surface values for the reaction front during the reduction process.

From the perspective of specific surface area (i.e., its value), cubic or parallelepiped-shaped briquettes would be more appropriate, but they suffer from greater degradation during handling.

For waste materials with low reducibility, increasing the specific reaction surface can be achieved by briquetting ores or waste into multi-cavity or tubular briquettes with internal cavities, even though the briquetting installations become more complex from a structural and functional point of view compared to the simpler forms mentioned above. For waste materials with medium reducibility, tubular briquettes are considered a very good solution.

RESEARCH REGARDING ADVANCED DEGASSING OF STEELS FOR MANUFACTURING AUTOMOTIVE COMPONENTS

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ABSTRACT

Continuous improvement of steel quality to obtain superior mechanical and technological characteristics is a goal of global manufacturers. For achieving this scope, the secondary treatment of steel is necessary, applied after its evacuation from the elaboration furnace. Besides the correction of the chemical composition and advanced removal of elements such as O2, S, P, advanced degassing leads to an appropriate structure in terms of flakes, porosity and inclusions in the steel composition. The current paper presents a study on a number of 20 steel samples, St 52.3A, used for manufacturing automotive components. The steel is elaborated in an Electric Arc Furnace (EBT), secondary treated in Ladle Furnace (LF), degassed in a Vacuum Degassing (VD) installation and continuously cast on a Continuous Cast (CC) aggregate equipped with three wires. For the samples analyzed the secondary treatment parameters for argon bubbling and vacuum were optimized to reduce the H2 and N2 content in the liquid steel.

ANALYSIS OF TECHNOLOGICAL PARAMETERS FOR CASTING AND SOLIDIFICATION OF BRAKE SHOES, USING PROCESS SIMULATION

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ABSTRACT

In general, the processes of casting and solidification of the liquid alloy influence the quality of the castings, respectively the micro and macrostructure, compactness, mechanical strength, dimensional accuracy, surface quality, etc. Also, a particular influence on solidification is exerted by the constructive factors of the casting (geometry, dimensions) and technological factors (type of cast alloy, casting temperature, nature of the shape, feeding system, massing method, etc.), which leads to the need to simulate the process and compare the results obtained with industrial practice. The paper aims to simulate the casting-solidification process of the cast alloy intended for obtaining brake shoes cast from phosphorous cast iron, in order to anticipate the behavior of the liquid alloy during industrial technological processes.

RESEARCH ON COMBINED TECHNIQUES FOR SILVER RECOVERY FROM X-RAY FILMS AND RESIDUAL SOLUTIONS

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ABSTRACT

Radiographic films, increasingly less common today, pose a problem for the storage spaces of medical, industrial, and other institutions, becoming waste with negative economic value. Recycling these wastes by recovering silver and the polymeric substrate is a major concern in current research. Methods described in the literature include the use of NaOH or NH_3 solutions, yielding variable silver recovery rates. The paper presents two technological variants tested in laboratory conditions, which combine leaching with NaOH with the use of ammonia, glucose, and formaldehyde. Additionally, the experimental procedure applied to the liquid residue of copper (II) and silver resulting from the filtration of the solid suspension, using copper cementation, is described. The obtained results were validated through laboratory analyses, including EDX and SEM determinations.

RESEARCH ON THE VALORIZATION OF SIDERITIC WASTE IN THE STEEL INDUSTRY

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ABSTRACT

The paper presents the results obtained in the laboratory on the processing of siderite waste in the form of briquettes usable in the steel industry. Siderite waste together with a series of powdery wastes were processed by briquetting, obtaining a Carbofer type by-product used in the production of steel as a slag foaming agent. The experimental recipes were tested in the laboratory in the production of steel in an induction furnace. The by-products obtained were used as a slag foaming agent, thus the powdery wastes are recycled, obtaining ecological, technological and economic advantages.

EXPERIMENTAL STUDY ON CONCRETE INCORPORATING RECYCLED PLASTIC FROM BOTTLES AND DETERGENT CONTAINERS AS AGGREGATE REPLACEMENT

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ABSTRACT

Plastic pollution continues to be a formidable issue globally, with millions of tons of waste discarded annually. While various sectors have explored methodologies for sustainable waste management, the construction industry presents a unique opportunity for large-scale utilization of recyclable materials. Concrete is the predominant material used in construction, known for its durability and strength. However, the extraction of its traditional aggregates contributes significantly to environmental degradation due to quarrying and transportation activities. This study aims to explore an innovative method of reducing concrete's environmental impact by substituting conventional coarse aggregates with shredded plastic waste, specifically sourced from polyethylene terephthalate (PET) bottles and high-density polyethylene (HDPE) detergent containers. By integrating these recycled materials, the study not only addresses pressing environmental concerns but also contributes to the conservation of dwindling natural resources. The adoption of such practices could signal a substantial shift towards sustainable building practices, aligning with global sustainable development goals.

EFFECT OF WATER SORPTION ON THE MECHANICAL PROPERTIES OF DIRECT AND CAD/CAM SUBTRACTIVE DENTAL RESIN COMPOSITES

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ABSTRACT

This study evaluated the effects of water sorption on the flexural strength of direct (Gradia Direct Anterior A2, Tetric Evo Ceram A2, and Filtek Z550 A2) and CAD/CAM subtractively processed dental resin composites (Vita Enamic, Brilliant, Cerasmart, and Tetric). A total of seventy specimens were prepared, dehydrated, immersed in distilled water for 30 days, and subsequently re-desiccated to simulate intraoral conditions. All samples were then standardized to final dimensions of 14 × 4 × 1.2 mm and subjected to three-point bending tests.

Flexural strength was measured using a three-point bending test adapted from ISO 4049:2019 (for direct composites) and ISO 6872:2015 (for CAD/CAM materials). The span length was set at 10 mm, and testing was performed at a crosshead speed of 0.75 mm/min using a universal testing machine. The flexural strength (σ) was calculated using the standard formula, where F is the maximum load at fracture (N), L is the span length (mm), b is the specimen width (mm), and d is the thickness (mm).

Although the specimen dimensions differed from those specified in the original ISO standards, the testing protocol adhered to the same mechanical principles and was adapted to a mini-flexural configuration, as commonly employed in previous studies on both direct and CAD/CAM resin composites.

POSTERS

STRUCTURE-PROPERTIES RELATIONSHIP IN MODIFIED SEASHELLS: A PERSPECTIVE FOR WATER PURIFICATION

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ABSTRACT

Seashells architecture has inspired scientists and engineers in exploring the connection between their structure and some useful properties. The adsorption capabilities of these natural materials, well known and explored, can be improved by altering their structure in a convenient and controlled manner. Seashells collected from the Romanian Coast of the Black Sea were broken into pieces, and fragments of specific dimensions were collected and considered for this study. The surface of these fragments was structurally modified by chemical methods, then they were tested for water purification. In order to compare the efficiency of the applied modifications, non-modified seashells were tested for similar applications. Results revealed that the capacity to remove specific water polluting ions has increased with 20-35% for the modified shells after 5 minutes since the beginning of the test, compared with the non-modified shells. The artificially induced surface modifications were investigated by visualizing shell samples with a scanning electron microscope.
Acknowledgement: This work was supported by 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.

PHOTOCATALYTIC ACTIVITY OF TRIVALENT BISMUTH IN CA-BI-O TERNARY SYSTEMS

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ABSTRACT

Numerous bismuth-based compounds have been produced in large quantities by researchers, and their potential uses as semiconductors, superconductors and photocatalysts have been revealed. As a result, their optical and structural properties are being closely examined, especially their capacity to absorb visible light. The search for single-phase and stable compositions is an important goal in material synthesis, and calcium-bismuth-oxide (Ca-Bi-O) ternary systems are particularly attractive due to their remarkable photocatalytic ability. Several Ca-Bi-O combinations, such as Ca2Bi2O5, CaBi2O4 and others, have shown significant photocatalytic activity in the degradation of phenols, medications and others.

This research focuses on obtaining trivalent bismuth within the Ca-Bi-O ternary system using a novel fast precipitation method. The study investigates the impact of different molar ratios on the resulting phases and their subsequent photocatalytic performance. Characterization techniques, including X-ray diffraction (XRD) and Raman spectroscopy, are employed to identify the phases and crystalline properties of the synthesized material. The compounds' chemical identification through the determination of chemical bond vibrations was conducted using Fourier Transform Infrared (FT-IR) spectroscopy. At the same time, the elemental composition and morphology were examined using scanning electron microscopy coupled with energy-dispersive spectroscopy (SEM/EDX).

Acknowledgement: This work was supported by 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.

YBO_3 SYNTHESIS STRATEGIES: A COMPARATIVE APPROACH

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ABSTRACT

UVC radiation is used nowadays for various applications, such as environmental, water, and food decontamination, tumor therapy, and photocatalysis. UVC-emitting materials could be used to develop biological water purification methods via up-conversion under visible light excitation that would be economically advantageous. YBO_3 and $YAl_3(BO_3)_4$ are good hosts for rare-earth-doped phosphors with high UVC transparency and chemical durability, and with $YAl_3(BO_3)_4$ demonstrating nonlinear optical properties. Here, YBO_3 was synthesized by solution combustion with ammonium nitrate as an oxidizer and compared to the solid-state method. Although the reaction was initiated by combustion at 450 °C, pure-phase YBO_3 required a later heat treatment at 1000 °C due to early phase separation. Solid-state synthesis, on the other hand, yielded phase-pure YBO_3 directly. This result indicates, broadly, the need for optimization of the solution combustion process in order to minimize the presence of intermediate non-stoichiometric phases.

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

DEVELOPMENT OF Y2SiO5:Pr³/PDMS HYBRID MATERIALS FOR UV-ACTIVATED ANTIMICROBIAL APPLICATIONS

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ABSTRACT

Ultraviolet C (UVC) radiation, a highly effective antimicrobial agent, finds extensive applications in the decontamination of water, food, and environmental surfaces. Blue-to-UVC upconversion (UC) now makes such low-cost blue light sources an important alternative for antimicrobial applications. In this study, the bactericidal application of $Y_2SiO_5:Pr^{3+}$ and its PDMS-based composite against Escherichia coli ATCC 8739 was evaluated. The material characterization was done using FTIR, XRD, and PL spectroscopy to confirm the successful synthesis of the phosphor and to study its UP behavior. The microbiological assays comprised two main experiments: one consisting of direct contact of bacterial suspensions with $Y_2SiO_5:Pr^{3+}$ and no irradiation, and the other where irradiation was provided through a PDMS/$Y_2SiO_5:Pr^{3+}$ composite film deposited on glass. Control methods consisted of testing either and both an uncoated glass surface or non-irradiated bacterial suspensions. $Y_2SiO_5:Pr^{3+}$ showed moderate cytotoxicity upon direct contact, while the composite was non-cytotoxic. Illumination through the PDMS/$Y_2SiO_5:Pr^{3+}$ membrane reduced viable bacterial counts by ~25%, indicating a promising avenue for portable light-activated antimicrobial strategies. Acknowledgement: This study was supported by Romania's National Recovery and Resilience Plan, NRRP, project grant number C9-I8-28/FC 760107/2023.

COPPER PHTHALOCYANINE PIGMENT: SPECTROSCOPIC CHARACTERIZATION AND WATER-SPLITTING ELECTROCATALYTIC PROPERTIES

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ABSTRACT

Rising global temperatures during summer increasingly affect ecosystems and surface-exposed materials by accelerating thermal degradation under supra-optimal conditions. To mitigate these effects, the development of efficient light-reflective materials—particularly pigments for controlling ultraviolet (UV), visible, and infrared (IR) radiation—is gaining importance. Copper phthalocyanine (CuPc), a synthetic blue pigment, has attracted attention for its applications in organic sensing devices, solar cells, and as a pigment in heritage conservation [1]. Recently, CuPc has also been tested on creeping bentgrass (Agrostis stolonifera) to evaluate its ability to attenuate light at the leaf surface, demonstrating promise in reducing heat stress in plants [2]. Beyond its botanical applications, the pigment's distinctive optical properties may help slow the degradation of artworks exposed to elevated temperatures [3, 4]. In this study, we investigated the structural and functional characteristics of CuPc films. Structural characterization was conducted using Raman and FTIR spectroscopy, while electrochemical testing evaluated the pigment's catalytic activity in water-splitting reactions. These electrocatalytic properties offer insights into CuPc's redox behavior under humid and electrochemically active conditions, factors critical to both its environmental functionality and long-term stability in cultural heritage contexts. Future work perspectives - Hyperspectral Imaging analysis.

ORGANIZING COMMITTEE

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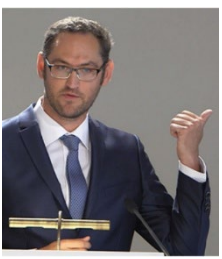

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