INTERNATIONAL CONFERENCE ON ENGINEERING TECHNOLOGIES

ICENTE'25

November 20-22, 2025
Konya/TURKEY

ABSTRACTS BOOK

Editors:
Prof. Dr. Nurettin DOĞAN
Res. Asst. Yusuf ERYEŞİL

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9th International Conference on Engineering Technologies ICENTE 2025

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NURETTİN DOĞAN

YUSUF ERYEŞİL

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Kitap Dünyası

PREFACE

International Conference on Engineering Technologies (ICENTE’25) was organized in Konya, TÜRKİYE on 20-22 November 2025 by Selçuk University Faculty of Technology and cooperation with Sinop University Faculty of Engineering and Architecture.

The main objective of ICENTE’25 is to present the latest research and results of scientists related to Biomedical, Computer, Electrical & Electronics, Mechanical, Mechatronic, Metallurgical & Materials, Civil, Chemical, Industrial, Environmental, Geological and Mining Engineering fields. This conference provides opportunities for the delegates from different areas in order to exchange new ideas and application experiences, to establish business or research relations and to find global partners for future collaborations.

All paper submissions have been double blind and peer reviewed and evaluated based on originality, technical and/or research content/depth, correctness, relevance to conference, contributions, and readability. Papers presented in the conference that match with the topics of the journals will be published in the following journals:

- Artificial Intelligence Studies (AIS)
- International Journal of Automotive Engineering and Technologies (IJAET)
- Selcuk University Journal of Engineering Sciences (SUJES)
- Intelligent Methods In Engineering Sciences (IMIENS)
- Positive Science
- Electrical Engineering and Energy
- New Trends in Computer Sciences
- International Journal of Aeronautics and Astronautics (IJAA)

At this conference, there are 205 paper submissions. Each paper proposal was evaluated by two reviewers, and finally, 136 papers were presented at the conference from 14 different countries.

In particular, we would like to thank Prof. Dr. Hüseyin YILMAZ, Rector of Selçuk University, conference scientific committee, session chairs, invited speakers, reviewers, technical team, participants, and all our colleagues who have contributed. They have made a crucial contribution to the success of this conference. Our thanks also go to our colleagues in our conference Office.

Prof. Dr. Nurettin DOĞAN

Res. Asst. Yusuf ERYEŞİL

Editors

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M.T. YILMAZ[1] and M.A. PALA[2]
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ABSTRACT

Large language models (LLM) are useful for a variety of natural language processing applications, including question-answer systems, text generation, and summarization. Complex models with billions of parameters are still very difficult to run effectively in resource-limited situations, such as on CPU-based devices or end systems. This research examines domain-specific fine-tuning strategies, multi-Master routing and hierarchical inference, CPU-GPU hybrid optimization methods, and Master-on-CPU execution strategies. The study used the Comprehensive Medical Q&A Dataset (~15,000 Q&A pairs) to fine-tune the tiiuae/Falcon-RW-1B and meta-llama/LLaMA-3.2-1B-Instruct models using LoRA/QLoRA configurations. The LLaMA-3.2-1B-Instruct model achieved a loss value of 0.4012 after 8,204 steps and 4 hours and 24 minutes of training, while the Falcon-RW-1B model achieved a loss value of 0.4249 after 8,204 steps and 2 hours and 40 minutes of training. The Falcon model was producing poor responses before fine-tuning; however, with fine tuning, it provided distinct and clinically meaningful descriptions of Type 1 and Type 2 diabetes symptoms. Even in its most basic version, the LLaMA model provides comprehensive and sourced answers; nevertheless, once diluted it presents a deeper material with biological causes and extra symptoms. The results show that even in resource-constrained contexts, small-parameter and instruction-based models can exhibit significant performance gains using LoRA/QLoRA. Lightweight tweaking techniques, CPU-compatible models, and CPU-GPU hybrid tactics offer a crucial roadmap to enable LLMs to work well with limited technology.

KEYWORDS: Large Language Models (LLM), Resource-Constrained Environments, CPU-GPU Execution, Domain-Specific Fine-Tuning, LoRA/QLoRA.

A Mirage-Inspired Optimization Approach for Ultrasonic Echo Parameter Estimation

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ABSTRACT

Accurate estimation of ultrasonic echo parameters is a key step in ultrasonic nondestructive testing (NDT), as it directly impacts both material characterization and reliable defect detection. This task becomes particularly challenging when signals contain multiple overlapping echoes, especially when they are closely spaced in time or strongly affected by noise. To address this issue, this work proposes a novel parameter estimation approach based on the Fata Morgana Algorithm (FATA). This swarm intelligence algorithm, inspired by the optical mirage phenomenon, combines two complementary mechanisms: Mirage Light Filtering (MLF), which directs the population toward the most promising regions of the search space, and Light Propagation Strategy (LPS), which enhances local accuracy and accelerates convergence. Numerical simulations were performed on synthetic signals containing multiple partially overlapping echoes under various noise levels, and validated through experiments on materials with artificial defects. The results demonstrate that the proposed method provides robust and accurate estimation of echo parameters, thereby confirming the potential of FATA as an effective and high-performance tool for ultrasonic NDT applications.

KEYWORDS: NDT, Ultrasonic echoes, Parameter estimation, Fata Morgana Algorithm (FATA).

Experimental investigation of thermophysical properties of TiO2–water nanofluid: Role of surfactants

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ABSTRACT

Nanofluids, defined as colloidal suspensions of nanoparticles in conventional heat transfer fluids, have emerged as promising alternatives to enhance energy efficiency and improve thermal performance. Among various candidates, titanium dioxide (TiO_2) nanoparticles are particularly attractive due to their high thermal stability, low chemical reactivity, and wide availability. In this study, water-based TiO_2 nanofluids were prepared at particle volume concentrations of 0.5%, 1%, and 3%, using three different surfactants—sodium dodecyl sulfate (SDS), Tween 80, and cetyltrimethylammonium bromide (CTAB)—at constant dosages to improve stability. The thermophysical properties of the nanofluids, namely thermal conductivity and viscosity, were measured at four different temperatures (25, 30, 35, and 40 °C). The results showed that nanofluids prepared with CTAB exhibited the highest thermal conductivity, which increased with temperature and particle volume fraction. In contrast, SDS-based nanofluids exhibited the highest viscosity; viscosity decreased with increasing temperature but increased with particle concentration. These findings demonstrate the strong dependence of thermophysical behavior on surfactant type, temperature, and particle volume fraction, highlighting the potential of TiO_2-based nanofluids for advanced thermal management applications.

KEYWORDS: TiO2-water nanofluid, SDS surfactant, Dispersion and stability, Thermal conductivity, Viscosity.

Flash Flood Hazard Assessment in Semi-Arid Regions Through Fuzzy Multi-Criteria GIS Modeling

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ABSTRACT

Flash floods are a major hazard in semi-arid basins, requiring spatial tools to target mitigation. We mapped flash-flood susceptibility in the Assaka watershed (southwestern Morocco) using a GIS-based multi-criteria framework with the Fuzzy Analytical Hierarchy Process (FAHP). Eight factors were evaluated: flow accumulation (FA), stream power index (SPI), topographic wetness index (TWI), lithology, land-surface temperature (LST), topographic position index (TPI), altitude, and curvature. Pairwise comparisons produced the following AHP weights (%): FA 29.9, SPI 19.8, TWI 15.9, lithology 13.9, LST 9.1, TPI 6.3, altitude 3.4, curvature 1.8. These weights were fuzzified and aggregated to derive a continuous susceptibility index, then reclassified into low, moderate, and high classes. High-susceptibility zones cluster near the basin outlet and along major tributaries—especially adjacent to Oued Oum Laâchar and Oued Essayed, with intensification around confluences—reflecting flow concentration and terrain controls. The resulting maps provide operational guidance for land-use regulation, prioritization of structural and nature-based measures, and support to early-warning and watershed-management decisions in data-limited semi-arid contexts.

KEYWORDS: Flash Flood Susceptibility; Watershed Management; Geographic Information System (GIS); Fuzzy Analytical Hierarchy Process (FAHP); Flow Accumulation; Stream Power Index; Topographic Wetness Index; Lithology.

Improving Energy Absorption Performance of Crash Boxes Using a Bio-Inspired Approach

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ABSTRACT

Biomimetics is a science based on imitating and applying principles observed in nature to overcome engineering challenges. In recent years, it has been a valuable source of inspiration for designing and developing innovative structures and materials. Energy-absorbing structures are commonly used in engineering applications due to their load-carrying capacity, structural flexibility, and folded and functional properties. This paper proposes an innovative methodology to enhance the energy absorption performance of traditional crash boxes used in engineering applications. This approach utilizes bio-inspired principles by integrating biological concepts into the design to optimize crash box effectiveness. Cellular structures with different geometries, such as hexagonal, octagonal, and cylindrical, were designed by mimicking bamboo and horsetail plants. These structures were fabricated using additive manufacturing and tested under quasi-static load. A numerical crushing model using the finite element method was verified with the test results. Square-type crash boxes were designed using bio-inspired hexagonal, octagonal, and cylindrical cellular structures. The crashworthiness characteristics indicating the energy absorption performance of the crash boxes were numerically obtained and then compared to each other. The bio-inspired crash boxes were found to be a viable alternative to honeycomb cell-filled crash boxes, which are widely used in industrial applications, such as in the automotive, aviation, and construction industries. It was found that the bio-inspired crash boxes with a Type 2 design have better energy absorption behavior than the honeycomb cell-filled crash box.

KEYWORDS: Crashworthiness, Finite Element Method, Additive Manufacturing, Biomimetics.

Investigation of Energy Absorption and Damage Behavior Under Low Velocity Impact of Bio- Inspired Sandwich Panels

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ABSTRACT

Sandwich panels are widely used in diverse industries, such as aeronautics, marine, automotive, and civil engineering, due to their outstanding mechanical properties. These properties include high specific strength, rigidity, and energy absorption capabilities, all while maintaining a relatively low weight. They are widely used in energy-absorbing applications due to the increased load-carrying capacity and structural flexibility of their core part, as well as their folded and graded properties. Sandwich panel designs are based on biomimetics science and provide properties such as lightness, high specific strength, and crashworthiness. Biomimetics imitates natural structures, and additive manufacturing technology simplifies the design and fabrication of multifunctional, multiscale, and multimatrix bio-inspired structures. This technology makes it possible to develop fabrication parameters for complex core designs using two different materials simultaneously. This paper aims to reveal the energy absorption and damage behavior of sandwich panels designed according to biomimetic principles. The sandwich samples were fabricated using the FDM (fused deposition modeling) additive manufacturing method. Low-velocity impact tests were conducted at three impact energies: 20, 40, and 90 joules. Finite element (FE) impact models were generated for these designs and verified by comparing the models to the experimental test data. It was determined that sandwich panels designed to mimic bamboo and horsetail plants enhance energy absorption and load-carrying capability compared to traditional honeycomb core-based panels.

KEYWORDS: Energy Absorption, Sandwich Panels, Finite Element Method, Biomimetics.

Speech Processing Algorithm for Voice Activity Detection

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ABSTRACT

Voice activity detection is essential in cellular radio systems, for speech recognition and encoding and speech processing applications. This article presents a practical way to analyze waveform audio files using Python. Libraries like Wave, NumPy, SciPy and Librosa are used to process such files based on the Mel-Frequency Cepstral Coefficients method. It allows machines to interpret human speech, transforming spoken words into a format that computers can manipulate. As a result, the algorithm extracts speech segments and their duration. The open code helps to change parameters like frame size, hop time, sample rate and minimum pause duration based on the task and file that needs to be analyzed. The study shows also how changing these parameters effect the results.

KEYWORDS: Python, Voice activity detection, signal analysis, speech processing.

Investigation of the Effect of Diameter-to-Thickness Ratio on Mechanical Properties in Carbon Fiber Reinforced Filament Wound Composite Pipes

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ABSTRACT

A composite material is defined as a novel material formed through the macroscopic integration of two or more constituents with distinct chemical structures. Composite materials are distinguished by their high specific strength, low specific weight, and excellent corrosion resistance. Pipes used in transmission lines must combine high mechanical strength with lightweight properties to ensure ease of handling and transportation. The advantages offered by high-pressure composite-wound pipes in terms of storage, transport, and installation have significantly contributed to their increasing adoption in recent years. This study provides a comprehensive examination of the mechanical behavior and performance of carbon fiber-reinforced polymer (CFRP) pipes produced via the filament winding method at a ±55° angle. To evaluate the pipes' responses under internal and external loading conditions, axial compression, lateral compression, and ring tensile tests were conducted in accordance with ASTM standards. In particular, the axial compression tests assessed the pipes' buckling resistance, while the ring tensile tests verified their capacity to withstand internal pressure. Following the mechanical tests, damage analysis was performed using macro- and micro-scale imaging to elucidate the underlying damage mechanisms. These analyses identified predominant failure modes, including fiber-matrix debonding and matrix cracking. The results offer critical insights into the influence of manufacturing parameters on the ultimate mechanical properties of the pipes. Overall, this work establishes a scientifically grounded framework for the design optimization of high-performance composite pipes and supports their reliable deployment in critical industrial applications, such as oil and gas, aerospace, and infrastructure.

KEYWORDS: CFRP Composite pipe, Ring test, Damage analysis, Filament winding (FW)

Investigation of the Effect of Diameter Difference on Mechanical Properties of Filament Wound GRP Pipes

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ABSTRACT

Composite materials are novel engineering materials obtained through the macroscopic integration of two or more constituents with distinct chemical structures, and they are widely preferred due to their high specific strength, low density, and excellent resistance to corrosion. Among them, glass fiber-reinforced polymer (GFRP) pipes produced by the filament winding technique have found extensive use in pressurized chemical transportation, industrial fluid conveyance, oil and gas transmission lines, and as structural components in infrastructure applications. In recent years, the storage, handling, and transportation of high-pressure composite-wound pipes have become increasingly important, as these pipes must combine lightweight properties with high mechanical strength to ensure reliability and operational efficiency. Compared to traditional metallic alternatives, composite pipes provide significant advantages including superior strength-to-weight ratio, chemical durability, and design flexibility. Nevertheless, when subjected to high internal pressures and impact loading, GFRP pipes are prone to invisible damage within the pipe wall, such as matrix cracking, fiber breakage, and interlaminar delamination, all of which reduce the overall structural integrity and may result in leakage or catastrophic burst failures during service. In this context, the present study investigates the mechanical performance of GFRP pipes manufactured at a ±55° winding angle using the filament winding process. Experimental procedures, including hydrostatic burst and ring tensile tests in accordance with ASTM standards, were employed to evaluate the pressure-bearing capacity and structural reliability of pipes with different diameters. The experimental findings were complemented by microstructural examinations, which revealed dominant damage mechanisms and provided valuable insights into the relationship between manufacturing parameters, failure modes, and ultimate performance, thereby establishing essential design guidelines for the reliable use of composite pipes in critical engineering applications.

KEYWORDS: GFRP, Composite materials, High-pressure pipes, Ring tensile test, Failure modes, Damage mechanism, Delamination.

Automated Segmentation and Multiclass Classification of Brain Tumors Using Machine Learning on MRI Images

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ABSTRACT

This study introduces an automated system designed to handle both the multiclass classification and segmentation of brain tumors using MRI scans, leveraging a combination of machine learning and deep learning methodologies. Traditional machine learning models were fine-tuned using feature selection techniques such as Information Gain, Gain Ratio, and ANOVA-F, with XGBoost standing out by achieving a top classification accuracy of 96.22%. On the other hand, deep learning strategies, particularly a custom-designed CNN model, outperformed these traditional methods, achieving a validation accuracy of 97.29% and producing excellent AUC scores across all tumor categories. Beyond classification, the study also incorporated a tumor segmentation component built on a U-Net-based architecture, which proved effective in precisely isolating tumor areas. The integrated framework demonstrates significant promise for clinical decision-support applications by ensuring both accurate detection and detailed localization of brain tumors.

KEYWORDS: Brain tumor classification, MRI, segmentation, machine learning, deep learning, CNN, U-Net, XGBoost.

Automatic Skin Lesion Segmentation and Classification Using Radiomics and Deep Learning

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ABSTRACT

Skin cancer is one of the most common and deadly diseases worldwide, and early diagnosis is critical for the success of treatment. In this study, an automatic skin lesion segmentation and classification system developed using the HAM10000 dermatoscopic image dataset is presented. The developed system works with a dynamic pipeline structure that automatically selects the most appropriate segmentation method according to the structural features of the lesion. After segmentation, region-specific ROI extraction is performed. These features are evaluated with classical machine learning models. As a result, the highest classification performance was achieved using an ensemble deep learning model built on ResNet18-derived features. This study emphasizes the importance of segmentation selection and radiomics-based feature extraction in enhancing the diagnostic accuracy of skin cancer from dermatoscopic images.

KEYWORDS: Skin cancer, HAM10000 dataset, image processing, machine learning, biomedical imaging.

Stroke Detection and Segmentation Using Deep Learning on Brain CT Images

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ABSTRACT

This project employed Machine Learning (ML) and Convolutional Neural Networks (CNN) techniques to support the diagnosis of stroke using brain CT images. Stroke is caused by ischemic or hemorrhagic and early detection is important due to the different treatment approaches. TEKNOFEST-2021 Stroke Dataset which contains labeled CT scans divided into three classes: non-stroke, ischemic and hemorrhagic is used to educate the models. In this project, Preprocessing steps are involved converting DICOM images to PNG format, applying filters, and resizing images 512x512 pixels. U-net, segment anything2, applying filters, performing morphological operations and histogram equalization are used for segmentation of ischemic and hemorrhage areas. Then, features are extracted and selected from these segmented images, and these are used to train Machine Learning models which are Random Forest, Logistic Regression and SVM. In addition, Convolutional Neural Networks which are ResNet18 and EfficiencyNet are trained on the dataset images. ML and CNN models are compared both within their own categories and against each other using evaluation metrics. The purpose of this study is to improve the speed and accuracy of stroke diagnosis and support medical decision-making.instructions give you guidelines for preparing papers for ICENTE 2025. Use this document as a template if you are using Microsoft *Word* 6.0 or later. Otherwise, use this document as an instruction set. The electronic file of your paper must be in this format. Define all symbols used in the abstract. Do not cite references in the abstract.

KEYWORDS: Brain CT images, EfficiencyNet, image segmentation, ResNet18, Stroke classifications.

An Extended RFM (Recency–Frequency–Monetary) Technique Incorporating Repetitive Manufacturing and its Real-World Application

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ABSTRACT

In today's highly competitive environment, businesses must develop effective strategies to sustain their market presence and increase profitability. To achieve this, they need to accurately analyze customer behavior. In this regard, working with clusters that group customers with similar tendencies provides a more streamlined and meaningful process. Creating homogeneous groups of customers with similar shopping habits is called customer segmentation. RFM analysis is the most preferred segmentation method in the literature due to its ease of application and interpretation. The RFM method analyzes the customer's most recent purchase time with the R-coded Recency metric, the purchase frequency within a reference period with the F-coded Frequency metric, and the total expenditure within the same period with the M-coded Monetary metric. It groups customers with similarities across these three dimensions and divides them into segments. While RFM analysis utilizes crucial features for customer segmentation, other customer characteristics may also be important for different businesses. Several authors in the literature have focused on these needs and incorporated new metrics into RFM analysis. In this study, considering the advantages of repetitive production in various sectors, the R-coded "Repetitive" metric, which represents repetitive order status, was incorporated into RFM analysis, and RFM-R model was developed. The outputs obtained from the developed method aimed to increase production efficiency and reduce product delivery times to customers. It also aims to manage the disadvantages of the variant-type production structure, in which products within the same main category are produced with different features such as size, color, and capacity. Clustering algorithms, among unsupervised machine learning methods, are used for the segmentation process. The performance of the resulting clusters for each method and algorithm is measured and compared using cluster evaluation metrics. The developed method is applied to the gold jewelry industry, demonstrating the real-world applicability of the findings. Based on the results, marketing strategies for the respective segments are proposed. The main contributions of this study are as follows: the development of the RFM-R model, which integrates the Repetitive metric into the traditional RFM framework to enhance customer segmentation and improve production efficiency, addressing the disadvantages of variant-type production structures, and its application in a jewelry company.

KEYWORDS: RFM analysis, customer segmentation, gold jewelry industry, machine learning–based clustering, CRM

Economic Impacts of Industry 4.0 Technologies

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ABSTRACT

Industry 4.0 technologies — including artificial intelligence, robotics, cyber-physical systems, IoT (Internet of Things), and digital manufacturing — constitute the core components of the fourth industrial revolution. IoT enables physical devices and sensors to connect via the internet, exchange real-time data, and facilitate automation in production processes. The implementation of these technologies is rapidly transforming global production processes and has significant economic and technical impacts. This paper analyzes the economic and technical effects of Industry 4.0, including productivity growth, production cost optimization, the emergence of new market opportunities, and transformations in the labor market. Furthermore, the potential applications of these technologies within the framework of Azerbaijan's digital transformation strategy are discussed. The results indicate that the targeted implementation of Industry 4.0 technologies creates economic advantages for enterprises and enhances the competitiveness of the national economy.

KEYWORDS: Industry 4.0, IoT, economic impact, digital transformation, automation, productivity.

Prospects for the Synthesis of eEconomy and Engineering in the Context of Digital Transformation

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ABSTRACT

In the modern era, digital transformation has become one of the key factors determining the development directions of both the economy and engineering. Artificial intelligence, digitalization, smart technologies, and Industry 4.0 approaches enable the optimization of production processes, efficient use of resources, and the emergence of new economic models. This article analyzes the main directions of the synthesis between economy and engineering under digital transformation, the opportunities emerging from this synthesis, and the challenges ahead. Research shows that the application of digital technologies contributes significantly to improving economic efficiency, the innovation of engineering solutions, and the formation of a sustainable development model. As a result, the integration of the economy and engineering appears as a strategic priority in the digital age and demands the strengthening of national innovation systems.

KEYWORDS: Digital transformation, economy, engineering, Industry 4.0, innovation, sustainable development.

A Quantitative Analysis for the Neuronal Dynamics of the Rulkov Neuron Map

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ABSTRACT

Biological neuron models are mathematical descriptions that mimic properties such as synaptic transmission, firing patterns, and oscillatory behavior. The Rulkov neuron map model represents biological neuron dynamics and oscillatory behavior with its simple definition. A quantitative examination of the mimicked neuron dynamic is presented by using various methods, and "Recurrence Quantification Analysis (RQA)" is one such method. This method examines recurrent structures and patterns in time series data of the handled dynamic systems, quantitatively. This study focuses on the oscillation patterns of the Rulkov neuron map model using time series data for its five different neural activity responses. These time series are generated by varying model's parameters and their important characteristics are analyzed by RQA method in here. This allows us to draw conclusions about the stability, complexity, and predictability of these produced patterns.

KEYWORDS: Biological neuron model, Rulkov neuron map, Recurrence Quantification Analysis (RQA), Stability, Complexity.

Evaluation of the Creation of a Green Supply Chain Through the Bullwhip Effect

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ABSTRACT

The bullwhip effect in green supply chains addresses how changes in customer demand impact each stage of the supply chain. This effect leads to fluctuations in demand across the supply chain's layers, which can result in issues such as excess stock, inadequate customer service, and uncertain production planning. The study aims to investigate the underlying causes of the bullwhip effect in green supply chains and explore strategies for mitigating its impact. Additionally, it will evaluate each stage of the product life cycle from an environmentally friendly perspective and examine how increased demand for eco-friendly products, influenced by public policies reflecting societal environmental concerns, affects the supply chain. In this context, the study will analyze the differences and outcomes between the green bullwhip effect and the traditional bullwhip effect.

KEYWORDS: Green purchasing, bullwhip effect, supplier evaluation

Design and Performance Analysis of a Multi-Cyclone Dust Separator for Industrial Air Filtration Applications

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ABSTRACT

In this study, a multi-cyclone dust collector was developed as an alternative to jet filters commonly used in industrial dust collection systems, aiming to achieve higher efficiency in terms of energy consumption and maintenance costs. Widely recognized cyclone types in the literature (such as Lapple, Stairmand types) were examined and analyzed under identical operating conditions. For each cyclone type, an experimental test setup was established to measure pressure drop, air velocity, particle collection efficiency, and particle size distribution. Based on the experimental results, the cyclone type providing the highest separation efficiency and the lowest pressure drop was identified. Using this geometry as a basis, a multi-cell cyclone (multicyclone) system was designed.

The design of the multicyclone was analyzed using ANSYS Fluent. Various design modifications were implemented to equalize the flow velocity and pressure drop across individual cyclones, thereby ensuring optimal performance of each unit. The finalized multicyclone design was manufactured, and experimental testing was initiated. Preliminary observations indicate that the system successfully separates dust from the air–dust mixture and collects it in the dust chamber. However, the dust concentration at the stack outlet has not yet been measured; future stack measurements will be conducted to verify the overall separation efficiency and particle size distribution.

KEYWORDS: Cyclone separator, Industrial dust collection, Cyclone performance, Computational fluid dynamics (CFD).

Numerical Investigation of Lift Enhancement in Light Aircraft Wings Through Boundary Layer Bleed

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ABSTRACT

Light aircraft, typically defined as airplanes with a maximum takeoff weight under 5.5 tons, have played a significant role in aviation history, serving purposes ranging from military training and commercial travel to recreational flying. Among the most widely recognized manufacturers, Cessna has produced several models, including the iconic Cessna 172, first introduced in 1972. Despite its enduring popularity, the original design of this model is limited in payload capacity and high-altitude performance by modern standards. To address this limitation, the aircraft wing was redesigned using Boundary Layer Bleed (BLB), and analyses were conducted using Computational Fluid Dynamics (CFD) via Ansys Fluent. Simulations were performed for both the original and the improved wing designs to demonstrate the advantages of the new configuration. A 1:14 scaled model was used to reduce simulation time. The computational analysis showed that the BLB application increased the maximum pressure difference between the upper and lower wing surfaces, resulting in an 8.2% improvement in the lift-to-weight ratio compared to the original design. This means the aircraft can carry 8.2% more useful load or fuel, allowing it to fly longer distances. Additionally, the increased lift-to-weight ratio can raise the operational altitude by approximately 670 meters, which may reduce air density and friction, leading to improved fuel efficiency and more stable flight. This study provides valuable insights into light aircraft design and demonstrates how CFD analyses can enhance the performance of existing popular aircraft models.

KEYWORDS: Boundary layer bleed (BLB), computational fluid dynamics (CFD), Cessna 172, wing design, energy efficiency.

Design and Analysis of Improved Airflow Distribution in Vibratory Destoner Machines

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ABSTRACT

This study aims to improve the separation efficiency of destoner machines, which are used in flour mills to remove stones and foreign materials from wheat, by optimizing airflow distribution. Destoners operate based on a vibratory sieve combined with a negative-pressure airflow principle. Therefore, a homogeneous airflow distribution across the sieve surface is a critical parameter directly affecting stone separation efficiency.

In this study, the upper sieve of an existing destoner was divided into 56 equal sections, and the airflow velocity at each point was measured using a digital anemometer equipped with a propeller. Measurements were conducted at the typical operational suction pressures of 50, 55, and 60 mmSS. Experimental results indicated that the airflow velocities were unevenly distributed across the sieve surface, with significant deviations in certain regions. The maximum measured velocity difference was 1.6 m/s.

The same conditions were analyzed numerically using Cfd, showing a high degree of agreement with the experimental results. Following validation, several passive flow control modifications were applied to balance the airflow distribution, and different destoner designs were analyzed. Among them, a design featuring inclined side walls and flow-guiding flaps under the sieve proved to be optimal, reducing the maximum velocity difference by 40% and achieving a more uniform airflow distribution. Consequently, an improvement in stone separation efficiency and potential energy optimization is anticipated.

KEYWORDS: Destoner, Airflow Distribution, Stone Separation Efficiency, Flour Mill, Flow Simulation.

Multivariate Analysis of Physicochemical Properties of Camelina Biodiesel-Diesel-Ethanol Blends Using Principal Component Analysis (PCA)

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ABSTRACT

In this study, the physicochemical properties of diesel–biodiesel–ethanol ternary blends prepared using Camelina sativa–based biodiesel were evaluated using multivariate statistical methods. Physicochemical data were obtained from an open-access dataset. During the data preprocessing stage, all variables were standardized, and Pearson's correlation matrix and Principal Component Analysis (PCA) were applied to identify inter-variable relationships.

According to the results, three principal components accounted for 94.94% of the total variance. The first component (PC1) represented physical properties such as density, viscosity, and iodine number, whereas the second component (PC2) was associated with combustion and oxidative stability. Increasing the ethanol content reduced the viscosity and density of the fuels, improving their flow characteristics but causing a slight decrease in the combustion stability.

These findings indicate that camelina-based blends can be considered as environmentally sustainable alternative fuels. Furthermore, this study demonstrates the effectiveness of PCA in biodiesel quality assessment and confirms that multivariate characterization is a powerful tool for biofuel formulation and optimization.

KEYWORDS: Camelina sativa, biodiesel, ethanol blend, multivariate analysis, PCA, fuel characterization.

Predicting Customer Purchase Behavior through Time-Series Models and Product Type Clustering: An Approach for Personalized Recommendation Systems

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ABSTRACT

The aim of this study is to analyze customers’ past purchasing behavior in order to predict the next product type they are likely to purchase and to provide personalized recommendations. The dataset includes variables such as purchase date, product type, brand, price, gender, segmentation, and customers’ favorite products and brands. Comprehensive feature engineering was performed, incorporating derived features such as the ratio of discounted products, seasonal purchase distributions, time intervals between purchases, and proximity to special days. Since the target variable originally consisted of nearly 300 product types, dimensionality reduction was applied. Using the OpenAI text-embedding-3-large model, each product type was semantically vectorized, and clusters were formed via the Affinity Propagation algorithm, reducing the classes to 31 product categories. Several time-series classification models were tested, including XGBoost, LightGBM, Random Forest, Logistic Regression, and Graph Convolutional Networks (GCN). Performance evaluation based on top-1 and top-5 accuracy revealed that the Random Forest model achieved the highest performance after hyperparameter optimization, reaching 50% top-1 accuracy and 79% top-5 accuracy.

The recommendation engine integrates predicted top-5 product clusters with event history (clicks, add-to-cart actions, purchases, and favorites) from the past six months, calculating weighted event scores to refine personalized suggestions. For customers without recent event history, recommendations are generated based on purchase history and predicted top clusters. Beyond the baseline results, this research highlights the effectiveness of combining semantic clustering with classical machine learning approaches for large-scale retail prediction problems. Unlike traditional recommender systems that operate on narrow product ranges or collaborative filtering methods limited by data sparsity, the proposed framework leverages both semantic embeddings and event-driven behavioral signals. This dual-layered approach not only improves predictive accuracy but also enhances the adaptability of the system to dynamic customer preferences. The study demonstrates practical applicability in real-world retail environments, where accurate and timely recommendations can significantly increase customer satisfaction, boost sales conversion, and strengthen brand loyalty.

KEYWORDS: Customer Behavior Analysis, Recommendation Systems, Time-Series Classification

A Comparative Thermal Analysis of Electric Vehicle Battery Pack Configurations and the Impact of Airflow Velocity on Heat Dissipation Efficiency in Thermal Management Systems

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ABSTRACT

In this study, the thermal performance of different air-cooling channel geometries (U-, Z-, and J-type) was evaluated based on a battery pack model comprising cylindrical Ni-MH battery cells. The battery module and cooling channels were modeled using the ANSYS (Student version), and a total of 144 numerical simulations were conducted for various inlet-outlet positions (ranging from 10 to 40 mm) and air velocities (ranging from 2 to 4 m/s). Average cell temperatures were determined for each configuration, and comparative analyses of thermal performance were performed.

According to the findings, the models incorporating J-type air channels exhibited the most effective cooling performance, characterized by the lowest temperature values and the most uniform temperature distribution. Although the Z-type design also yielded effective results, U-type configurations failed to provide sufficient efficiency under certain conditions. In this context, the study highlights the critical impact of channel geometry, air velocity, and inlet-outlet arrangement on the performance of battery cooling systems, offering valuable insights for the design of future battery modules.

KEYWORDS: Thermal management, Battery pack, Heat transfer, CFD, Modeling.

Development of a Rule-Based Decision Support and Control System for Autonomous Warehouse Operations and ERP Integration

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ABSTRACT

There is a significant technological gap between the business logic layer of Enterprise Resource Planning (ERP) systems and the physical execution layer of Material Flow Control Systems (MFCS) used in fully automated warehouse processes. This technological gap stems from the lack of proactive control of the systems and their limitation to reactive data exchange, thereby preventing truly autonomous and decision-driven operations. In this study, a hierarchical master-slave architecture was created between ERP and MFCS, and a rule-based and innovative decision support and control system was developed. The developed system integrates a dynamic ABC Classification Algorithm that uses real-time ERP data to optimize stock placement processes according to stochastic demand models, and a FIFO structure that optimizes shipping decisions in a multi-criteria manner by considering material receipt and production batch dates, thereby creating an integrated decision support and control mechanism. This approach transforms ERP into a central information hub, coordinating all warehouse operations without human intervention. Findings from the pilot application indicate that this integrated system can reduce order processing time by an average of 35% and increase inventory placement accuracy by 98%. As a result, an integrated cyber-physical logistics infrastructure has been developed that eliminates the need for manual decision-making in the "dark warehouse" concept, ensures data integrity, and increases operational efficiency; thus, a solid foundation has been laid for the transition to fully autonomous and data-driven warehouse management systems.

KEYWORDS: Autonomous Warehouse, Enterprise Resource Planning, Decision Support System, Material Flow Control System, Cyber-Physical Systems.

Development of a Voice-Controlled, Wearable Technology-Based Interaction Module for ERP Systems in Industrial Environments

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ABSTRACT

Current Enterprise Resource Planning (ERP) systems, primarily designed for office environments with keyboard and mouse interaction, are inefficient for dynamic industrial settings such as production floors and warehouses. This creates a significant operational challenge for operators who perform tasks using their hands in environments where physical activity is intense, hindering real-time data exchange and operational continuity. This study presents an innovative and integrated ERP interaction module that combines wearable technology and voice commands to solve such problems. The proposed system enables personnel to interact with the ERP system via voice commands through smart glasses or smart watches, providing a "hands-free" working opportunity. This enables simultaneous data entry while performing tasks such as inventory management and quality control. The developed module also includes a Natural Language Processing (NLP) engine specifically adapted to industrial terminology and a low-latency communication protocol optimized for resource-constrained wearable devices. Findings from user acceptance tests show that the voice-controlled module reduces task completion time by up to 60% in critical operations such as product picking, while also reducing human-caused errors by over 80%.

KEYWORDS: ERP, human-computer interaction, industrial environments, NLP, wearable technology.

Mechatronics Evolution based on Meta-system Transitions Theory

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ABSTRACT

This paper investigates the evolution of mechatronics and argues that metasystem transitions are undergone from simple mechatronic systems to large scale high complexity cyber-mechatronic systems. It is revealed that mechatronics enabling technologies benefited from the mechatronics approach and design progress too and their interdependence in the evolution of technology are commented. The evolution of the components, structure and characteristics, of the mechatronic systems is presented as well as the changes in control and intelligence are surveyed to show the mechatronic systems transition from quantitative to qualitative changes in mechatronics technology. Finally, the cybernetics approach is proposed for the organization of the mechatronics synergetic collectives adapting to metasystem transition evolution mode.

KEYWORDS: Mechatronics, meta-systems transition, cybernetics, interdependencies.

Effect of Outer-Ply Orientation on the Bending Performance of Stitched 0/90 NCF Carbon Laminates

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ABSTRACT

The present study evaluates the flexural response of 0°/90° stitched non-crimp fabric (NCF) carbon laminates as a function of surface-ply orientation and symmetry. Four 12-ply families were manufactured by vacuum bagging at room temperature and tested in three-point bending at a constant span-to-thickness ratio (t/L = 1/40): symmetric 0° surface (S0), unsymmetric 0°/90° (U0), unsymmetric 90°/0° (U90), and symmetric 90° surface (S90), with six specimens per family (N=24). The force–deflection data were converted to stress–strain, and determined flexural modulus and flexural strength. The findings indicate that the orientation of the outer ply exerts a predominant influence on performance outcomes. S0 demonstrates the highest levels of stiffness and strength ($E \approx 45 \pm 2.6$ GPa; $\sigma_f \approx 473 \pm 28.4$ MPa), followed by U90 (39.7 ± 2.4 GPa; 435 ± 22 MPa), U0 (38 ± 2.8 GPa; 377 ± 21.8 MPa) and S90 (32 ± 1.8 GPa; 375 ± 19 MPa). In comparison with S90, S0 exhibits an approximate increase of 40% in modulus and 26% in peak load, while maintaining constant thickness. Failure was governed by surface plies (compression-face-kinking, tension-face-cracking), and stitching introduced local heterogeneity but did not control the global response. The findings provide a straightforward guideline for bending-dominated components: the placement of 0° plies at the surfaces is recommended, and for unsymmetric stacks, the orientation of the 0° face in tension under bending loadings is advised.

KEYWORDS: Flexural performance; Stitched NCF; Outer-ply orientation; Three-point bending.

Machine Learning-Based Assessment of Construction Project Delays

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ABSTRACT

Delays in construction projects lead to significant negative consequences, such as cost increases, resource wastage, and failure to complete the project on time, posing serious risks for both investors and project stakeholders. Accurately identifying the causes of delays and predicting these adverse outcomes in advance are critical for minimizing risks in project management processes and enabling more efficient use of resources. In this context, the use of machine learning techniques for analyzing and predicting delay factors in construction projects has gained increasing importance. This study is based on a publicly available dataset collected through a survey conducted among stakeholders involved in the investment and construction process, encompassing 32 different delay factors. Each factor in the dataset was evaluated by participants using a 5-point Likert scale. To determine the importance levels of delay causes and to predict delay risks in projects, various machine learning algorithms such as Support Vector Machines (SVM), Artificial Neural Networks (ANN), and K-Nearest Neighbors (KNN) were applied. Comparative analyses showed that the factors with a more significant impact on delays could be successfully predicted. The obtained results contribute to the development of strategic decision-making mechanisms aimed at improving project planning and management processes in the construction sector. Furthermore, this study provides an important contribution to the literature regarding the applicability of machine learning techniques in construction management. For future work, it is recommended to conduct comprehensive comparisons of different machine learning algorithms to enhance model performance, update the dataset with broader and more diverse samples, and develop dynamic time series-based prediction models. These approaches will enable more effective and reliable management of construction projects.

KEYWORDS: Construction delays, K-Nearest Neighbors (KNN), Machine Learning, Support Vector Machines (SVM), Artificial Neural Networks (ANN).

Design and Implementation of the GRIMS Platform: A Multi-Layered Approach to Ionospheric Data Processing and Visualization

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ABSTRACT

Monitoring space weather conditions plays a crucial role in understanding and forecasting the impact of ionospheric anomalies on critical systems such as GNSS positioning, communications, and satellite operations. Parameters such as Total Electron Content (TEC), Proton Density, Solar Wind Speed, F10.7 index, Kp, and Dst are essential for detecting and interpreting these variations.

In this study, we present the design and architecture of the Global and Regional Ionosphere Monitoring System (GRIMS), a web-based platform developed to process and visualize multi-source ionospheric data. The platform integrates near-real-time data from global providers (NASA, NOAA, ESA, IGS, etc.), processes them using automated scripts and routines, and delivers interactive visualizations via a user-friendly web interface. GRIMS combines satellite-based TEC maps, geomagnetic indices, and GNSS observation data to offer a layered insight into the ionosphere’s dynamics.

The system is structured in multiple layers, including a backend data engine (downloading, parsing, computing), a data storage logic (organized by day-of-year and source), and a modern frontend interface capable of rendering global/regional anomaly maps, time series, and interactive plots. This architecture not only ensures extensibility and automation but also enables academic users and researchers to monitor ionospheric disturbances with high temporal resolution.

The current implementation of GRIMS is publicly accessible at www.online-grims.com and has been scientifically validated and documented in the peer-reviewed publication: https://doi.org/10.1007/s10291-024-01702-x. The system represents a novel and open-access tool for space weather studies, educational use, and ionospheric event detection.

KEYWORDS: Ionosphere, vtec, GNSS, software, web application

PSO Based Multi Criteria Design and Optimization Tool for Air Gapped EE Core Inductors

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ABSTRACT

This paper presents a MATLAB based multi criteria design tool for the systematic and manufacturable design of air gapped EE core inductors used in power electronics. The framework combines physics based analytical models with Particle Swarm Optimization to search the design space efficiently while respecting practical constraints. The workflow begins with Area Product based pre sizing, and limits on window fill, saturation, and current density are applied at the outset. Fringing effects for both the center and side legs are incorporated through geometry driven corrections, so the dependence of inductance on the air gap is represented with improved fidelity. Conductor losses are computed as the sum of direct current resistance and Dowell based high frequency skin and proximity components. Core loss is evaluated using material specific Steinmetz parameters that are consistent with the operating point. A compact thermal equivalent limits the allowable temperature rise and supports joint electromagnetic and thermal feasibility. The search space is made manufacturing aware by selecting from catalog core and wire libraries, by using integer turn counts, and by defining stepped air gap values, which yields a discrete and practical domain. The objectives, total loss and volume, are normalized and combined into a single weighted target. Violations of physical constraints activate elimination and penalty strategies and guide the swarm toward feasible candidates. Selected designs are checked in ANSYS PEmag. In a representative resonant inductor case, the inductance difference between the tool and the finite element solution is about six to seven percent and remains within a ten percent target band. This work was supported by the ITU BAP unit under project MYL-2024-46178.

KEYWORDS: Inductor design, PSO, fringing, Dowell AC loss, Steinmetz core loss, thermal modeling, manufacturability, resonant inductor.

Comparative Analysis of Software Design Visualization Methods

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ABSTRACT

Visualization is a key part of software design, helping developers, analysts, and stakeholders understand proposed systems and engage in their development. Using visualization techniques leads to better designs, fewer mistakes, and improved project results. As software systems grow more complex, skills in visualization become crucial for professionals. Many online tools are available for creating diagrams. This article explores the use of Gantt charts and Kanban boards for process visualization, along with other methods like sequence diagrams, entity-relationship diagrams, and Business Process Model and Notation (BPMN). Choosing the right tools and techniques should depend on the specific needs of the project and the team. The article also provides a comparison of major tools to help practitioners make well-informed decisions.

KEYWORDS: Software, design, visualization, Gantt chart, Kanban board, mind map, sequence diagram, ER diagram, BPMN.

Does AI Affect The Authenticity Of Evidence Presented At Court?

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ABSTRACT

Artificial Intelligence (AI) has brought transformative changes to the field of video and audio forensics, allowing both enhancement of existing evidence and generation of new media content. While AI-enhancement tools aim to clarify and improve the quality of evidence, AI-generated media often blurs the lines between reality and fabrication. This dual capability presents significant challenges to the legal system in terms of evaluating the quality of evidence presented at court. Understanding these challenges is crucial for maintaining the integrity and reliability of judicial proceedings. The growing reliance on AI tools to analyse, enhance, or generate evidence in criminal investigations and court cases is a double-edged sword. While AI can process data at scales and speeds far beyond human capabilities, it also brings an over-reliance on its outputs. There is a prevailing belief in the infallibility of AI, which can lead to the assumption that any evidence processed or created by these technologies is inherently trustworthy. A unique problem that plagues both AI-enhanced and AI-generated content is the phenomenon known as "hallucination." In the context of AI, hallucination refers to the generation of realistic but incorrect or entirely fictional data that did not exist in the original input. Thus, it is clear that the legal and ethical implications surrounding AI-generated and AI-enhanced media are vast and complex. From a legal standpoint, the use of these technologies in creating and modifying evidence challenges existing laws on admissibility and integrity of digital evidence. Many legal frameworks have yet to catch up with the technological advancements in AI, leaving gaps in regulations that can be exploited by those wishing to introduce manipulated evidence in court.

KEYWORDS: Artificial Intelligence, Audio Forensics, Deepfake, Video Forensics.

Considering AI's Capability to Influence Human Perception: A Questionnaire-Based Study

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ABSTRACT

Artificial Intelligence (AI) is so prevalent in our society that one could say that it is firmly embedded in our daily lives. AI technologies have the potential to interrupt existing social standards and cultural ethics, such as the significance of human touch in relationships and societies. To mitigate these negative consequences, AI technologies should be made and incorporated in a way that improves and complements human capabilities. This may be done by ensuring AI systems training on diverse and inclusive data sets, and that bias is continuously evaluated and addressed. The main objective of this investigation was to assess the extent to which AI can shape human perception in decision making using various techniques and methodologies, supported by findings from a questionnaire. This was considered through using a number of AI generated images of human faces, covering male, female, adult and child.

KEYWORDS: Artificial Intelligence, Bias, Deepfake, Perception.

Research on the Impact of Citizen Science Based on Distributed Computing on Sustainable Development Goals

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ABSTRACT

Citizen science projects on distributed computing enable the engagement of volunteers in processing large data sets and modeling complex scientific processes. Such projects accelerate fundamental and applied research while simultaneously contributing to the achievement of the UN Sustainable Development Goals (SDGs). This article analyzes the role of citizen science in achieving sustainable development goals, demonstrating the relationship between citizen science on distributed computing and the sustainable development. Key initiatives, including SETI@home, Folding@home, World Community Grid, and GIMPS, are also reviewed, and their contributions to health, energy, climate, innovation, and partnerships are analyzed.

KEYWORDS: Citizen science, Industry 4.0, distributed computing, e-science, sustainable development, Sustainable Development Goals, big data.

Enhancing Security Protocols in IoT Networks

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ABSTRACT

In this paper, the author investigates security issues in Internet of Things (IoT) networks, existing protection mechanisms, and how to enhance them. As IoT technologies are increasingly being applied across various industries such as healthcare, transport, industry, and domestic fronts, cybersecurity attacks on such systems have also grown immensely. This paper focuses on strengthening data protection in IoT scenarios through the use of lightweight cryptographic primitives, authentication schemes, and inter-network filtering methods. The results highlight the advantages of an optimized security protocol that is resource-aware, considering the limitations of IoT devices without compromising security.

KEYWORDS: IoT, network security, cryptography, authentication, data protection, security protocol, cybersecurity.

A Synthetic Data Generation Approach for programming Keystrokes

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ABSTRACT

Data collection in educational informatics applications is a challenging and time-consuming process. Regular collection of user interaction data and appropriate data structuring are essential; in particular, gathering and filtering usage traces such as keystrokes and editor interaction behaviors requires substantial effort. For machine learning models to train properly, large samples and appropriate hyperparameterization are necessary, and distinct datasets are also required for model testing. Expanding the sample typically requires requests to additional institutions, which in turn demand numerous documents (consent forms, privacy notices, ethical committee approvals), prolonging bureaucratic procedures. After these administrative hurdles are overcome, practical deployment—installing the required editor on each workstation, informing teachers/staff, and ensuring students use the program correctly—further increases workload and study duration; in some cases, projects are delayed, suspended, or cancelled. Synthetic data generation is a commonly used approach in such contexts. Synthetic datasets can be employed both for training and for testing machine learning systems. In this study, we generate synthetic samples from real user data consisting of keystrokes and editor-usage behaviors. Because the produced data closely resemble real interaction traces, they are suitable for use in training and evaluating models. The synthetic data augmentation procedure we describe can be adopted by other researchers conducting similar work.

KEYWORDS: Synthetic data generation, educational informatics, keystroke analysis, machine learning, data augmentation.

Investigation of Deep Soil Mixing Columns with Ground Granulated Blast Furnace Slag Durability in Sulfate Containing Soils by Triaxial Tests

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ABSTRACT

The durability of deep soil mixing (DSM) columns in sulfate-containing soils can become a significant problem. The situation is complicated by the fact that the sulfate-containing soil is the base material of the DSM columns, meaning that sulfate is not merely an external factor. In this study, ground granulated blast furnace slag (GGBFS) was used substitute of CEM I 42.5 R cement to increase the sulfate resistance of soil-crete elements constructed with DSM in sulfate-containing clayey soils. The fine-grained soil selected for the study was obtained through excavation from a local site. The experimental design was conducted using the Central Composite Design (CCD) method of Response Surface Methodology (RSM). Three groups of samples were produced and exposed to a 2% MgSO4 solution for 60, 120, and 180 days. At the end of the sulfate immersion periods, the triaxial compressive strengths of the specimens were determined. The results were analyzed using RSM, and a model equation was generated. A statistically significant model was established. The most influential parameter was the binder/soil (B/S) ratio. While the GGBFS/B ratio, which represents the GGBFS substitution rate in the binder, was effective, it was determined that a ratio above 0.5 could reduce long-term sulfate resistance.

KEYWORDS: Deep Soil Mixing, Sulfate Resistance, Response Surface Method, Ground Granulated Blast Furnace Slag.

Coloring Effect of Ferrochrome Processing Plant Waste on Porcelain Tiles

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ABSTRACT

This study investigated the usability of industrial waste generated from a ferrochrome processing plant as a colorant additive in the ceramic tile industry. Ferrochromium plant waste was added at 2-4-6% to the underglaze mixtures used in composite transparent glazes and matte products. The samples were sintered in an industrial furnace at 1200°C for 45 minutes. The color properties of the resulting surfaces were evaluated based on L*, a*, and b* values. According to the analysis results, the color tone of the samples darkened significantly with increasing waste content, while L* (lightness) and b* values decreased and a* values increased. These findings demonstrate that ferrochrome-containing waste acts as an effective colorant within the glaze system, resulting in brown tones on the surface. Consequently, it was determined that ferrochrome processing plant waste can be considered an environmentally friendly alternative colorant in porcelain tile production.

KEYWORDS: Porcelain tile, ferro chrome waste, colorant, L, a, b analysis.

Characterization of Molybdenum Coatings Applied by Thermoreactive Diffusion (TRD) Method on New Generation Nodular Graphite Cast Iron (GGG70)

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ABSTRACT

New generation spheroidal graphite cast iron is a material that is widely used in industrial applications and has excellent mechanical properties. However, its performance is limited in harsh conditions such as corrosion and high temperature. The aim of this study is to obtain Molybdenum (Mo) based coatings by Thermoreactive Diffusion (TRD) method to improve the surface properties of Spheroidal Graphite Cast Iron (GGG70), a common engineering material, and to extend its lifespan. Coating processes were carried out at two different temperatures, 1000 °C and 1100 °C, and for 1, 3 and 5 hours.

The resulting coatings were characterized in detail by obtaining XRD, Optical Microscope and Microhardness data. Microstructural studies have shown that the coating thickness is strongly dependent on both process temperature and diffusion time. In general, a thicker, more continuous and more homogeneous coating layer was formed on samples coated at 1100 °C compared to 1000 °C. As time increased at 1100 °C, the coating thickness exhibited a significant increase, proving that high temperature significantly accelerated diffusion kinetics. In coatings at 1000 °C, more irregularity and porosity were observed at the coating-matrix interface, especially for short periods of time. The hardness values of the coated surfaces increased significantly compared to the average hardness of the substrate GGG70 matrix. The high hardness on the surface is associated with the presence of high hardness intermetallic phases (MoC, MoO3, FeMo..) detected in X-Ray Diffraction (XRD) analyses. This study reveals that TRD process parameters have a direct and strong effect on the surface morphology and mechanical properties of GGG70 cast iron.

KEYWORDS: Cast iron, TRD, Molybdenum Coating, Microhardness.

Comparison of Deep Learning Models and Vision Transformers in Pneumonia Detection from Chest X-Ray Images

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ABSTRACT

In this study, various deep learning and vision transformer models have been trained for the purpose of detecting lung inflammation (Pneumonia) and evaluated via performance metrics such as accuracy, precision, recall, and f1-score. The deep learning models were AlexNet, GoogleNet, ResNet, a custom CNN and a VGG-based custom CNN. The vision transformer models were BEiT, SWIN, MobileVit and TorchVision Vit_B_16. Among these, the highest accuracy was achieved by the Vit_B_16 model with 89.74% on the test data set, while the precision, recall and f1-score values were 86.10%, 99.70% and 92.40%, respectively. The next high-performing model was GoogleNet with 85.58% accuracy, 81.40% precision, 99.70% recall and 89.50% f1-score. The performance metrics of AlexNet were very close to GoogleNet with 85.10% accuracy, 80.90% precision, 99.70% recall and 89.40% f1-score. In contrast, the BEiT model showed lowest performance compared to the other pretrained models in terms of accuracy and precision of 75.80% and 72.10%, respectively. The SWIN model also had low performance with 78.53% accuracy and 74.50% precision. The performace metrics of BEiT model were worse than our custom CNN model in terms of accuracy and precision. Our custom CNN model had 75.90% accuracy, 72.30% precision, 99.70% recall and 83.70% f1-score. Our VGG-based custom CNN model had the highest recall value of 100% along with MobileVit and BEiT. All the other models had 99.70% precision. In conclusion, the Vit_B_16 TorchVision model outperformed the other models in pneumonia detection with its highest performance in terms of accuracy, precision and f1-score.

KEYWORDS: Pneumonia Detection, Deep Learning Models, Vision Transformers, Classification.

Investigation of the Mechanical Behaviour of Superalloy Bolted Joints under Extreme Thermal Conditions for Aerospace Applications

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ABSTRACT

In recent years, the demand for advanced fastening elements has significantly increased, particularly in the aerospace and defence industries, where components are required to operate reliably under extreme environmental conditions. Literature surveys reveal that while bolted joint behaviour has been studied at room temperature and moderately elevated conditions, comprehensive analyses covering both low- and high-temperature regimes remain limited. Moreover, there is a lack of detailed studies addressing the stress and fatigue behaviour of superalloy fasteners operating at temperatures approaching 700 °C. This study focuses on the thermo-mechanical performance of superalloy bolted joints widely used in turbine and structural applications. Analytical and numerical evaluations were performed for bolted flange assemblies operating at room temperature (24 °C), 350 °C, and 700 °C. The investigation includes the determination of bolt preload, axial stiffness, and stress distribution under combined thermal and mechanical loading. Finite Element Analysis (FEA) is also conducted in ANSYS Workbench to compare results obtained from analytical calculations. The results show that increasing temperature leads to a reduction in stiffness and preload due to thermal expansion mismatch and stress relaxation. At 700 °C, the M10 aerospace-standard bolts experience notable tensile stress variation, indicating the onset of integrity-critical conditions. Additionally, the analysis confirms that maintaining sufficient preload and stiffness is essential to preserve clamping integrity and prevent loss of structural stability at elevated temperatures. Overall, the study provides a comprehensive assessment of the mechanical response of superalloy bolted joints at elevated temperatures. The findings contribute to the design optimization of fastening systems used in aerospace propulsion structures, offering practical insights for ensuring safety, reliability, and performance under severe thermal conditions.

KEYWORDS: Bolted joint, superalloys, high temperature, aerospace fasteners, thermo-mechanical analysis.

Application of Artificial Intelligence in EGovernance: Concepts, and Real-World Examples

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ABSTRACT

This study investigates the integration of Artificial Intelligence (AI) into digital governance systems and its impact on public administration efficiency. It analyzes the concepts of e-government, e-governance, and digital governance, highlighting their differences and development stages. The research examines AI methods such as Machine Learning, Natural Language Processing, Computer Vision, and expert systems, and evaluates their applications in citizen-oriented services. Comparative examples from Estonia, Singapore, the United Kingdom, and Azerbaijan demonstrate how AI enhances service delivery, transparency, and adaptive decision-making. The study also identifies challenges related to ethical frameworks, legal regulations, and human capacity, proposing strategic directions for AI deployment in governance. Overall, AI is presented as a transformative tool for creating more efficient, transparent, and citizen-centric public administration.

KEYWORDS: AI, digital governance, e-governance, public services, strategy.

E-Commerce Reviews Classification with Deep Learning-based and Transformer-based Language Models

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ABSTRACT

With the rapid advancement of technology, the e-commerce sector has been growing significantly, and user reviews have become a crucial factor influencing consumers' purchasing decisions. Therefore, categorizing user comments on e-commerce platforms has become essential for improving customer satisfaction and enhancing the accuracy of recommendation systems. In this study, deep learning-based and transformer-based language models were trained and compared to classify e-commerce reviews. The models used include BERT, DistilBERT, RoBERTa, GPT-2 based Transformer, LSTM, and Conv1D. Their performances were evaluated using Accuracy, Precision, Recall, and F1-score metrics.

According to the experimental results, the DistilBERT model achieved the highest overall performance, reaching 98.29% accuracy, 98.29% precision, 98.29% recall, and 98.29% F1-score, outperforming all other models. The BERT model showed a very similar performance, obtaining 98.13% accuracy, 98.13% precision, 98.13% recall, and 98.13% F1-score. In contrast, the RoBERTa model produced slightly lower results, with 97.71% accuracy, 97.72% precision, 97.71% recall, and 97.71% F1-score. Among the traditional deep learning architectures, the Conv1D model demonstrated strong results, achieving 97.50% accuracy, 98.58% precision, 97.04% recall, and 97.80% F1-score, thereby outperforming the LSTM model, which obtained 96.45% accuracy, 98.40% precision, 95.68% recall, and 97.02% F1-score. The Transformer-based architecture also performed competitively, reaching 96.32% accuracy, 98.37% precision, 97.74% recall, and 98.06% F1-score, although it slightly lagged behind the BERT-based models. Overall, these findings indicate that pretrained transformer-based language models outperform traditional deep learning approaches in the task of e-commerce review classification.

In conclusion, the comparison results indicate that transformer-based language models generally achieve higher accuracy and better generalization capability in classifying e-commerce reviews. Among them, DistilBERT stands out as the most effective and efficient model for this task, combining high accuracy with computational efficiency.

KEYWORDS: E-commerce, Deep Learning, Transformers, Language Models, Text Classification.

Deep Reinforcement Learning for Perishable Inventory Management under Stochastic Demand and Backordering

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ABSTRACT

Perishable products require effective inventory management under uncertain demand to balance economic losses and service levels. Deep Reinforcement Learning (DRL) methods are increasingly being employed as decision-support tools in the inventory management of perishable products, due to their strong problem-solving capabilities. This study proposes a DRL-based framework to optimize replenishment policies for perishable products under stochastic demand, positive lead times, and backordering case, assuming a single-product, single-echelon inventory system. The environment is formulated as a Markov Decision Process (MDP) to capture the sequential decision-making dynamics of the perishable inventory system. The state vector encapsulates the age-distributed inventory position together with historical backorder levels and observed customer demand quantities, while the action space is continuous, representing flexible order quantities. The reward function is defined based on backorder and perishable costs, guiding the agent toward minimizing the total expected cost. Given the continuous nature of the action space, policy gradient methods are adopted, and the Proximal Policy Optimization (PPO) algorithm is employed to ensure stable policy updates through its clipped surrogate objective function. The proposed PPO-based approach is expected to dynamically adapt ordering decisions to inventory age and demand variability, thereby reducing total costs and perishability rates, and to provide a robust and generalizable framework for managing high-dimensional, uncertain perishable inventory systems.

KEYWORDS: Perishable product, deep reinforcement learning, proximal policy optimization, inventory management.

Ruthenium-Based Nanoparticles Supported within Carbon Nanotubes for Enhanced Electrochemical Oxygen Evolution Reaction

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ABSTRACT

Hydrogen is increasingly recognized as a clean and sustainable energy carrier with significant potential to alleviate the global energy crisis. Among various production methods, water electrolysis is a well-established technique for generating high-purity hydrogen. In both acidic and alkaline media, the overall electrolysis process involves hydrogen evolution at the cathode (HER) and OER at the anode. However, the process is limited by OER at the anode, which requires a high thermodynamic potential of 1.23 V versus RHE (Reference hydrogen electrode). In practice, the operating voltage can exceed 1.8 V due to several factors, including the slow kinetics of the oxygen evolution reaction (OER). Additionally, insufficient charge transport can arise from contact resistance at the interface between the electrode materials and the electrolyte. This substantial energy requirement contributes significantly to the overall cost of hydrogen production. To address this challenge, considerable efforts have been devoted to lowering the energy barrier of the OER by developing highly efficient electrocatalytic systems. While HER generally proceeds with relatively fast kinetics, OER remains the rate-limiting step due to its sluggish reaction dynamics and complex multi-electron transfer mechanism. Therefore, enhancing OER kinetics is critical for improving the efficiency of water-splitting systems. Ruthenium-based nanoparticles (NPs) have attracted attention as promising OER electrocatalysts owing to their favorable binding energetics with oxygen-containing intermediates (e.g., OH*, O*, and OOH*) involved in the OER pathway. However, the catalytic performance is often constrained by limited electrical conductivity and insufficient surface area. To overcome these, researchers have explored strategies, including the use of a conductive support material such as carbon supports, to enhance catalytic activity and stability. While such modifications have shown improvements, they frequently result in non-uniform structures and lack precise control over active site distribution. Moreover, the synthesis of these advanced materials often requires complex procedures and incurs additional costs. At present, the literature lacks a comprehensive approach that effectively addresses all of these limitations in a single system.

In this study, a straightforward, solvent-free, environmentally friendly, and cost-effective two-step synthesis method was developed to fabricate highly crystalline, stabilized, and catalytically active ruthenium nanoparticles and their oxides supported within the one-dimensional (1D) carbon nanotubes (CNT). The synthesis of carbon-supported metallic Ru NPs (Ru@CNT) involved the initial vapor-phase deposition of triruthenium dodecarbonyl within CNT, followed by thermal decomposition of the carbonyl ligands. Comprehensive characterization of the resulting catalyst was conducted using transmission electron microscopy (TEM), powder X-ray diffraction (XRD), energy-dispersive X-ray spectroscopy (EDX), and thermogravimetric analysis (TGA). Ru@CNT material was then thermally annealed in air to produce ruthenium oxides. The electrocatalytic OER performance of Ru-based catalysts was then evaluated under both acidic and alkaline conditions and compared to commercial OER catalysts, as well as to hollow CNT. Overall, ruthenium oxides supported nanotubes exhibited higher OER efficiency in both pH environments. This is attributed to the optimal adsorption and desorption of the ruthenium oxides with reaction intermediates, facilitating water dissociation at lower potentials. Furthermore, nanoscale confinement of NPs at the interior cavity of CNT restricted their migration and coalescence, and the strong interactions between nanoparticles enabled facile charge transport from/to active sites of Ru-based NPs.

KEYWORDS: Ruthenium nanoparticles, Ruthenium oxides, Carbon nanotubes, Electrochemical water splitting, Oxygen evolution reaction.

Performance of Machine Learning Algorithms for Rainfall Prediction in Weather Forecasting

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ABSTRACT

Accurate rainfall prediction is essential for agricultural planning, disaster management, and water resource allocation. Traditional forecasting methods often struggle to capture the complex, non-linear relationships between atmospheric variables, necessitating the use of advanced machine learning techniques. This study used various machine learning classifiers for predicting rainfall in a weather forecasting dataset. The dataset was preprocessed by addressing class imbalance through undersampling, and key features were selected using Recursive Feature Elimination (RFE).

A range of classifiers, including Logistic Regression, Ridge Classifier, K-Nearest Neighbors, Gradient Boosting, Decision Trees, Random Forest, and XGBoost, were utilized. The dataset was split into 80% for training and 20% for testing. Performance evaluation metrics were employed to assess the effectiveness of the classification models. The results indicate that Random Forest, Gradient Boosting, and XGBoost achieved perfect accuracy, precision, recall, and an F1-score of 1.00. Traditional models such as Logistic Regression and Ridge Classifier also demonstrated competitive performance.

This research addresses the gap in comparative analyses of machine learning models for meteorological tasks and highlights the significance of model selection and feature engineering. The findings contribute to improving weather forecasting accuracy, directly impacting agricultural productivity, flood prevention, and urban planning. Future work may explore deep learning approaches and incorporate additional meteorological features to further enhance predictive performance.

KEYWORDS: Rainfall Prediction, Machine Learning, Weather Forecasting, Class Imbalance, Feature Selection.

MCDM and Forecasting-Based Decision Support Approach for Investments

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ABSTRACT

Many situations that have seriously affected the economy recently, such as wars, epidemics, challenges related to climate change and natural disasters, make investment planning and decision-making very difficult. In economies with increasingly fragile structures, financial and investment instruments carry a lot of risk and variability. In this case, classical forecasting methods are methodologically inadequate in making a reliable investment decision. In this study, a decision support approach that can be used effectively in investment planning with the integration of Multi-Criteria Decision Making and forecasting is presented. In this presented approach, CRITIC method was used in the weighting phase, MAIRCA method in the multi-criteria decision making phase and Fuzzy Time Series method in the estimation phase. The constructed methodology was applied on BIST 30-monthly data for 2024. In the study, parameters such as high and low price values, volume, debt/share ratio, earnings/share ratio, along with share prices, were included in the analysis process. According to the criteria weight values obtained in the study, the most effective parameters were determined as volume, equity/debt ratio and earnings per share, respectively. Performance measurements and prediction accuracies of the forecast values obtained in the study were tested with MAPE and RMSE metrics. The coefficient of variation (MAD) was used as an indicator of risk level. The analysis results show that the presented decision support approach provides quite consistent and robust results and can be useful for decision makers in making reliable decisions in investment plans.

KEYWORDS: CRITIC, MAIRCA, Fuzzy Time Series (FTS), BIST 30.

Flexible Network Management With SDN (Software Defined Networking) and NFV (Network Function Virtualization)

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ABSTRACT

The rapid development of communication technologies, cloud computing, and the Internet of Things (IoT) has created a pressing demand for flexible, scalable, and intelligent network management architectures. Traditional network infrastructures, which depend on hardware-defined, static configurations, have become increasingly inefficient in addressing the dynamic requirements of modern digital services. To overcome these challenges, Software Defined Networking (SDN) and Network Function Virtualization (NFV) have emerged as transformative paradigms in next-generation network design.

SDN introduces centralized and programmable control by separating the control plane from the data plane, thus allowing administrators to manage the entire network through a software-based controller. NFV, on the other hand, virtualizes essential network functions—such as routing, firewalls, and load balancing—enabling their deployment on standard, non-proprietary hardware rather than costly, vendor-specific devices. The integration of SDN and NFV results in a highly adaptive, software-driven network ecosystem that supports rapid deployment of services, automated orchestration, and dynamic traffic optimization.

This paper presents a comprehensive analysis of the SDN–NFV architecture, exploring their individual components, operational principles, and synergistic relationship. The study also discusses their joint impact on cloud computing, edge environments, and 5G networks, highlighting how software-defined control and virtualized functions together enhance Quality of Service (QoS), reduce operational costs, and enable on-demand scalability. Finally, it outlines current challenges in interoperability, standardization, and security, while emphasizing the potential of AI-driven automation and intent-based networking as future directions for achieving fully autonomous network management.

KEYWORDS: Software Defined Networking (SDN), Network Function Virtualization (NFV), Virtual Network Functions (VNF), network management, Quality of Service (QoS), programmable networks, cloud networking, automation and orchestration.

Reinforcement Learning Based Stabilization Control of a 2-DOF Platform

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ABSTRACT

In this study stabilization control of a two degrees of freedom (2-DOF) system was investigated from reinforcement learning (RL) point of view. 2-DOF stabilization systems utilized on maritime platforms encounter distinct challenges due to chaotic, multi-axis disturbances resulting from wave-induced motion. Conventional control techniques, especially PID (Proportional-Integral-Derivative) controllers, have been extensively used but show limitations in managing the nonlinear and time-varying dynamics that are characteristic of maritime environments.

This study presents a comparative analysis of reinforcement learning-based stabilization methods compared to traditional PID control for 2-degree-of-freedom mechanisms on sea platforms. Model-free RL methods are compared with traditional PID controllers under various wave-induced disturbance scenarios, and the results are examined. Steady-state error, settling time, robustness, and computational efficiency are some of the areas where RL methods are evaluated against PID. Furthermore, while PID controllers require significant manual tuning and system identification for changing operational conditions, RL-based methods are studied for their adaptation to changing sea conditions through learning processes. While the computational requirements of RL algorithms are higher during the initial training phase, they are minimized during the deployment phase.

The results imply that model-free RL techniques present adaptability to fluctuating sea conditions without the need for extensive system identification or manual adjustments. RL techniques offer a viable alternative to conventional control strategies, delivering enhanced robustness without the requirement for extensive system identification or ongoing manual adjustments. This establishes a basis for control systems in maritime stabilization applications.

KEYWORDS: Reinforcement Learning, Control, Stabilization, PID, 2-DOF.

Deep Learning Approaches for Forensic Writer Identification: A Comparative Study of Transfer Learning and Metric Learning Models

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ABSTRACT

Handwriting analysis is a branch of science used to determine the author and document authenticity and is frequently encountered in forensic cases. While forensic handwriting analysis used to rely on expert visual judgment and low-parameter feature extraction, today, with the development of machine learning and artificial intelligence models, applications that consider a wide range of parameters and achieve high accuracy are now available. In this study, two deep learning algorithms for author identification were tested using a dataset consisting of 2,430 scanned handwriting samples from 90 participants in three separate sessions. First, data augmentation and normalization techniques were applied to enhance handwriting discrimination and improve accuracy. Using a Convolutional Neural Network (CNN) architecture, the system was taught textural and linear representations from handwritten images. The CNN was evaluated using a categorical cross-entropy loss function and cross-validation at the author level.

In the second application, the Siamese Neural Network (SNN) model was applied after the same data augmentation and normalization techniques, and triple-loss learning was performed to learn feature embeddings that reflect similarity between handwriting samples. Using the learned metrics, both closed-set and open-set validation scenarios were created to capture intra-author consistency and inter-author variability. While our experimental results are not fully complete, the CNN-based learning model achieved strong classification accuracy on a known author population, while the SNN model demonstrated superior generalization when tested on previously unseen sessions or unobserved authors. The SNN model was found to be more robust to session-level changes such as temporal shifts in writing pressure, pen type, and handwriting style. Our results indicate that CNNs provide discriminative classification power within the dataset, while Siamese embeddings provide reliable validation across sessions.

KEYWORDS: Forensic handwriting analysis, writer identification, transfer learning, Siamese network, triplet loss, CNN, metric learning, deep learning, interpretability, open-set validation.

Green Synthesis of Zinc Oxide Nanoparticle on Cotton Fabric and Its Antibacterial Activity Against Dental Pathogen Streptococcus Mutans

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ABSTRACT

In the present study, zinc oxide nanoparticles (ZnO NPs) were synthesized on cotton fabrics using plant extracts for oral wound dressing applications. Scanning electron microscopy (SEM), energy-dispersive spectroscopy (EDS), and Fourier transform infrared spectroscopy (FTIR) were used to analyze synthesized ZnO NPs. The antibacterial activity was performed by the agar well diffusion method against the dental bacterial strain Streptococcus mutans (S. mutans). Mutans (S. mutans). S. mutans, an oral pathogen, is able to adhere to solid surfaces via the pellicle, a thin layer of salivary glycoproteins. Gram-positive cocci bacteria are responsible for the initial development of biofilm during attachment. S. mutans' ability to enter the bloodstream and bind with fibrinogen to form bacterial and platelet bridges is critical for endocarditis infection pathogenicity via platelet aggregation. The results indicated that ZnO NP-cotton fabrics have antibacterial efficiency and can be used as oral applications.

KEYWORDS: Green synthesis, cotton fabric, zinc oxide, nanoparticle, dental pathogen

Sustainable Textile Fibers

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ABSTRACT

Currently, textiles are utilized in various sectors, including construction, automotive, agriculture, medicine, and aviation, alongside apparel and home textiles. The textile industry is among the sectors that consume the most natural resources, energy, and chemicals, resulting in negative impacts on the environment. Sustainable textile studies involve items that minimize the use of natural resources and energy, are non-toxic and non-allergenic, and are biodegradable or recyclable, together with the production techniques associated with these products. The objective of sustainable textiles is to guarantee that the product life cycle—including manufacturing, use, and waste—ends without negative impacts on the environment or individuals, while preserving an optimal balance between supply and demand in the future. A sustainable product requires sustainable raw materials. The sustainability of fiber production, as the raw material for textiles, forms the foundation of sustainability efforts. In this context, researchers are conducting studies not only to use existing textile fiber resources more efficiently but also to identify new textile fiber resources. This study focuses on the sustainability of textile fibers.

KEYWORDS: Textile, fibers, sustainable, raw material, natural fibers.

Methods for Increasing Efficiency in Various Programming Languages

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ABSTRACT

This essay is concerned with theoretical and pragmatic approaches to increasing the efficiency of programming languages. It explores the approaches to optimization, code simplification, and algorithmic optimizations that enable programmers to effectively use time and system resources. The article further states the performance aspects of popular programming languages such as C++, Python, Java, Go, and Rust.

KEYWORDS: Programming language, efficiency, optimization, algorithm, compiler, code quality.

Issues of Developing a Smart Button to Prevent Child Abduction

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ABSTRACT

Child abduction remains among the most daunting social concerns in today's society. In spite of heightened awareness and application of surveillance tools, cases still happen because there is no real-time monitoring of children's locations. This paper suggests the creation of an innovative smart button for preventing child abduction. The device will be small, discreet, and comfortable to wear as a fashion accessory on a child's apparel, capable of transmitting real-time GPS data and panic messages to parents or guardians.

KEYWORDS: Child protection, intelligent button, GPS location, real-time tracking, wearable technology.

Website For The Online Legal Aid Center For Persons With Disabilities

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ABSTRACT

People with disabilities in Uzbekistan face numerous legal and social problems, including workplace discrimination, exclusion of equal access to education and healthcare services, and limited access to legal aid. The concept of an Online Legal Aid Center for Persons with Disabilities is a combined digital platform for providing accessible, free, and inclusive legal assistance. The study analyzes existing national and international programs, defines their deficiencies, and proposes an innovative solution that involves the integration of AI-based case classification, VR/AR-based legal education, and interactive assistive technologies to enhance inclusivity and legal aid delivery effectiveness.

KEYWORDS: legal aid, accessibility, artificial intelligence, disability rights, VR/AR learning, inclusion, Uzbekistan.

Deep Learning-Based Classification of Medicinal Plant Leaf Diseases Using the AI-MedLeafX Dataset and Explainable Artificial Intelligence

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ABSTRACT

Early and accurate detection of foliar diseases in medicinal plants is crucial for maintaining the quality and safety of plant-based pharmaceutical materials. This study focuses on the automated classification of thirteen classes belonging to four medicinal plant species: Cinnamomum camphora, Terminalia chebula, Moringa oleifera, and Azadirachta indica. The evaluated disease categories include Healthy, Bacterial Spot, Shot Hole, Powdery Mildew, and Yellow Leaf. Experiments were conducted using the AI-MedLeafX dataset, which contains 65,148 expert-validated and standardized images with a resolution of 512×512 pixels. Transfer learning-based deep learning architectures, including DenseNet201, InceptionV3, VGG16, and NASNetMobile, were trained and evaluated using a 10-fold cross-validation protocol. Among the tested models, DenseNet201 achieved the highest performance, with an average accuracy of 91.26%, macro precision of 88.90%, macro recall of 89.45%, and macro F1-score of 88.94%. InceptionV3, VGG16, and NASNetMobile achieved 87.28%, 86.88%, and 83.85% accuracy, respectively. In addition, explainable artificial intelligence techniques were employed, utilizing Grad-CAM to analyze the visual reasoning of the most successful model. The findings demonstrate that transfer learning-based deep learning models provide a strong foundation for multi-class classification of medicinal plant diseases and that integrating explainable AI enhances the interpretability and reliability of the results. This study contributes to the development of scalable and sustainable agricultural monitoring systems supported by interpretable deep learning frameworks.

KEYWORDS: Explainable artificial intelligence, Deep Learning, Leaf Disease Classification, Transfer Learning, Computer Vision.

MLINTEL: A Hybrid Machine Learning-Based Angular Momentum Analysis Framework with Blockchain-Enabled User Security for Real-Time Abnormal Gait Detection

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ABSTRACT

While physiotherapy is effective for muscle injury recovery, standard routines often fail due to individual variability. With over 6 million Anterior Cruciate Ligament (ACL) injuries reported annually and nearly one in four ACL surgery patients not regaining full pre-injury mobility, there is a growing need for digital rehabilitation tools. This study introduces a smart knee rehabilitation device that uses a gyroscopic sensor to track angular movement (x, y, z axes) and calculate knee joint angular momentum. A machine learning–based mobile application analyzes real-time movement, flags irregular patterns made with the dataset [1] HuGaDb from github, and visualizes deviations from healthy motion. It generates progress graphs to illustrate mobility and gait improvements post lower-body injury. The system offers personalized recovery assessments, leveraging real-time data and individual variability. Beyond gait monitoring, the device supports rehabilitation of various lower body injuries and neurological conditions affecting movement. It provides actionable insights for physiotherapy or lifestyle changes, with future plans to integrate deep learning for precise healing predictions and tailored treatment timelines. With our current model using LSTM accuracy to detect gait pattern is 75% and with a LSTM + CNN the accuracy is 90%. To ensure secure handling of patient data, the application incorporates a blockchain-enabled user authentication system, allowing login through decentralized identity accounts (such as MetaMask or other blockchain-linked credentials). This guarantees privacy, data integrity, and transparent access control for users' medical information.

KEYWORDS: Gait Cycle, Health Monitoring Application, IoT, AI/ML, Blockchain.

Establishing Unmanned Aerial Vehicle (UAV) Air Corridors in Türkiye: A Strategic Framework for Logistics, Health and Defense

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ABSTRACT

Unmanned Aerial Vehicles (UAVs) have emerged as a disruptive technology, transitioning from military reconnaissance to widespread civil applications such as logistics, healthcare, disaster management, agriculture, energy, security, and urban planning over the last two decades [1]. This shift establishes UAVs not merely as flying platforms but as fundamental elements of a holistic air transport and logistics ecosystem. In this context, the concept of “UAV Air Corridors” refers to the creation of designated routes, layered traffic lanes, and airspace configurations to ensure safe, orderly, and efficient flight operations for unmanned systems. Similar to highways in road traffic, these air corridors also assume a similar role: standardized routes, traffic regulations that reduce the risk of collision, optimal route selection, and emergency management [2]. The establishment of these corridors is critical for high-density inter- and intra-city UAV operations. For a country with significant geostrategic importance and a network of both large cities and rural regions like Türkiye, designing such corridors is of strategic value for national security and economic development.

KEYWORDS: UAV Air Corridors, Unmanned Traffic Management (UTM), Drone Logistics, Healthcare, Defense, Strategic Planning.

Design and Implementation of an Intelligent Multi-Supplier Tour Management Platform within the Context of Digital Transformation

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ABSTRACT

This study examines the design, architectural framework, and sectoral efficiency impacts of an intelligent tour management platform developed to accelerate digital transformation in the tourism industry. In today's tourism ecosystem, suppliers and tour operators often manage fragmented operations across multiple disconnected systems, leading to inefficiencies in data integrity, process visibility, and managerial coordination. The proposed system offers a supplier-centric, integrated, and scalable digital transformation model that effectively addresses these challenges. The platform is built upon a multi-supplier architecture, providing each supplier with customized dashboards, authorization layers, and data visibility levels. Suppliers can digitally manage all operational processes such as tour creation, hotel and cabin management, additional service configuration, user authorization, sales reporting, and change log monitoring. This integrated structure has resulted in a 65% reduction in manual data entry, a 40% improvement in transaction completion time, and up to a 30% increase in sales management efficiency.

The system architecture is designed to be fully compatible with big data analytics, enabling the standardized collection and storage of supplier, sales, tour category, and user interaction data. This architecture establishes a strong foundation for the integration of advanced analytical applications such as demand forecasting, dynamic pricing, and supplier performance modeling using machine learning algorithms. Thus, the platform not only digitalizes operational workflows but also contributes to the development of data-driven decision support mechanisms. Furthermore, the platform's modular and microservice-based design enhances its sustainability and scalability dimensions. This allows both small regional suppliers and large multinational tour operators to operate efficiently within the same ecosystem. Through cloud-based data processing and secure API integrations, the system can be seamlessly adapted to various geographic markets. This adaptability demonstrates that digital transformation in tourism can be expanded sustainably on both local and international scales. In conclusion, the study demonstrates that digital transformation in the tourism industry can be achieved sustainably at a multi-supplier scale. The findings reveal that measurable efficiency gains can be realized through process automation, data management, and analytical capacity building. Therefore, the proposed platform represents a concrete and scalable example of data-centric digital transformation in tourism technologies.

KEYWORDS: Tourism Technologies, Digital Transformation, Multi-Supplier Architecture, Operational Efficiency, Big Data.

Accelerating Drug Discovery Using Artificial Intelligence: Approaches and Prospects

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ABSTRACT

The process of drug discovery is traditionally time-consuming, costly, and plagued by high attrition. Advances in artificial intelligence (AI) over the past few years have immense potential to accelerate various steps in drug development, from the discovery of targets to compound screening to pharmacokinetic optimization. The article reviews the current status of AI-based technologies in drug discovery with a focus on machine learning algorithms, deep learning architectures, and computational methods that have been found to enhance efficiency. Case studies demonstrate how AI has reduced discovery timelines and increased success rates in preclinical trials. Data quality, interpretability, and regulatory acceptability are some of the challenges addressed as well. The study concludes that the incorporation of AI in drug development pipelines can accelerate innovation, reduce costs, and maximize the chances of discovering effective therapeutic agents.

KEYWORDS: Artificial Intelligence, Drug Discovery, Machine Learning, Deep Learning, Pharmacokinetics, Computational Drug Design.

Modeling the Combustion Process in a Spark Ignition Engine with Single and Double Vibe Functions

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ABSTRACT

Different predictions are put forward about the future of automotive mobility. Although the number of electric vehicles has increased, some uncertainties regarding these vehicles have not disappeared for manufacturers and consumers. Therefore, internal combustion engines used in hybrid vehicles, etc., should be improved in terms of efficiency and exhaust gas emissions. Simulation studies accelerate this development process. In this study, a single cylinder research engine model was created using a one-dimensional simulation program (AVL Boost). The combustion process in the model was formed using the Vibe function. Experimental studies confirmed that the single Vibe function could not fully represent the measured pressure curve. In the selected engine operating conditions, the shape factor (m) was taken as 2.0, the combustion duration (0-90% period) as 38 CA and the alpha coefficient as 6 in the single Vibe approach. It was determined that the pressure curve obtained with the Single Vibe function showed more deviation during the expansion process, especially after the position where the maximum pressure occurred. For this reason, studies were conducted with the double Vibe function, which is also used in the literature. In this case, in the first section where 82.5% of the fuel is burned, the shape factor (m1) is determined as 2.7 and the combustion duration is determined as 33 CA. The alpha coefficient was chosen as constant in both sections. The pressure curve obtained with the double Vibe function was in good agreement with the measured pressure curve. Under these conditions, maximum cylinder pressure and net indicated mean pressure are calculated with a 1% deviation.

KEYWORDS: Spark ignition engine, Vibe function, one dimensional model, shape factor, combustion duration.

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Design and Implementation of an SNMP-Enabled Ethernet Switch for In-Vehicle Embedded Systems

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ABSTRACT

The increasing integration of electronic subsystems in-vehicle such as IP cameras, validators, and driver control panel has created a growing need for unified management architecture in public transportation networks. These systems require reliable data communication and continuous power supply to ensure operational stability and passenger safety. To address this requirement, a Power over Ethernet (PoE)–enabled managed Ethernet switch was developed using the STM32F107RCT6 microcontroller, which features an ARM Cortex-M3 core, an embedded Ethernet Media Access Control (MAC), and a Reduced Media Independent Interface (RMII) interface. The switch provides both communication and power distribution to multiple devices through a centralized network topology, ensuring energy-efficient and synchronized operation across all connected components. In this study, a Simple Network Management Protocol (SNMP)–based monitoring and control architecture was implemented on the same embedded platform. The firmware integrates the Lightweight IP (LWIP) stack to enable TCP/IP-based communication and real-time data exchange between the microcontroller and the network infrastructure. A custom Management Information Base (MIB) structure was designed to define and access device-specific parameters such as PoE port power status, vehicle ignition state, and battery voltage level. Through the implemented SNMP agent, the switch gains full managed-switch functionality, allowing remote configuration, monitoring, and diagnostics directly over the ethernet connection. This eliminates the need for additional communication interfaces or higher-level protocols, as the system can be fully managed using standard SNMP manager software via the existing network cable. The proposed implementation provides an efficient and low-resource solution for embedded network management in-vehicle.

KEYWORDS: PoE Ethernet Switch, SNMP, STM32, LWIP, Custom MIB, Embedded Network Management.

Feature Selection in Medical Data Using the Crested Porcupine Algorithm and the Island Model

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ABSTRACT

This study introduces a new feature selection method that combines the Crested Porcupine Optimizer and the Island Model. In experiments using the Lung Cancer dataset, the method was tested with a KNN classifier. Crested Porcupine Optimizer balances accuracy and dimensionality reduction while selecting the most relevant features. The island structure enhances overall performance by maintaining diversity. Results show that over 83% accuracy was achieved with 5 islands and 10 individual migrations, along with high performance using only 6 features. These findings demonstrate the method's usefulness in clinical data analysis, achieving high accuracy with few features.

KEYWORDS: Crested Porcupine Optimizer, Island Model, Feature Selection, K-Nearest Neighbor, Lung Cancer Data.

Angle Measurement in Orthoradiogram Images Using Deep Learning

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ABSTRACT

Accurate and rapid evaluation of lower extremity deformities is of critical importance in orthopedic diagnosis and treatment processes. In traditional methods, deformity analyses are performed manually using precise angular measurement tools such as goniometers; however, this process is time-consuming and subject to observer variability. In this study, a deep learning–based system was developed to automatically detect the anatomical landmarks required to calculate the mechanical axis angles mLPFA, mLDFA, mMPTA, and mLDTA, and to perform the corresponding angle calculations. The YOLOv11-Pose model was employed to detect key points of the femur and tibia bones, adopting a keypoint-based approach rather than segmentation-based methods commonly found in the literature. A total of 774 images were obtained from The Osteoarthritis Initiative (OAI) database, followed by preprocessing and annotation procedures. The model's performance was evaluated using precision, recall, mAP50, and mAP50–95 metrics, achieving 99.61%, 99.90%, 99.45%, and 97.86%, respectively. The model was integrated into a C# based software application, enabling physicians to obtain deformity analysis results with a single command. The findings demonstrate that the proposed system provides a fast, reliable, and highly accurate deformity analysis, serving as an effective alternative to manual measurement methods. Moreover, this study accelerates clinical decision-making processes and offers a methodological alternative to segmentation-based approaches.

KEYWORDS: Deep Learning, Keypoint Detection, Medical Imaging, Deformity Analysis, Lower Extremity.

Attention Mechanisms in EEG Seizure Prediction: Temporal, Spatial, and Spatiotemporal

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ABSTRACT

EEG-based seizure prediction remains challenging due to the complex spatiotemporal nature of preictal brain dynamics. While deep learning has shown promise, many architectures implicitly treat spatial locations and time points uniformly. This study quantifies the value added by attention on a lightweight EEG model via three variants: Temporal Attention (TA), Spatial/Channel Attention (SA), and Spatiotemporal Attention (STA). We use the CHB-MIT dataset with 12 subjects spanning different ages and seizure types. All variants share an identical training protocol and closely matched parameters. We report Sensitivity, False Alarms per hour (FAR/h), F1, AUC, PR-AUC, and FPR at Sensitivity = 0.8. The evaluation isolates the contribution of attention along temporal, spatial, and joint spatiotemporal axes, providing a reproducible protocol for seizure-prediction studies.

KEYWORDS: Attention, Epilepsy, Spatial, Seizure, TCN, Temporal.

The Effect of Production Parts Stock and Order Parameters on Coverage Range and Stock Load:An Optimization Approach

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ABSTRACT

The objective of this thesis is to optimize the stock and order characteristics of around 2,000 production parts and assess how they affect coverage days and overall inventory costs in a manufacturing setting. One important measure of material availability in production planning is the coverage value (RW), which is the number of days that existing stock can supply production demand. While inadequate coverage increases the chance of a stockout, excessive coverage causes excessive inventory storage and higher costs.

The study examines how a number of operational factors, such as safety stock level, order lot size, minimum order quantity (MOQ), lead time requirement, and products acceptance duration, affect coverage days. Both optimization modeling and descriptive analysis were used to statistically analyze these variables. The optimization model, which was created using a Genetic Algorithm (GA), seeks to balance the coverage of each part with its goal range (15–30 days) while minimizing the overall cost of inventory. The estimation accuracy of effective coverage days was increased by using a multi-regression approach to anticipate variable lead-time deviations.

This thesis combines optimization strategies based on artificial intelligence with quantitative analytic techniques. To evaluate the impact of important stock management parameters on coverage days (RW), a parametric analysis was conducted in the first stage on a dataset that included roughly 2,000 production items. The links between stock parameters and coverage performance were shown using statistical and visual techniques such box plots, scatter plots, and correlation analysis. To ascertain the ideal safety stock level, order lot size, and lead time needed for every part, a Genetic Algorithm (GA) was used in the second stage.The goal function of the GA is to ensure material availability without the possibility of a shortage by achieving the desired coverage level at the lowest feasible total stock cost. Decision variables such as safety stock, lot type, lead time requirement, and minimum order quantity (MOQ), if applicable, made up the chromosomes. In order to predict future demand sufficiency, coverage day simulations were carried out in the third stage utilizing the optimized parameters. The model was trained using historical data, and its accuracy and robustness were evaluated using test and validation sets. All analyses were carried out utilizing sophisticated data science libraries in the Python programming environment. Comparative scenario testing, sensitivity analysis, and cross-validation were used to confirm the results' reliability.

By lowering inventory costs, balancing coverage days, and lowering stockout risks, the created model directly improves operations when included into manufacturing organizations' decision-support systems. The suggested parameter optimizations are completely relevant to real industrial environments because the model is based on actual production data. In this way, the model strategically aids in minimizing material supply delays, preventing production line disruptions, and creating a leaner production structure. Moreover, the findings of this thesis could potentially form the basis of software projects in the manufacturing industry, specifically for the creation of prototype solutions that can be included into ERP/MRP.

KEYWORDS: Safety stock, coverage, genetic algorithm, artificial neural networks, order lot size, goods receipt time, inventory cost.

A Performance-Based Study on the Seismic Behavior of a 13-Story Reinforced Concrete Building on Very Soft Soil Using TBDY-2018 Criteria

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ABSTRACT

The 6.6 magnitude earthquake that struck the Bayraklı district of İzmir, one of Turkey's regions with a high seismic hazard, resulted in the collapse or severe damage of numerous buildings and caused significant loss of life. This tragic event once again emphasized the necessity of improving the seismic performance of existing and newly designed structures, particularly those located in areas with soft soil conditions and high earthquake risk. Although residential buildings in such regions are generally designed in compliance with earthquake code requirements, additional performance-based analyses for multi-story structures are essential to ensure higher reliability, minimize structural damage, and reduce both human and economic losses. In this study, the seismic performance of a newly designed 13-story reinforced concrete building constructed on ZF-class (very soft soil) ground was investigated. The structural model was developed in accordance with the soil parameters and earthquake design spectra specified in the Turkish Earthquake Code (TBDY-2018). Nonlinear analyses were carried out to assess the structural behavior under earthquake loading. The results obtained from these analyses including interstory drift ratios, plastic hinge formations, and section damage states were compared with the performance levels defined in the code. Based on these comparisons, the building's response to potential earthquake effects was evaluated in detail, providing insight into its overall seismic safety and identifying critical aspects that could be improved for better earthquake resistance.

KEYWORDS: Earthquake performance, Performance analysis, Reinforced concrete building, Structural system behavior, Soft soil.

Effect of Mechanical Alloying on the Structural and Magnetic Properties of Nanostructured FeCo and FeCoO Alloys

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ABSTRACT

This comprehensive study delves into the synthesis, structural evolution, and magnetic behavior of nanostructured iron-cobalt and iron-cobalt oxide alloys, emphasizing the influence of mechanical alloying on these properties. Fe-CoO and Fe-Co alloys were synthesized through high-energy ball milling, and their properties were examined using a combination of scanning electron microscopy (SEM), X-ray diffraction (XRD), and vibrating sample magnetometry (VSM). Our research focuses on the intricate relationship between milling duration, particle size reduction, microstructural modifications, and their impact on the magnetic and electromagnetic properties. Both alloys exhibited enhanced magnetic characteristics as milling time increased; however, key differences were observed in structural stability, and coercivity, behaviors. These findings provide valuable insights for optimizing the material properties for future industrial applications.

KEYWORDS: Nanostructured materials, FeCo, FeCoO, Magnetic and structural properties.

Next-Generation Approaches to Animal Welfare: AI and Biometric Technologies for Ruminants

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ABSTRACT

As in all other areas, digital transformation has also made rapid inroads into the livestock sector in recent years. As a result, artificial intelligence is also being used more and more frequently for the identification of ruminants, which has become an important area of research. Conventional methods such as ear tags, microchips, and RFID have their limitations as means of identification, particularly in animals that are naturally difficult to control and exhibit aggressive tendencies, due to problems such as wear and tear and data loss. Therefore, contactless identification systems such as computer vision, deep learning, and biometric authentication are receiving increasing attention.

This study extensively evaluates the current approaches, advantages, and limitations of using artificial intelligence and computer vision technologies for ruminant identification. Research was conducted on the automatic recognition of biometric features such as faces, nose prints, skin patterns, and body morphology using deep learning-based architectures. Furthermore, the process of data collection, the influence of imaging conditions on model performance, and the importance of data augmentation techniques were discussed.

In conclusion, it was emphasized that AI-supported identification systems can contribute to improved animal welfare, better disease detection, increased production efficiency, and stricter traceability standards. However, it was concluded that large-scale field applications require larger datasets, multimodal approaches, and explainable AI mechanisms.

KEYWORDS: Artificial Intelligence, Identity Detection, Ruminants.

Convolutional Neural Network–Based Emotion Recognition Using Time–Frequency Analysis of Raw EEG

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ABSTRACT

Emotion recognition systems have become an important research area in human–machine interaction and psychological health technologies, relying on the analysis of indicators such as facial expressions, voice, body language, and physiological signals to recognize emotions. Particularly in fields such as education, mental health, and neuromarketing, accurate and real-time emotion recognition enables intelligent systems to produce more meaningful, context-appropriate, and personalized responses. In recent years, a large number of studies have focused on electroencephalography (EEG), as EEG provides detailed information about the brain's physiological state. In this study, we used the publicly available SEED-IV dataset to perform a four-class emotion classification (happy, scared, sad, and neutral). Unlike many previous SEED-IV studies, we directly utilized the raw EEG signals. The data were filtered using traditional preprocessing techniques, interpolation was applied to address missing data, and time–frequency features were extracted from the augmented signals using STFT. These features were used to train a lightweight two-dimensional convolutional neural network (2D-CNN) composed of two convolutional layers. The proposed model achieved an average test accuracy of 93.58% (±0.69) over five runs, with an average F1-score of 0.936 (±0.0069).

KEYWORDS: Convolutional Neural Network, Emotion Recognition, Data Augmentation, STFT, Electroencephalography (EEG).

Hyperparameter Optimization of the RF-DETR Model for Gun and Knife Detection in Surveillance Cameras

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ABSTRACT

Gun and knife detection in security systems plays a vital role in enhancing public safety by enabling the early detection of potential threats. However, the application of the RF-DETR model in this field and its hyperparameter optimization are limited in the literature. This study examines the performance of the RF-DETR model for gun and knife detection on a small-scale dataset and evaluates the effect of hyperparameter optimization on the most suitable model. A dataset consisting of 1,503 images was used to compare the RF-DETR, RT-DETR, and YOLOv11 models. Each model was trained using data augmentation techniques such as scaling, mosaicking, and random cropping, with transfer learning DINOv2 for RF-DETR, ResNet50 for RT-DETR, and the medium variant for YOLOv11. An early stopping method was applied for each model, and model performance was evaluated using the mAP@0.5 metric. The RF-DETR model achieved an mAP@0.5 score of 0.894, outperforming both RT-DETR and YOLOv11. Furthermore, its real-time applicability was demonstrated with class-based F1 scores (F1_gun = 0.811, F1_knife = 0.861) and a speed of 22.45 FPS. Following these results, nine experiments were conducted on the RF-DETR model using combinations of decoder layer counts (3, 6, 9) and query counts (100, 300, 500). The performance of the experiments was evaluated using the mAP@0.5:0.95, precision, recall, and F1 scores. Hyperparameter optimization demonstrated that RF-DETR can deliver high performance on security cameras with small datasets, increasing its accuracy by 4.3%.

KEYWORDS: RF-DETR, Hyperparameter Optimization, Object Detection, Surveillance Cameras, Transformer.

Experimental, Numerical, and Nondimensional Study on the Dynamics of Underwater Towed Cables

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ABSTRACT

The hydrodynamic performance of underwater towed cables is of critical importance both in terms of achieving maximum depth with minimum cable length and in ensuring the efficient performance of the acoustic sonar system. In this study, which was conducted to determine the hydrodynamic characteristics, both numerical and experimental investigations were carried out to predict the depth performance of underwater towed cables equipped with different fairing types. Three fairing configurations—namely, the hairy, helical, and ribbon types —were tested in different sample sizes at the ITU Ata Nutku Ship Model Experimental Laboratory. The experiments aimed to determine the tangential (Ct) and normal (Cn) components of the drag coefficient under controlled flow conditions, and to identify the most suitable fairing type for maximum depth performance. The measured coefficients were then used to determine the hydrodynamic forces and as input parameters in a finite element model (FEA) developed to simulate the nonlinear dynamics of the towed cable under gravitational, buoyant, and tow-body forces. Here, the tow-body forces are the gravitational, buoyant, and drag forces of the towed structure, which is attached to the end of the cable and houses the acoustic sonar system. A similarity study was also conducted using the cable's drag force components and the tow-body parameters. Using the resulting dimensionless numbers, scaled-down models were created to predict the depth performance of full-scale systems. Parametric studies examined the effects of towing speed, cable length, and fairing type on steady-state depth and trajectory. The results show that the fairing types used significantly alter the cable's hydrodynamic characteristics, and these changes ultimately affect depth performance. This study used both experimental and numerical methods to measure the hydrodynamic drag forces acting on underwater towed cables and to calculate drag coefficients. Subsequently, a combination of dimensional analysis and a finite element model was developed to estimate the system's depth performance.

KEYWORDS: Underwater Towed Cable, Finite Element Analysis (FEA), Dimensionless Analysis, Drag Coefficient, Fairing, Hydrodynamic Performance.

Determination of the Change in Rated Values of an Induction Motor in S1 Continuous Operation Considering Cooling Effects Using Finite Element Analysis

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ABSTRACT

In today's industry, the machinery sector has a wide range of applications. Requirements vary significantly across different applications, primarily due to differences in performance criteria, space limitations, and environmental conditions. Compressor and vacuum pump applications are specific in terms of space constraints, where motor outer diameters are often limited. For such applications, compact permanent magnet solutions with high power density or forced cooling methods are used to enhance power output.

In this study, a three-phase, class F, two-pole, 2.2 kW IE3 efficiency class induction motor with diameter and thermal constraints was analyzed using the finite element analysis under different operational conditions. Different cooling methods was used to obtain the same resultant temperature for different power ratings to determine the rated power of the operation that certain cooling methods or cooling level applied. Resultant power values were compared with nameplate values. The test motor was evaluated under both standard and forced cooling conditions, and significant improvements were observed in efficiency and thermal performance with forced cooling. Additionally, at the thermal limit of the insulation system, forced cooling enabled a considerable increase in load capacity within the same thermal boundaries. Increased power density levels are also calculated and given in comparison.

KEYWORDS: Finite Element Analysis, Cooling Method, Induction Motor, Thermal Modeling, Efficiency Improvement.

Biotechnological Applications to Mitigate Environmental Pollution

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ABSTRACT

Urbanization, mining, and industrialization are the main causes of environmental pollution. Air, water, and soil pollution are the most fundamental types of environmental pollution. Particularly at the beginning of the industrial revolution, the long-term effects of pollution were not anticipated. Therefore, the necessary measures were not taken in time; environmental pollution has become a permanent threat to quality of life. It is essential to develop biotechnological applications aimed at reducing this threat as much as possible. Over the years, many biotechnological solutions, such as biofuels, biopesticides, and bioremediation, have been developed in a more economical and sustainable manner. In addition to using wild type organisms or their waste products, genetically modified organisms are also used in the development of these solutions. This study aims to address the main causes of environmental problems and introduce the primary biotechnological solutions that will eliminate these causes. This study also covers technical details, the current situation, and future approaches to existing biotechnological solutions.

KEYWORDS: Environmental Pollution, Biotechnology, Biofuels, Biopesticides, Bioremediation.

A Digital Framework for Historical Law: NLP Applications to the Mecelle-i Ahkâm-ı Adliyye

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ABSTRACT

This study presents a computational framework for the thematic classification and semantic analysis of the Mecelle-i Ahkâm-ı Adliyye (1868–1876), the foundational Ottoman Civil Code. The corpus comprises 1,673 legal articles organized into 16 thematic "Books," each reflecting a distinct area of civil law. A comparative supervised learning approach was implemented, combining deep transformer-based modeling with traditional machine learning baselines. An optimized Turkish Bidirectional Encoder Representations from Transformers (BERT) model (dbmdz/bert-base-turkish-cased) was fine-tuned with class weighting, oversampling, and extended input length (512 tokens). It achieved 86.9% accuracy and a 0.847 Macro-F1 score, closely matching the Support Vector Machine (SVM) baseline (87.76%, Macro-F1: 0.8686). While SVM yielded slightly higher accuracy, the transformer captured richer semantic relations among Ottoman legal terms. By preserving Ottoman-origin lexicon and addressing class imbalance, the study ensures semantic and linguistic fidelity. This study contributes to the relatively underexplored application of supervised Natural Language Processing (NLP) methods to Ottoman legal corpora. The research bridges digital humanities and computational law, offering a scalable framework for thematic classification, semantic retrieval, and diachronic modeling of historical legal discourse.

KEYWORDS: Mecelle, Ottoman Law, Legal Text Classification, Natural Language Processing, Turkish BERT.

Improvement of Clustering Performance With Chaotic Logistic Map-Based Black Winged Kite Algorithm (CBKA)

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ABSTRACT

Clustering is a significant optimization problem aimed at grouping data based on their similarities. In this study, the performance of the Black Winged Kite Algorithm (BKA) for clustering tasks is enhanced by using the Chaotic Black Winged Kite Algorithm (CBKA), which integrates chaotic mapping techniques with the logistic map. While BKA, inspired by the behavior of natural systems, offers an effective method for solving clustering problems, it faces certain limitations, such as early convergence and the tendency to get stuck in local optima. To address these issues, CBKA utilizes the logistic map to improve the search capability and clustering performance. Experimental results demonstrate that CBKA outperforms BKA in clustering problems, yielding more accurate and effective results. These findings highlight CBKA as a robust alternative for solving clustering problems, offering stronger performance in comparison to traditional methods.

KEYWORDS: Clustering, Black Winged Kite Algorithm (BKA), Chaotic Mapping, Optimization Algorithms.

The Impact of HSR Systems on Real Estate and Entrepreneurship in Türkiye

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ABSTRACT

This study investigates the impact of High-Speed Rail (HSR) systems, which have been in service since 2009, on real estate prices and entrepreneurship. Considering lines that have been in service for at least ten years, the study examined the provinces where passenger transportation is provided on the Ankara-Eskişehir, Ankara-Konya, and Ankara-Istanbul lines. The selected criteria were determined based on literature and expert opinions as follows: 'Employment rate', 'GDP', 'Number of workplaces', 'Number of tradesmen', 'Number of closed businesses', 'Number of housing units', 'Land price', 'Commercial real estate price', and 'Housing price'. Annual changes for the selected provinces between 2021 and 2025 are shown on the map using Geography Information Systems. The impact of HSR systems on the determined criteria on real estate and entrepreneurship was evaluated by experts using the AHP technique. Using the TOPSIS technique, the rankings based on the criteria weights and relevant data were examined for the years 2021 and 2025 using the TOPSIS technique. It is expected that the results obtained from these studies will contribute to the planning of HSR in future studies.

KEYWORDS: HSR planning, Real estate, Entrepreneurship, MCDM, GIS.

Numerical Investigation for Wake Characteristics of an Elliptical Cylinder

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ABSTRACT

Wake characteristics of an elliptical cylinder have been numerically examined at Re = 150 and Re = 250. The numerical results have been exhibited as pressure distributions, streamwise velocity components and cross-stream velocity components. The peak pressure values have been identified at the locations directly in front of the elliptical cylinders. This phenomenon is attributable to the flow stagnation point where the value of local velocity is zero. The observed pressure increment is associated with the conversion of kinetic energy into pressure. Conversely, the lowest values for pressure have been recorded in the wake regions of the elliptical cylinders. The influence of the tips on both the upper and lower regions of the elliptical cylinder has been shown to induce flow separations. It has resulted in the development of a wake region behind the elliptical cylinder. The characteristics of the wake region revealed intricate flow patterns. The highest values of the streamwise velocity components have been observed because of separated flow. In this context, the effect of oscillation became particularly pronounced. Flow deceleration has been distinctly noted for the upstream region of the elliptical cylinder. On the other hand, the lowest streamwise velocity components have been attained in the wake regions. These flow separations also led to the formation of distinct clusters. The maximum and the minimum values of cross-stream velocity components have been obtained by the upper and lower tips of the elliptical cylinders, respectively. Furthermore, the directions for the maximum values are clockwise and these are counterclockwise for the minimum values.

KEYWORDS: Elliptical cylinder, drag coefficient, flow characteristics, Reynolds number, wake region.

Hybrid model for DGA Detection in Cybersecurity: FastText, CNN, BiLSTM, and Multihead Attention

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ABSTRACT

Domain Generation Algorithms (DGAs) is a crucial threat in modern cybersecurity; it enables malware to generate dynamically pseudorandom domain names for command-and control (C&C) communication to evade blacklisting detection mechanism. Many concealing techniques are used to address network botnets, thus DGAs still require more effective process. This work presents a novel hybrid deep learning model integrating FastText, Convolutional Neural Networks (CNNs), Bidirectional Long Short-Term Memory (BiLSTM) and Multihead Attention mechanisms for strong DGA detection. Our methodology uses FastText's subword-level semantic representations to capture morphological patterns, CNNs for the local feature extraction, BiLSTM for bidirectional context modeling, and attention mechanisms to identify prominent sequence dependencies. We evaluate the hybrid model on the University of Murcia Domain Generation Algorithm Dataset (UMUDGA) combined with Alexa top 1 million legitimate, resulting in 97,3% accuracy, 97,29% F1-score and 99,6% ROC-AUC. Comparative analysis with baseline methods such Random Forest, LSTM, CNN and GAN demonstrate superior performance and generalization capability. Our hybrid architecture addresses the limitations of traditional machine learning and deep learning approaches; it provides an efficient and scalable solution for real-time DGA detection for cybersecurity.

KEYWORDS: Domain Generation Algorithms (DGAs), CNN, BiLSTM, Multihead Attention, Cybersecurity.

A Hybrid NLP Framework for Multi-Task Social Media Analysis: Stance, Emotion and Topic Detection in Polarized Discourse

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ABSTRACT

Social media is where many of today's geopolitical debates play out, including highly sensitive issues like the Israeli-Palestinian conflict. But these conversations aren't simply "positive" or "negative." They combine positions, emotions, and themes in ways that basic sentiment tools miss. We present a Natural Language Processing (NLP) framework that looks at Reddit discussions through three lenses at once: stance (pro-Palestinian, pro-Israeli, or neutral), emotion (e.g., anger, fear, sadness), and topics (themes discovered via topic modeling). Using 50,000 Reddit comments, we initially labeled stance by subreddit and trained an Extreme Gradient Boosting (XGBoost) classifier. Headline metrics looked strong—91.9% accuracy and 91.6% weighted F1 on a 10,000-comment test set—but the data were 72% neutral, so we also used Balanced Accuracy (83.9%). That revealed uneven recall: 79.6% for pro-Israeli and 73.4% for pro-Palestinian comments. Emotion analysis showed neutral tone at 40%, substantial negativity—anger at 25.3%—and very little joy <2%. Topic modeling surfaced recurring threads on specific conflict events, history, political leaders, and international diplomacy. Together, these views offer researchers and policymakers a clearer, more responsible picture of polarized online discourse—and a reminder to look beyond headline accuracy when evaluating NLP on imbalanced, sensitive data.

KEYWORDS: Natural Language Processing (NLP), Stance Detection, Emotion Analysis, Topic Modeling, Machine Learning.

Investigation of the Creep Performance of Basalt Fiber-Reinforced Hot Mix Asphalt Under Different Temperatures

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ABSTRACT

Asphalt is the most widely used paving material globally due to its cost-effectiveness, ease of construction, and smooth driving surface. However, its susceptibility to deformation and frequent maintenance requirements under increasing traffic loads and environmental stress underscore the need for performance-enhancing modifications. Basalt fibers, known for their high tensile strength, heat resistance, and eco-friendliness can be used as an alternative to mitigate this imperfection. This study investigates the influence of basalt fiber reinforcement on the static creep behavior of hot mix asphalt (HMA) under varying temperature conditions for four different dosages (0.00%, 0.05%, 0.15%, and 0.25% by weight of aggregate). 100 mm diameter specimens were prepared by using a gyratory compactor and subjected to static creep testing at 25°C and 60°C under a constant axial stress of 500 kPa for 3600 seconds. The Marshall Stability and Flow tests identified 0.05% fiber content as the optimum dosage, enhancing both load-bearing capacity and deformation control. At 25°C, the inclusion of basalt fibers significantly reduced accumulated strain and improved creep stiffness, with 0.05% content yielding the best performance. In contrast, at 60°C, fiber-reinforced mixtures exhibited higher strain and lower stiffness than the control, indicating reduced effectiveness of fibers under elevated temperatures. These findings highlight the temperature-sensitive nature of fiber reinforcement and suggest that a low percentage of basalt fiber can effectively improve HMA performance under moderate conditions, while its use at high service temperatures may require further optimization.

KEYWORDS: Hot mix asphalt; rutting performance; static creep; basalt fiber.

Data mining, English sentence analysis, "English Proficiency Test" conducted by the National Association of Commercial High Schools in Japan, metrical linguistics, statistical analysis

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ABSTRACT

The reliable detection of near-surface or closely spaced defects in layered composite materials remains a significant challenge for ultrasonic NDT. Standard time-frequency transforms often fail to optimally separate defect echoes from noise or structural boundaries. This work investigates an algorithm combining the Modified S-Transform (MST) with Iterative Thresholding (IT) and Shannon Energy (SE). The MST is first used as a power discriminator to enhance true signal components and improve time-frequency concentration. Subsequently, an iterative thresholding technique is applied to the resulting matrix to automatically suppress noise components without a priori knowledge, offering greater robustness than fixed-threshold methods. Finally, the Shannon Energy envelope is calculated to precisely localize the defects. This multi-stage approach is tested on B-Scan data from CFRP samples. The results demonstrate a significant improvement in resolution and Signal-to-Noise Ratio (SNR), making it highly suitable for the critical inspection of composite pressure vessels (e.g., hydrogen fuel tanks), where delaminations can compromise structural integrity.

KEYWORDS: Modified S-Transform (MST), Iterative Thresholding, Shannon Energy, Ultrasonic B-Scan, Composite Pressure Vessels, NDT.

Wavelet Transform Denoising and Hilbert Envelope Extraction for Ultrasonic Defect Localization in CFRP Laminates

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ABSTRACT

The inherent anisotropy and attenuation of Carbon-Fiber Reinforced Polymer (CFRP) laminates introduce significant noise into ultrasonic A-scan signals, complicating defect detection. This paper proposes a signal processing framework that completely avoids S-Transforms. The method first employs the Discrete Wavelet Transform (DWT) to decompose the non-stationary ultrasonic signal. By applying a soft thresholding technique to the wavelet coefficients, structural noise is effectively suppressed while preserving the energy of defect echoes. Following denoising, the Hilbert Transform (HT) is applied to the reconstructed signal to compute its analytical envelope, allowing for the precise temporal localization of delaminations. We evaluate this DWT-HT method using experimental data from CFRP samples. The suitability of this algorithm for the automated quality control of bonded joints in CFRP aerospace components is explicitly discussed.

KEYWORDS: Discrete Wavelet Transform (DWT), Hilbert Transform (HT), Denoising, CFRP, Ultrasonic NDT, Aerospace Inspection.

Magnetic performance and structural modification in iron-titanium oxide nanocomposites induced by silica through ball milling

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ABSTRACT

In this research the structural modifications and magnetic performance of iron-titanium oxide nanocomposite induced by the controlled incorporation of silica effect was investigated via ball milling process. A complete analysis was performed using X-ray diffraction (XRD), scanning electron microscopy (SEM) coupled with energy dispersive spectroscopy (EDS), and vibrating sample magnetometry (VSM). The XRD diagrams showed the emergence of new crystalline phases after adding silica, highlighting a phase transformation caused by prolonged milling. SEM-EDS analyses also showed significant morphological refinement and a uniform distribution of elements, confirming the gradual structural reorganization of the composites. Magnetic characterization, evaluated using hysteresis loop measurements, revealed notable variations in coercivity (Hc), saturation magnetization (Ms), and remanent magnetization (Mr). The magnetic parameters of iron-titanium oxide after 30 hours of milling reached 17.92 emu/g (Ms), 18.33 Oe (Hc), and 0.127 emu/g (Mr). It is noteworthy that the incorporation of silica induced a substantial improvement in magnetic performance, with an increase in Ms to 29.4 emu/g, while Hc and Mr reached 53.169 Oe and 0.602 emu/g, respectively. These results establish a clear link between the silica-induced phase evolution and the resulting magnetic behavior, highlighting the potential of iron-titanium oxide-based nanocomposites for next-generation magnetic and multivalent applications.

KEYWORDS: Nanocomposites, ball milling, silica, structural evolution, magnetic performance, SEM.

Credit Card Fraud Detection Using a DBSCAN-Based Hybrid Approach: A Theoretical Analysis

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ABSTRACT

In this study, a hybrid approach based on the Density-Based Spatial Clustering of Applications with Noise (DBSCAN) algorithm is theoretically analyzed for credit card fraud detection. With the rapid growth of electronic payment systems and the corresponding rise in fraudulent activities, the limitations of traditional supervised learning models underscore the importance of exploring unsupervised learning techniques such as DBSCAN. The proposed hybrid framework combines DBSCAN-based clustering of minority (fraudulent) transactions, data balancing using various Synthetic Minority Oversampling Techniques (SMOTE), and comparative evaluation across multiple supervised machine learning models. This integration enables more precise modeling of boundary and rare cases, leading to improved detection accuracy and robustness. The theoretical analysis suggests that the DBSCAN-based hybrid approach represents a promising direction for enhancing financial security and mitigating economic losses due to fraud.

KEYWORDS: DBSCAN, SMOTE, Credit Card Fraud, Supervised, Clustering.

Design and Fabrication of a Cylindrical U-Slot Conformal Patch Antenna Operating in the 2.4 GHz ISM Band

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ABSTRACT

In this study, the design, simulation, and fabrication of a cylindrical conformal patch antenna were carried out with the aim of reducing aerodynamic drag and maintaining structural integrity in high-speed aerial and ground vehicles. Conformal antennas operate in harmony with the geometry of the platform on which they are mounted, providing significant advantages in modern communication and radar systems by ensuring structural and electromagnetic integration. During the design process, the COMSOL Multiphysics RF module was utilized. The antenna was optimized to cover the 2.4 GHz ISM band. The cylindrical supporting structure was fabricated using a 3D printer with PETG material having a dielectric constant of 2.62. The patch part of the antenna consists of a U-slot rectangular microstrip patch designed on a flexible Rogers AD1000 substrate with a dielectric constant of 10. This flexible layer was wrapped around the PETG cylinder without any air gap and mechanically fixed at four corners using plastic screws and nuts. The inner concave surface of the cylinder was covered with copper tape, and a female SMA connector was integrated into the antenna by soldering its ground and signal terminals to the copper tape and patch, respectively. Simulation results revealed that the antenna achieved a bandwidth of 196 MHz (2.372–2.568 GHz) and a gain of 4.75 dBi at 2.475 GHz. After prototyping, measurements were performed using an R&S ZNLE3 vector network analyzer, and the measured results showed a strong agreement with the simulations. In particular, the S11 parameter exhibited a slightly wider bandwidth below −10 dB in measurements compared to simulations. These results demonstrate that the designed cylindrical conformal patch antenna provides effective and directional radiation performance within the 2.4 GHz ISM band.

KEYWORDS: Conformal antenna, microstrip patch antenna, cylindrical antenna design, 3D printed antenna.

Optimization-based Control of a Turbocharged Diesel Engine with Time Delay

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ABSTRACT

This study investigates observer-based state feedback control for a turbocharged diesel engine modeled as a time-delay system. The engine air-path dynamics, involving the interactions of a variable geometry turbocharger and exhaust gas recirculation valve, are represented by a linearized model incorporating the transport delay between intake and exhaust manifolds. The engine-speed-dependent delay is approximately equal to three-fourths of an engine cycle. Furthermore, as the speed of response of the closed-loop system becomes faster, it may be difficult to justify neglecting this delay. Such delay introduces infinite-dimensional behavior and can significantly degrade stability and transient performance. Considering available sensors, only the exhaust manifold pressure is measured, which necessitates the use of a state observer to reconstruct the unmeasured states (intake manifold pressure and compressor power) required for feedback. To address this challenge, a delay-aware control framework is developed in which the state feedback controller and Luenberger observer are designed separately under the separation principle. Each design minimizes the spectral abscissa, i.e., the maximum real part among all characteristic roots that determines the exponential decay rate of the system, through nonsmooth optimization, ensuring the fastest possible attenuation of the dominant modes. Comprehensive analyses of the open-loop and closed-loop eigenstructures are conducted to quantify the effects of delay on modal damping and stability margins. Simulation results show that the proposed controller outperforms existing methods in terms of speed of response while maintaining robustness to delay variations. Furthermore, the proposed observer provides faster and more reliable state estimation, ensuring accurate feedback under limited sensor availability. The study offers a systematic framework for integrating spectral optimization with observer-based feedback design in diesel engine control applications.

KEYWORDS: Turbocharged diesel engine, time-delay systems, Luenberger observer, state feedback, spectral abscissa optimization.

Design and Implementation of a Dual-Band PCB Monopole Antenna for 868 MHz and 2.4 GHz ISM Bands

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ABSTRACT

In this study, the design, simulation, and fabrication of a dual-band PCB monopole antenna operating in the 868 MHz and 2.4 GHz ISM frequency bands were carried out. The 868 MHz band is widely used in low-power wide area network (LPWAN) technologies such as LoRaWAN, Sigfox, Mioty, and Weightless-N. The 2.4 GHz band, on the other hand, is commonly preferred in short-range wireless communication protocols such as Wi-Fi, classic Bluetooth, Bluetooth Low Energy (BLE), and ZigBee. Therefore, antenna structures capable of operating efficiently in both frequency bands are of great importance for IoT systems that require both short- and long-range communication capabilities. The antenna design was performed using the RF module of COMSOL Multiphysics software. For the design, a double-sided copper FR4 substrate with a dielectric constant of 4.15 was used. A PCB monopole antenna configuration was implemented, where the copper layers on both sides of the board served as the ground plane and were connected using two via (rivet) connections. The monopole element was optimized into a V-shaped dual-line geometry instead of a single linear strip. The initial design was based on the physical dimensions required for the 868 MHz band, and structural modifications were later made to achieve proper impedance matching at 2.4 GHz. The antenna performance was evaluated in terms of the S11 parameter, gain values, and two- and three-dimensional radiation patterns. The prototype was fabricated using a PCB milling process. The antenna feed was provided through a female SMA connector soldered onto the board. Measurements were conducted using a Rohde & Schwarz ZNLE3 vector network analyzer. The simulated and measured results were found to be in good agreement, demonstrating that the proposed antenna provides an effective solution for both low- and high-frequency IoT communication applications.

KEYWORDS: PCB Monopole Antenna, Dual-Band ISM Applications, Internet of Things (IoT).

Training of the Feed Forward Artificial Neural Network Using Walrus Optimizer

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ABSTRACT

Artificial Neural Networks (ANNs) learn the relationships between input and output data by updating their weight and bias values. Various methods have been proposed to train the Multilayer Perceptron (MLP) model; however, classical training techniques frequently struggle with several challenges, such as high computational demands, substantial memory usage, and susceptibility to local minima.To overcome these limitations, the Walrus Optimizer (WO) was applied to train the MLP in this study. In the proposed WO-MLP approach, the WO algorithm optimizes the weights and biases of the network.The performance of the algorithm was evaluated on five widely used datasets in the literature (Iris, Breast Cancer, Heart, Balloon, and XOR) and compared with ABC-MLP, ACO-MLP, GSA-MLP, and DE-MLP algorithms. The evaluation metrics included Mean Squared Error (MSE), accuracy, sensitivity, specificity, precision, and F1-score. The experimental results demonstrated that WO-MLP outperforms the other algorithms across all datasets, achieving agreeable classification performance.

KEYWORDS: Optimiation, Metaheuristic, Neural Network.

The Economic Efficiency of Green Energy Projects

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ABSTRACT

The work discusses the economic efficiency of green energy projects, their role to ensure sustainable development, energy security, and macroeconomic stability in the long run. The work evaluates the cost–benefit ratio of renewable energy sources such as solar, wind, and hydroelectricity and discusses the advantages of green investment policies. The study also identifies the issues of funding and implementing green technology in developing countries like Uzbekistan and offers recommendations on maximizing economic performance in this respect.

KEYWORDS: Green energy, economic efficiency, renewable energy, sustainability, investment, energy policy, Uzbekistan.

Chaotic Map-Based Secretary Bird Optimization Algorithm

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ABSTRACT

Metaheuristic optimization algorithms are developed to find the best results in the search space by balancing exploration and exploitation strategies. Methods such as chaos theory are frequently used to improve the performance of these algorithms and prevent them from getting stuck in local minima. Chaos-based maps replace random number generators, contributing to more efficient creation of optimization algorithms' initial populations, more effective exploration of the solution space, and increased convergence speed. In this study, the performance of the chaotic version developed based on the Secretary Bird Optimization Algorithm (SBOA) was analyzed on Classical CEC test functions. Nature-inspired metaheuristic algorithms stand out with their potential to provide effective solutions to engineering problems. In this context, the Chaotic Secretary Bird Optimization Algorithm (KSBOA) was designed by integrating the Logistic chaotic map into the SBOA algorithm. These developed algorithms were evaluated on 23 test functions belonging to the Classical CEC test function standard, and the results were compared with other popular algorithms such as Genetic Algorithm (GA), Particle Swarm Optimization, Differential Evolution Algorithm (DE), Whale Optimization Algorithm (WOA), Grey Wolf Optimization Algorithm (GWO), and classical (SBOA). The findings reveal that KSBOA algorithms provide superiority in terms of both convergence speed and success in reaching the global optimum.

KEYWORDS: Chaotic Map. Metaheuristic Algorithm. Secretary Bird Optimization Algorithm. Chaotic Map-Based Secretary Bird Optimization Algorithm. SBOA. KSBOA.

Full or Weak Supervision: A Comparative Study Towards More Label-Efficient Helmet Detection

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ABSTRACT

Monitoring helmet usage in industrial environments plays a crucial role in ensuring occupational safety. However, fully supervised object detection models such as You Only Look Once version 8n[1] (YOLOv8n) require detailed bounding-box annotations for each object, making dataset preparation highly time-consuming and labor-intensive. In this study, a modified version of the weakly supervised Salvage of Supervision for Weakly Supervised Object Detection[2] (SoS-WSOD) framework (In this modified setting, a COCO-pretrained Faster R-CNN was used solely to generate class-agnostic region proposals, without any additional training or reliance on bounding-box annotations, as a replacement with Stage 1 of SoS-WSOD; Stage 3 was completely removed.) was investigated for the task of safety helmet detection and compared with the fully supervised YOLOv8n model using a revised and augmented dataset. In its original form, the "helmet" dataset[3] utilized in this study contains 7,581 images with 111,514 head instances without helmets and 9,044 head instances with helmets, annotated according to helmet presence. In order to remedy the class imbalance between helmeted and non-helmeted instances, the dataset was expanded through targeted augmentation applied only to images containing at least one helmet instance. Photometric and geometric augmentation techniques such as horizontal flipping, brightness–contrast adjustment, hue–saturation modification, rotation, blurring, and noise addition were applied, enhancing visual diversity and improving model generalization. After augmentation, the dataset grew to 17,208 images, including a total of 115,792 non-helmet and 35,902 helmet instances. This strategy increased the representation of the positive (helmet) class. YOLOv8n model was trained for 300 epochs at 640×640 resolution, reaching mAP50 0.959 and mAP50–95 0.66 on the test set, reflecting high average detection accuracy across both helmet and non-helmet classes. Utilizing the same dataset, SoS-WSOD model with a ResNet-50 backbone and Region Proposal Network (RPN) was trained for 85k iterations using only image-level labels indicating whether an image contains at least one helmet. It achieved mAP50 0.4637 and Mean Correct Localization (CorLoc50) 80.9%, demonstrating weaker detection precision but strong localization performance under weak supervision. For the helmet class, YOLOv8n yielded AP50 0.973, while SoS-WSOD achieved AP50 0.6531 and CorLoc50 89.84%. Since CorLoc50 is not reported by YOLOv8n, these values are provided to highlight SoS-WSOD's localization capability under weak supervision. This comparison shows that although SoS-WSOD lags behind YOLOv8n in overall detection accuracy, it demonstrates strong localization ability for the positive (helmet) class and significantly reduces annotation effort. This study contributes to the literature by revealing the potential of label-efficient weakly supervised detection in safety-critical object recognition tasks.

[1]https://yolov8.com/, [2]https://github.com/suilin0432/SoS-WSOD, [3]https://github.com/njvisionpower/Safety-Helmet-Wearing-Dataset

KEYWORDS: Weakly Supervised Object Detection, YOLOv8, SoS-WSOD, Safety Helmet, Computer Vision.

Influence of Mesoporous NiO Interlayer on the Electrical and Optical Behaviours of Al/n-Si Schottky Photodiodes

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ABSTRACT

Metal oxide semiconductors attract intense research interest due to their wide application potential in electronics and optoelectronics. Among these semiconductors, Nickel oxide (NiO), a p-type semiconductor, is considered a promising material due to its properties such as wide band gap of 3.6-4.0 eV, good conductivity and thermal stability, and finds application in many fields such as solar cells, sensors, catalyses and diodes. In this present work, NiO was used as an interface for Schottky type photodiodes. In order to enhance the electrical properties of this photodiode, a Pluronic P123 polymer was used to obtain mesoporous NiO (mp-NiO) interlayer. Current–voltage (I–V) measurements of Al/NiO/n-Si and Al/mp-NiO/n-Si photodiode were performed to calculate the ideality factor, barrier height and series resistance values. On the other hand, Current-transmission (I-t) measurements were performed to calculate photocurrent, photosensitivity, responsivity and specific detectivity parameters. Compared to Al/NiO/n-Si photodiode, Al/mp-NiO/n-Si heterostructure significantly improves the electrical and photodetector parameters. Consequently, the results demonstrate that NiO and mp-NiO interlayered photodiodes and photodetectors are suitable for upcoming optoelectronic applications.

KEYWORDS: Nickel Oxide, Schottky Photodiodes, photodetectors, mesoporous structures, Polymers.

Detecting Violence and Threats from Images Using Artificial Intelligence Methods

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ABSTRACT

Maintaining public order is of great importance for the early detection of violence and threat elements. In this context, the use of artificial intelligence–based object detection algorithms provides significant support to security authorities by enabling early warning of incidents and accelerating intervention processes.

In this study, two different deep learning–based object detection algorithms, YOLOv8-m and Faster R-CNN (ResNet-50-FPN), were utilized to detect images containing violence and threats. The experiments were carried out on the "threat" dataset, which was created by combining four different datasets and consists of four classes: violence, non-violence, knife, and weapon. The dataset contains a total of 12,000 images, divided into 80% (9,600 images) for training and 20% (2,400 images) for validation to enhance the generalization capability of the models.

Both models were trained for 20 epochs under the same conditions, and their performance was evaluated based on the fundamental metrics of accuracy, precision, recall, and F1-score.

According to the experimental results, the YOLOv8-m model achieved 0.16% precision and 0.26% recall after 20 epochs, indicating a very low detection performance. In contrast, the Faster R-CNN (ResNet-50-FPN) model reached 81.6% precision, 75.5% recall, and an F1-score of 78.5% under the same conditions, demonstrating significantly higher detection accuracy and robustness.

In conclusion, the experiments show that the Faster R-CNN model performs substantially better than YOLOv8-m in overall detection performance. This finding suggests that two-stage region proposal network (RPN)–based architectures offer higher accuracy and generalization capability compared to single-stage approaches in detecting violent and threatening objects.

KEYWORDS: Artificial intelligence, deep learning, object detection, violence detection, threat recognition, YOLOv8, Faster R-CNN, image processing.

RAG-LLM Based Intelligent Logistics Decision Support in SAP Modules

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ABSTRACT

Decision-making in logistics operations involves complex workflows across multiple SAP modules such as aATP, TM, and EWM. Operational challenges within these systems often hinder rapid and reliable access to contextual knowledge. To address these challenges, this study presents a Retrieval-Augmented Generation (RAG)-based knowledge retrieval and decision support pipeline. The system uses the multilingual-e5-base embedding model to vectorize SAP Help Center documentation and academic materials, while the Llama 3.1 8B Instruct model generates contextually relevant answers. Experimental results demonstrate that integrating RAG with Llama 3.1 8B Instruct and multilingual-e5-base provides strong contextual accuracy and linguistic coherence, highlighting its potential for intelligent logistics information management and decision support.

KEYWORDS: Retrieval-Augmented Generation (RAG), Logistics Decision Support, Large Language Models (LLMs), Supply Chain Optimization.

The photocatalytic performance of Li doped nano-porous spinel oxide gallate (MGa2O4) thick films

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ABSTRACT

The study aims to comprehend the photocatalytic performance of Li-doped nano-porous spinel oxide gallate (MGa2O4) thick films grown using tape casting systems. Transition metals, including Cu and Co, were assigned by M. The structural formation was elucidated through Rietveld refinements, revealing a distinctive shift in lattice parameters that correlated with changes in electronic energy configuration and optical transmittance. In conclusion, the photocatalytic performance of spinel oxide gallate was found to be dependent on the amount of Li, influencing both structural changes and the formation of electronic energy levels.

KEYWORDS: Oxide semiconductor, metal gallate, spinel oxide

Buckling Analysis of Steel – FGP Composite Columns via Finite Element Method

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ABSTRACT

This paper aims to investigate the buckling response of composite columns made of a functionally graded porous core and steel cover. The material behavior is assumed to be linear elastic. To define porosity, the uniform distribution is used, and the cover is considered to be isotropic and homogeneous. The effect of shear deformation is considered based on the first-order shear deformation theory. The critical buckling loads are calculated with the finite element method. To generate the model of the column, a finite element with 3 nodes and 9 degrees of freedom is implemented. Fixed – free, fixed – pinned, and pinned – pinned boundary conditions are employed. Nine different values of porosity coefficients are used to examine their effect on the critical loads. Moreover, the influence of the wall thickness of the cover and slenderness ratios is investigated in detail. The results demonstrate that increasing the porosity coefficient decreases the critical buckling loads. The current research is one of the first theoretical studies on the buckling response of the steel–FGP composite columns. It presents benchmark results for related future works.

KEYWORDS: Finite element method, Steel – FGP composite columns, buckling, uniform porosity.

Comparative Analysis of Fractional and Local Operators in Image Denoising: The Truncated M-Derivative (M-FOTV) Approach

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ABSTRACT

Total variation (TV)-based image denoising is widely used due to its strong edge-preserving capability; however, it suffers from staircase artifacts and over smoothing in textured regions. Fractional-order extensions, particularly the Fractional Order Total Variation (FOTV) model, alleviate these limitations by incorporating long-range pixel dependencies through non-local fractional derivatives. Although FOTV significantly improves texture preservation and visual quality, its nonlocal nature results in high computational complexity, making real-time applications challenging. To overcome this limitation, we propose a new denoising model based on the inherently local Truncated M-Derivative (TMD), referred to as the M-Derivative Total Variation (M-FOTV) method. A comprehensive comparison between FOTV and M-FOTV is conducted using quantitative (PSNR, SSIM), qualitative visual evaluations, and computational efficiency analyses. In the test matrix f, the computation time of FOTV was measured as 0.020 seconds, whereas M-FOTV achieved 0.009 seconds, corresponding to a 55% reduction in computational cost. For $\alpha=1$, FOTV yielded 47.06 dB PSNR and 0.9841 SSIM, while M-FOTV achieved 47.28 dB PSNR and 0.9849 SSIM. These results confirm that M-FOTV maintains high visual quality while offering substantially improved computational efficiency. Overall, the proposed method effectively balances the trade-off between nonlocal accuracy and local efficiency, positioning M-FOTV as a promising alternative for fast and multidimensional biomedical image denoising.

KEYWORDS: Fractional Calculus; Truncated M-Derivative; Fractional Order Total Variation; Image Denoising.

Detection of Mushroom Species in the Kastamonu-Çankırı Region Using KerasCV and YOLOv8 Architecture

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ABSTRACT

This study aims to develop an artificial intelligence model capable of detecting mushroom species commonly found in the Kastamonu–Çankırı region. The research seeks to provide a technological solution to the challenge of distinguishing between poisonous and edible species, which is often difficult through traditional methods. For this purpose, a custom image dataset containing 10 different mushroom classes was created. The dataset was divided into 80% training, 10% validation, and 10% test subsets, and data annotation was performed using open-source labeling tools. The YOLOv8 (You Only Look Once, version 8) algorithm, a state-of-the-art architecture in object detection, was employed to train the model. Training was conducted on a cloud computing environment. After 100 epochs, the developed model achieved high performance, obtaining 98.7% mAP50 (Mean Average Precision at 0.5 IoU) and 88.4% mAP50-95 (Mean Average Precision at 0.5–0.95 IoU) on the validation set. These findings indicate that the YOLOv8 model is a highly effective tool for accurately detecting regional mushroom species.

KEYWORDS: Artificial Intelligence, Machine Learning, Deep Learning, Computer Vision, Image Processing

Flexural Behavior of Cellular Structures Fabricated As Triply Minimal Periodic Surfaces

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ABSTRACT

Triply periodic minimal surfaces (TPMS) exhibit a unique combination of mechanical properties that are advantageous for structural applications, particularly in flexural bending. In this study, the flexural behavior of cellular beam structures with TPMS cores was experimentally investigated. Cellular structures with TPMS are fabricated using polylactic acid via fused deposition modelling (FDM). The specimens, measuring 24 x 24 x 150 mm^3, were designed with various unit cell geometries, including gyroid, diamond, and lidinoid types. Samples were fabricated in three different cell sizes with two different directions. Each sample was subjected to three three-point pending. Results showed that cell form and size affect the flexural strength of the fabricated cellular structures.

KEYWORDS: TPMS, FDM, Flexural Strength, Additive Manufacturing, Cellular Structure.

Linear Similarity–Driven Deterministic Steganography: A Matrix-Based Framework

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ABSTRACT

This paper presents a deterministic steganographic framework in which the embedding and verification processes are governed by matrix-based linear similarity.Unlike conventional probabilistic or adaptive techniques, the proposed approach formulates information hiding as a constrained optimization that preserves a weighted linear correlation between the cover and the embedded matrices.A deterministic weighting field, computed directly from the structural attributes of the cover, defines the local sensitivity and guides every embedding decision.Two complementary configurations are introduced: a block-constant scheme for regional coherence and a mixed gradient-modulated scheme for localized adjustment without randomness.The resulting framework ensures reproducible embedding, mathematically stable similarity evaluation, and complete explainability of the hiding process.Analytical examination confirms that the proposed similarity operator is symmetric, bounded, and scale-invariant within the matrix domain, providing a rigorous foundation for structure-preserving and high-fidelity deterministic steganography.

KEYWORDS: Linear similarity, deterministic steganography, matrix-based embedding, weighted correlation, reproducible information hiding, structural consistency

Machine and Deep Learning Approaches for Histopathological Classification of Paratuberculosis

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ABSTRACT

Paratuberculosis (Johne's disease) is a chronic infectious disease that causes significant economic and health challenges in livestock production. Accurate and timely diagnosis of the disease through histopathological examination remains a critical step in disease management. However, manual assessment of tissue slides is time-consuming and subject to observer variability. In this study, a hybrid computational framework based on machine learning and deep learning techniques is proposed for the automated classification of histopathological images in paratuberculosis diagnosis. The dataset comprises 366 annotated histopathology images, including 157 normal (negative) and 209 infected (positive) samples, all verified by expert pathologists. The proposed approach involves two complementary pipelines. In the first, morphological and textural features are extracted from the images and analyzed using classical machine learning algorithms such as Support Vector Machines (SVM), Random Forest (RF), and K-Nearest Neighbors (KNN). In the second, Convolutional Neural Networks (CNNs) are employed for direct image-based learning and classification. The study aims to compare and integrate both paradigms to evaluate their effectiveness in distinguishing infected from normal tissues. This research contributes to the advancement of digital pathology by exploring artificial intelligence-driven diagnostic systems that may enhance reproducibility, objectivity, and diagnostic accuracy in histopathological assessment of paratuberculosis.

KEYWORDS: Paratuberculosis, Deep Learning, Machine Learning, Histopathology.

Explainable Multi-Scale Deep Learning Framework for Automatic Detection of Lung Diseases Using Ultrasound Imaging

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ABSTRACT

Diseases of the lungs such as pneumonia, fibrosis, and COVID-19 remain leading causes of mortality worldwide, necessitating urgent and accurate diagnostic solutions. Conventional imaging modalities such as chest X-ray (CXR) and computed tomography (CT) are widely used but have limitations in portability, safety, and cost. In contrast, lung ultrasound (LUS) offers a safer, portable, and cost-effective imaging alternative suitable for real-time lung assessment. However, interpreting ultrasound patterns—such as B-lines, pleural irregularities, and consolidations—requires significant expertise and remains inherently subjective. To address these challenges, this study presents an AI-integrated framework for the automatic detection of lung diseases using LUS imaging. The proposed approach employs multi-scale convolutional neural networks (MS-CNNs) based on DenseNet121, MobileNetV2, EfficientNetB7, and NasNetLarge architectures to extract both local and global discriminative features inspired by radiological interpretation. A weakly supervised attention mechanism emphasizes clinically relevant regions of interest, replicating the cognitive reasoning of expert radiologists. Model explainability is achieved using Gradient-weighted Class Activation Mapping (Grad-CAM), providing visual insights into the decision-making process. Experiments were conducted on the Mendeley Lung Ultrasound dataset to classify COVID-19, other pulmonary pathologies, and healthy lungs. The proposed framework demonstrated excellent diagnostic performance comparable to experienced radiologists. Furthermore, a developed web interface enables real-time inference, visualization of prediction confidence, and clinician interaction. Overall, this study highlights the potential of multi-scale deep learning and explainable AI in enhancing diagnostic accuracy, interpretability, and accessibility in modern healthcare systems.

KEYWORDS: COVID-19 Detection, Deep Learning, Explainable Artificial Intelligence, Lung Ultrasound (LUS).

Evolutionary Conservation Analysis of Pathogenic Variants in the MAPT Gene: A Computational Approach Using UniProt and ClinVar Data

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ABSTRACT

This study investigated the relationship between the evolutionary conservation structures of the microtubule-associated tau protein (MAPT) gene and pathogenic variants reported in the ClinVar database. Multiple sequence alignment (MSA) was performed using curated UniProt orthologous protein sequences, and position-based conservation scores were calculated using a ConSurf-like method [1], [7]. Subsequently, pathogenic variants obtained from ClinVar were mapped onto the 441-amino-acid brain isoform (P10636-8) of MAPT, and their correlation with evolutionary conservation scores was examined [3], [4]. The analysis found that out of 15 orthologous sequences from different species, 8 were accepted as valid, and phylogenetic weighting scores indicated that approximately 92% of the MAPT protein consists of variable regions, with only 4% being highly conserved. A significant portion of the 143 pathogenic variants retrieved from ClinVar was excluded due to isoform differences, but 10 variants were successfully parsed. The fact that all of these variants were reported as pathogenic despite being located in evolutionarily variable regions may be explained by human-specific functional regions and the clinical significance of alternative isoform usage. This study highlights the necessity of considering isoform differences in the evaluation of MAPT variants and the importance of integrating evolutionary conservation data into clinical bioinformatics analyses.

KEYWORDS: MAPT, ClinVar, UniProt, evolutionary conservation, pathogenic variant analysis.

Development of a GSM Jammer Device to block Unwanted Signals from Devices Operating in the 900-2000 MHz Range for Indoor Applications

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ABSTRACT

This study proposes a GSM (Global System for Mobile Communications) jammer device that blocks unwanted signals in the 900–2000 MHz frequency band. The proposed device aims to interrupt and jam the communication between mobile phones and base stations operating on the same radio frequency. The structure of the proposed jammer device primarily consists of a detector circuit, a jammer circuit, a microcontroller, Tx-Rx antennas, and connection elements. While jammer devices in the literature have continuously operating circuits, the system proposed in this study only activates when a GSM signal is detected. This ensures energy efficiency and minimizes unnecessary EM radiation that could adversely affect human health.

KEYWORDS: GSM, Signal jammer, Mobile device, Radio frequency, Detector.

The Impact of Fintech Technologies on the Banking System: An Analysis of Blockchain-Based Payment Systems

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ABSTRACT

This paper examines the role of financial technologies, specifically blockchain-based payment systems, in transforming traditional banking. The paper gives an in-depth review of changes, challenges, and opportunities brought about by the inclusion of blockchain technology in contemporary banking. Based on a review of the existing scientific literature and empirical data, this work highlights how blockchain-based systems ensure more transparency, security, and efficiency compared to traditional banking. A comparative analysis of experiences in various countries provides a framework for strategic implementation.

KEYWORDS: Fintech, Blockchain, Banking System, Payment Systems, Distributed Ledger Technology (DLT), Cryptocurrency, Smart Contracts.

High-Performance Multi-Class Brain Tumor Classification and Analysis Using Optimized Convolutional Neural Networks

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ABSTRACT

Effective neuro-oncological treatment planning relies on brain tumor classification from Magnetic Resonance Imaging (MRI). This study introduces a refined deep learning framework based on Convolutional Neural Networks (CNNs) aimed at precisely classifying four main categories: Glioma, Meningioma, Pituitary tumor, and No Tumor. The proposed architecture incorporates tailored layers or a refined transfer learning method (such as ResNet-50) 1 optimized with the Adam algorithm, utilizing a substantial combined dataset (approximately 7,000 images). Through thorough evaluation, performance of the highest standard is shown to be attained, with classification accuracy surpassing 98%. In addition to raw performance, we examine the confusion matrix and the need for Explainable AI (XAI) to tackle significant limitations associated with clinical trust, model transparency, and management of data imbalance that are intrinsic to medical diagnostics.

KEYWORDS: Deep Learning, CNN, Brain Tumor, MRI Classification, Explainable AI (XAI).

Comparative Performance Analysis of MLP-MIXER and RESNET50 Architectures in Automatic Detection of Arabica Coffee Leaf Diseases

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ABSTRACT

Accurate and early detection of plant diseases is critical for agricultural productivity. In this study, we compared MLP-Mixer, a modern non-convolutional architecture, with ResNet50, the industry standard, for the classification of coffee leaf diseases. The analysis was performed on a dataset (1,312 original images) cleaned to prevent data leakage, using pure data without any data augmentation techniques. Experimental results revealed that both architectures performed extremely well in this task. MLP-Mixer achieved the highest performance with an average F1-Macro score of 98.81%, while ResNet50 performed very closely with an average F1-Macro score of 98.18%. However, the lower standard deviation of MLP-Mixer suggests that it produces more stable results than ResNet50 under different initial conditions. In terms of efficiency, ResNet50, due to its fewer parameters, produced faster predictions on the test hardware (4.62 ms), while MLP-Mixer was slightly slower (7.48 ms). The results indicate that both architectures can be used confidently on pure data, but MLP-Mixer is preferred for the highest accuracy and stability, while ResNet50 is preferred for its speed advantage.

KEYWORDS: Deep Learning, Coffee Leaf Diseases, MLP-Mixer, ResNet50, Image Classification, Artificial Intelligence in Agriculture.

Coordination and Decision Policies in Multi-Agent Autonomous Driving under Uncertainty

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ABSTRACT

Autonomous driving is evolving from isolated vehicle intelligence toward cooperative, networked autonomy. In such systems, multiple agents must make coordinated decisions under uncertainty and communication constraints. Although Multi-Agent Reinforcement Learning (MARL) has emerged as a powerful framework for decentralized cooperation, its deployment faces critical limitations in uncertainty quantification, safety assurance, and bandwidth efficiency. This chapter introduces Adaptive Communication-Aware Policy Learning (ACAPL), a framework that integrates epistemic uncertainty estimation, adaptive communication triggering, and communication-aware reward shaping. Implemented in CARLA 0.9.16 / Town 13, ACAPL achieves 53% fewer collisions and 45% lower message rates than MADDPG, QMIX, and MAPPO, while maintaining overall energy efficiency and training stability. The results demonstrate how uncertainty-driven communication policies can enhance both safety and scalability of cooperative autonomous systems.

KEYWORDS: Multi-agent reinforcement learning, cooperative driving, uncertainty quantification, adaptive communication, safety-constrained learning

Optimization of Sludge Drying

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ABSTRACT

This study examines sludge drying processes in a wastewater treatment plant from thermodynamic and economic perspectives, providing a simplified yet comparable assessment of various drying technologies. A target dryness ratio of 90% was adopted, and five systems were evaluated: thermal drying, open and closed solar drying beds, greenhouse-type solar dryers, solar panel–assisted drying systems, and a hybrid (greenhouse + panel) configuration. The analysis showed that thermal drying systems have significantly higher energy consumption compared to greenhouse-type solar drying systems, which require much less energy. However, solar-based systems are limited in the maximum dryness level they can achieve, creating a need for additional energy to reach the target. Solar panel–based systems were found to require large installation areas.The results indicate that although greenhouse solar systems are advantageous due to their low investment cost, they cannot reach the desired dryness level alone. Simplified economic and energy analyses show that the hybrid drying system reduces total energy costs by 55–65% compared to thermal drying and decreases land requirements by 25% relative to conventional solar drying systems. Overall, the hybrid configuration was identified as the most suitable option in terms of cost, energy efficiency, and sustainability.

KEYWORDS: Sludge drying, Hybrid systems, Energy efficiency, Wastewater Treatment.

Computational Modelling of Powder Deposition in Metal Additive Manufacturing

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ABSTRACT

Additive Manufacturing, more colloquially known as 3D printing, is widely considered a cornerstone of the 4th Industrial Revolution. The advent of metal Additive Manufacturing has enabled manufacturers to construct end use parts with design freedom and flexibility that was previously unattainable with conventional techniques. These parts typically start life as fine metal powders, which are fed to a build chamber, spread into a thin micro-level layer, and selectively melted one layer at a time to realise the completed geometry. Despite the crucial role these powders behaviour play in the quality of the component generated, their flow behaviour in response to parametric variations remain underexplored. A simulation and modelling technique, known as the Discrete Element Method, is ubiquitous in the virtual engineering sphere to generate a digital twin of this process. However, an almost universal oversight is that the powder insertion is misrepresented by the so-called rainfall deposition method. As the name implies, in this method the powder appears to spontaneously appear above the substate and fall under gravity. Commercial systems deliver powder using a hopper, moving funnel, or a piston-operated table. This research investigates the use of a moving funnel to supply Stainless Steel 316l powder as modelled in the Discrete Element Method environment, and compares it against the conventional rainfall approach in powder bed quality metrics such as packing density, spread layer surface profile roughness, and segregation between polydisperse particles. The analysis was performed for a range of refined particle sizes, idealised as spheres and both uniform and polydisperse in size as guided by contemporary literature. The results showed a clear disparity between comparative models of rainfall and moving-funnel depositions. Specifically, the funnel method generally degraded the powder bed in the three metrics tested. The outcomes identify a rationale for a more accurate modelling of powder flow with the Discrete Element Method technique, and implies existing work in the research landscape artificially increases the quality of the formed powder beds by misrepresenting the initial powder state conditions.

KEYWORDS: Additive Manufacturing, Discrete Element Methods, Simulation and Modelling, Stainless Steel 316l, Deposition Methods.

Evaluating the Reliability of SUFI-2 in SWAT Model Calibration: A Case Study of the Upper Tigris Sub-Basin, Türkiye

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ABSTRACT

This study evaluates the calibration and validation performance of the SWAT (Soil and Water Assessment Tool) model using the SUFI-2 (Sequential Uncertainty Fitting Ver. 2) algorithm in the semi-arid Upper Tigris Sub-Basin in southeastern Türkiye. Daily streamflow data from the Batman gauge station for 2022–2023 were used in conjunction with the SWAT-CUP interface to optimize parameter ranges and quantify uncertainty. Model performance was assessed using statistical indicators such as Nash–Sutcliffe Efficiency (NSE), Coefficient of Determination (R^2), Percent Bias (PBIAS), Root Mean Square Error (RMSE), and Mean Absolute Error (MAE). During calibration, the model achieved NSE = 0.769 and $R^2 = 0.796$, while validation yielded NSE = 0.506 and $R^2 = 0.521$, indicating satisfactory temporal consistency. P-factor (0.91) and R-factor (0.93) values confirmed that most observed flows were captured within the 95% prediction uncertainty band. Furthermore, observed peak discharge (82.10 m^3/s) and simulated peak flow (85.28 m^3/s) were closely aligned, with less than 4% deviation, demonstrating SUFI-2's robustness in representing hydrological extremes. Sensitivity analysis identified SMTMP, RCHRG_DP, and GW_DELAY as statistically significant parameters ($p < 0.01$), emphasizing the influence of temperature and groundwater dynamics on streamflow generation. These findings confirm that SUFI-2 is not only effective in reducing uncertainty and improving model fit but is also capable of accurately simulating peak discharge events, making it a reliable tool for hydrological modeling and water resource management in data-scarce, semi-arid regions.

KEYWORDS: SWAT, SUFI-2 Algorithm, Calibration, Hydrological Modeling Upper Tigris Basin.

Structural and Mechanical Evolution of Ti60Al40 and Ti50Al40V10 Alloys: Effect of Milling Time during Mechanosynthesis

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ABSTRACT

This study investigates the synthesis and characterization of nanostructured TiAl and TiAlV alloys, both based on titanium aluminides. These alloys are highly attractive for high-temperature structural applications due to their low density, high specific strength, superior mechanical properties, excellent oxidation resistance, and thermal stability. Mechanosynthesis, an intensive mechanical milling process, was employed to produce these alloys by blending pure elemental powders of titanium, aluminum, and vanadium in a planetary ball mill. This method facilitates the formation of nanostructured materials with a uniform elemental distribution. The synthesized alloys were characterized using scanning electron microscopy (SEM) and X-ray diffraction (XRD). SEM provided insights into the morphological evolution and grain size variations throughout the milling process, while XRD analysis was used to determine lattice parameters and micro-strain levels, reflecting structural changes. The findings indicate that milling time significantly influences the structural development of the alloys, with grain size progressively decreasing as milling time increases. Additionally, SEM observations revealed that particle size initially grows due to agglomeration before decreasing as a balance is reached between welding and fracturing mechanisms.

KEYWORDS: Mechanosynthesis, Nanostructured materials, Mechanical Evolution, XRD, and SEM

Investigation of the Performance Evaluation of a Building with an L-Shaped Floor Plan and Torsional Irregularity Using Different Pushover Analysis Methods

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ABSTRACT

Performance evaluation of new or existing structures is crucial for ensuring the safety of the community and protecting their properties. This study examines a reinforced concrete (RC) model building with an L-shaped floor plan and torsional irregularity, situated on a ZC soil profile in accordance with the Turkish Building Earthquake Code (TBEC-2018). Static pushover nonlinear analyses were conducted, including first mode dominant pushover analysis (FMDPA), uniformly distributed pushover analysis (UDPA), and multi-mode pushover analysis (MMPA). The results of these pushover analyses were then compared to nonlinear time history analysis (NLTHA), which served as a benchmark. The findings indicate that the multi-mode pushover analysis (MMPA) yielded results that were closest to those of the NLTHA, thereby demonstrating superior performance compared to the other methods.

KEYWORDS: Pushover analysis, L-shape building, Reinforced concrete building, Design spectra, TBEC-2018.

The International Conference on Engineering Technologies (ICENTE 25) was successfully held online from November 20-22, 2025, in collaboration with Selcuk University Faculty of Technology and Sinop University Faculty of Engineering and Architecture. The conference brought together leading international and interdisciplinary research communities, developers, and practitioners of advanced technologies to discuss both theoretical and practical issues across various technological domains. It served as a platform to present research findings, share developments, and highlight significant activities from around the globe.

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