INTERNATIONAL CONFERENCE
ON ENGINEERING TECHNOLOGIES

ICENTE'24

November 21-23, 2024
Konya/TURKEY

ABSTRACTS BOOK

Editors:
Prof. Dr. Şakir TAŞDEMİR
Prof. Dr. Nurettin DOĞAN

icente.selcuk.edu.tr

Kitap Dünyası

E-ISBN: 978-625-95385-9-4



8th International Conference on Engineering Technologies ICENTE 2024

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ŞAKİR TAŞDEMİR
NURETTİN DOĞAN

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E-ISBN: 978-625-95385-9-4

PREFACE

International Conference on Engineering Technologies (ICENTE'24) was organized in Konya, Turkey on 21-23 November 2024 by Selçuk University Faculty of Technology and cooperation with Sinop University Faculty of Engineering and Architecture.

The main objective of ICENTE'24 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)
- Gazi Journal of Engineering Sciences (GJES)
- International Journal of Automotive Engineering and Technologies (IJAET)
- International Journal of Energy Applications and Technology (IJEAT)
- Selcuk University Journal of Engineering Sciences (SUJES)
- Intelligent Methods In Engineering Sciences (IMIENS)
- Turkish Journal of Mathematics and Computer Science (TJMCS)
- Positive Science International

At this conference, there are 172 paper submissions. Each paper proposal was evaluated by two reviewers, and finally, 117 papers were presented at the conference from 4 different countries with 69 local and foreign universities and organizations participating.

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.

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UNCERTAINTY ANALYSIS OF ABDOMINAL AORTIC ANEURYSM USING MONTE CARLO SIMULATION

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ABSTRACT

Abdominal aortic aneurysm (AAA) is an important cardiovascular disorder. Generally, AAA progresses in a silent way and excessive dimensions of AAA pose a risk of rupture. The aneurysm rupture is a critical health condition with high mortality rate. Therefore, determining the risk of aneurysm rupture is crucial to prevent an impending AAA rupture and decide on a surgical intervention. In this study, uncertainty analyses are performed based on the Monte Carlo method in order to determine the rupture risk of an AAA. The maximum von-Mises stresses on the aneurysm wall which are previously reported in the literature are used in the Monte Carlo simulations. Since the patient-specific aneurysm geometries and material properties are unique for each patient, the rupture stress is assumed as a probability function with Gaussian distribution. For this purpose, three different approaches are used for the uncertainty analyses, namely low, intermediate, and high-risk approaches. The low-risk approach assumes that the rupture is mostly observed around 1000 kPa. The intermediate and high-risk approaches assume that the rupture will occur mostly around 750 kPa and 500 kPa, respectively. For a patient-specific AAA model, the rupture risks are found as 20.44%, 32.82%, and 46.54% for the low, intermediate, and high-risk approaches. It is concluded that the high-risk approach provides more conservative results, and the values beyond 50% can be categorized as risky. These uncertainty analyses provide important insights for the clinicians in order to decide on a surgical operation for the aneurysm.

KEYWORDS: Cardiovascular system, Abdominal Aortic Aneurysm, Rupture, Monte Carlo Simulation, Uncertainty Analysis.

ACKNOWLEDGMENT

This study is funded by TÜBİTAK (The Scientific and Technological Research Council of Türkiye) 3501-Career Development Program (Project number: 221M001).

OPTIMIZING POWER DISTRIBUTION SYSTEMS WITH INTEGRATED SOLAR PLANTS, DSTATCOM, AND EV CHARGING STATIONS USING RUNGE-KUTTA ALGORITHM

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ABSTRACT

This study presents an innovative approach to power distribution system optimization utilizing the state-of-the-art Runge-Kutta Algorithm (RKO). The research addresses the complex challenge of simultaneously allocating and sizing solar power plants and DSTATCOM within the distribution network. Additionally, it incorporates the strategic placement of 5 MW electric vehicle (EV) charging station, acknowledging the growing importance of electric mobility in modern power systems. The optimization process is guided by a dual objective function that aims to minimize both power losses and voltage deviations, thus enhancing overall system efficiency and stability. By leveraging the RKO's advanced meta-heuristic capabilities, this study offers a sophisticated solution to the multifaceted problem of integrating renewable energy sources, improving power quality, and accommodating emerging load patterns. The results demonstrate the effectiveness of the proposed methodology in achieving a balanced and optimized power distribution system. This research contributes significantly to the evolving field of smart grid management, providing valuable insights for power system planners and operators in the context of increasing renewable penetration and electrification of transportation.

KEYWORDS: Power Distribution Network (PDN), DG Allocation, Electric Vehicle (EV) Charging Stations, Allocation and Sizing, Meta-heuristic Algorithm.

OPTIMIZATION OF A 69-BUS POWER DISTRIBUTION SYSTEM USING RECONFIGURATION AND THE RUNGE-KUTTA ALGORITHM FOR MULTI-OBJECTIVE POWER LOSS AND VOLTAGE DEVIATION MINIMIZATION

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ABSTRACT

This paper presents the optimization of a 69-bus power distribution system utilizing a reconfiguration technique. Two key objective functions are considered: the minimization of active power loss and the reduction of voltage deviation index. The optimization process leverages the Runge-Kutta algorithm, applied as a state-of-the-art metaheuristic approach. Both single and multi-objective optimization scenarios are examined, allowing for a comprehensive evaluation of the system's performance. The results demonstrate significant improvements in both power loss and voltage deviation, highlighting the effectiveness of the proposed method for enhancing distribution system efficiency and stability.

KEYWORDS: Reconfiguration, Power Distribution Network, Metaheuristic Search Algorithm, Power Loss Minimization.

SIMULTANEOUS WIND TURBINE AND EV CHARGING STATION ALLOCATION IN A 33-BUS SYSTEM USING THE SLIME MOULD ALGORITHM FOR POWER LOSS MINIMIZATION AND VOLTAGE PROFILE IMPROVEMENT

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ABSTRACT

This study presents an advanced optimization approach for the simultaneous allocation and sizing of wind turbines and electric vehicle (EV) charging stations in a 33-bus distribution system. The primary objective is to minimize active power losses while improving the voltage profile, ensuring optimal integration of renewable energy sources and EV infrastructure. To solve this complex multi-objective problem, the Slime Mould Algorithm (SMA), a state-of-the-art metaheuristic, is employed due to its robust performance in distributed generation (DG) allocation. The proposed method demonstrates superior results in enhancing system efficiency and voltage stability, offering a promising solution for sustainable energy integration into modern power grids.

KEYWORDS: DG allocation, Power distribution network, Electrical vehicle charge stations, Optimization.

OPTIMIZING PHOTOVOLTAIC SYSTEMS USING THE ARTIFICIAL HUMMINGBIRD ALGORITHM FOR MAXIMUM POWER POINT TRACKING (MPPT) UNDER SHADING CONDITIONS

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ABSTRACT

This study presents an advanced approach for optimizing photovoltaic (PV) systems by applying the Artificial Hummingbird Algorithm (AHA), a state-of-the-art optimization technique, for Maximum Power Point Tracking (MPPT). The system consists of five KYOCERA 200W solar panels connected in series, with performance evaluated under both uniform and partial shading conditions. Accurately tracking the Maximum Power Point (MPP) in these scenarios is crucial for maximizing energy output and minimizing power losses. AHA, inspired by the foraging behaviour of hummingbirds, offers swift adaptation to changing environmental conditions, making it highly effective for MPPT applications. Simulation results demonstrate the algorithm's superior ability to quickly converge to the global MPP, even under challenging shading conditions. This research contributes to the advancement of robust MPPT strategies, showcasing the potential of bio-inspired algorithms in enhancing solar energy technologies.

KEYWORDS: MPPT, Partial Shading Conditions, Meta-heuristic serach algorithm, Artificial Hummingbird Algorithm, PV Panel.

THERMAL BUCKLING RISK IN RAILWAYS: AN ANSYS-BASED ANALYSIS FOR TÜRKİYE

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ABSTRACT

The impact of climate change on transportation systems is becoming increasingly significant, with railways being particularly susceptible. In this context, rail thermal buckling (RTB) is a critical issue that can lead to track deformation, heightening the risk of train derailments and accidents. High-speed railway systems are especially vulnerable due to their strict geometric tolerances. As global temperatures rise, RTB incidents are expected to become more frequent, necessitating engineering solutions to mitigate these risks. Despite its importance, academic studies on RTB remain limited, particularly regarding regional variations. This study employs ANSYS finite element modeling to assess the technical factors contributing to RTB across various regions of Türkiye. By calculating the difference between Stress-Free Temperature (SFT) and predicted maximum rail temperatures, the study identifies the cities with the highest risks. A 36-meter rail model was developed, and rail stress and buckling risk factors were analyzed using ANSYS static structural, steady-state thermal, and eigenvalue buckling modules. Results show a clear correlation between SFT and maximum rail temperature differences and RTB risk. Cities like Sivas, where this difference exceeds 42°C, are at the highest risk. In contrast, cities with higher rail temperatures but smaller differences between SFT and predicted minimum rail temperatures, such as İzmir, exhibit lower RTB potential.

KEYWORDS: Railway, Sun Kink, Climate Change, Finite Element Analysis, Eigenvalue Thermal Buckling.

2-D GEOMETRIC ACCURACY INVESTIGATION OF VAT-PHOTOPOLYMERISATION PRINTED YTTRIUM STABILISED ZIRCONIA CERAMICS

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ABSTRACT

Vat-photopolymerisation is among the most promising approaches in ceramic additive manufacturing due to its low production costs and high dimensional accuracy. However, because the printing method is based on a photopolymerisation reaction initiated by a light source, light scattering significantly affects the quality of printed parts. This issue is particularly pronounced in ceramics with high refractive indices, such as yttrium stabilised zirconia (Y_2O_3-ZrO_2), where achieving precise geometric accuracy becomes challenging due to increased light scattering. To address this, the cure depth and two-dimensional accuracy of ceramic suspensions were evaluated. The study examined two different particle sizes to assess their influence on dimensional accuracy due to varying levels of light scattering. Additionally, since the photopolymerisation process in ceramic suspensions is initiated by free radicals, various concentrations of photoinitiators were tested to determine their impact on both cure depth and geometric error. Both particle size and photoinitiator concentration were analysed under different exposure times to assess their effects on the printed parts. The results demonstrate that particle size and photoinitiator concentration play critical roles in determining the cure depth and geometric accuracy of ceramic green bodies.

KEYWORDS: Ceramic additive manufacturing, Ceramic vat-photopolymerisation, Ceramic green body dimensional accuracy.

NUMERICAL INVESTIGATION OF THE EFFECT OF STEEL BRACES ON MULTI-STORY REINFORCED CONCRETE FRAME BEHAVIOR

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ABSTRACT

Nowadays, the architecture of cities develops vertically instead of horizontally. due to increasing population and urbanization. Especially in cities defined as metropolises, the number of multi-story buildings increases day by day. However, the design of multi-story buildings is quite important under unpredictable loads such as earthquakes. For this reason, steel braces are used to increase the existing strength and rigidity of structures built in earthquake zones. Steel braces allow the structure to carry more load and displace less under horizontal loads. Thus, they increase the strength and rigidity of structures. In this study, reinforced concrete frames were modeled by SAP 2000 finite element software, and then concentric steel braces were added to these structures. As a result of the analysis, the strength, stiffness and story drift values of the structures were obtained. Thus, the structural behavior of the frames designed and analyzed under vertical load and earthquake effects was compared.

KEYWORDS: Reinforced concrete structure, earthquake, concentric steel brace, numerical analysis, structural behavior.

EFFECTIVENESS OF MULTILAYER RADIATION SHIELDS: A SIMULATION-BASED COMPARISON

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ABSTRACT

In radiation protection applications, the choice of shielding design plays a crucial role in ensuring optimal protection. Multilayer radiation shielding design is one of the options for these shielding applications. Multilayer radiation shielding applications combine different materials, with each material being specifically enhanced to protect against a particular type of radiation. These systems incorporate combinations of materials with varying atomic numbers. This study focuses on comparing single-layer and multilayer radiation shielding systems to highlight the superior performance of multilayer configurations. Using both GEANT4 and FLUKA simulation codes, the effectiveness of various materials and layer arrangements in attenuating ionizing radiation were analyzed. The results demonstrate that multilayer shielding offers enhanced radiation attenuation by leveraging the combined properties of different materials, reducing secondary radiation and improving overall shielding efficiency. These findings underline the importance of adopting multilayer approaches in critical applications, particularly in environments with complex radiation fields, such as in nuclear reactors and medical radiation facilities.

KEYWORDS: Multilayer radiation shielding, secondary radiation, GEANT4, FLUKA.

MECHANICAL PROPERTY ENHANCEMENT OF 31CRMOV9 STEEL THROUGH TITANIUM COATING BY ELECTRO-SPARK DEPOSITION FOLLOWED BY GAS NITRIDING.

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ABSTRACT

Nitriding steels have found applications across numerous sectors, including automotive, aerospace, energy, manufacturing, defense, and mechanical engineering, and they remain widely used for their durability and tribological properties. However, under high load amplitudes and prolonged use, particularly in components such as gear components and crankshafts, their surface properties may deteriorate. It is well known that mechanical properties can be enhanced through surface modification techniques, including gas nitriding. Additionally, the electro-spark deposition technique, recognized for its ease of application, has been widely employed to produce hard coatings.

In this study, 31CrMoV9 (DIN 1.8519) samples were coated with a pure titanium electrode using the electro-spark deposition technique, followed by a gas nitriding process applied to both bare and coated steel samples. Structural and phase analyses of the coating layers were conducted using optical microscopy and X-ray diffraction (XRD). The coating structures, morphologies, and elemental distribution were thoroughly characterized by scanning electron microscopy (SEM) coupled with energy dispersive X-ray spectroscopy (EDXS). Microhardness and block-on-ring wear tests were performed to assess the mechanical and tribological properties. The results indicated that the formation of TiN and Ti_2N phases in the coating layers led to a twofold increase in hardness and a 2.5-fold reduction in wear loss compared to gas nitrided steel samples.

AN EVALUATION OF SCHEDULING ALGORITHM IN MPTCP SYSTEMS: A COMPREHENSIVE SURVEY

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ABSTRACT

To provide high level of network connectivity and performance, mobile tools can be supported with multiple wireless interfaces. The Multipath TCP (MPTCP) technology is provided to employ the capabilities of multiple available connection minimizing the connectivity issues in case of a failure. One of the most significant parts of the MPTCP is packet scheduling algorithm. Many scheduling solutions are proposed to achieve higher performance in network. Path heterogeneity and packet losses are two most common issue in MPTCP wireless network which generate high Out-of-Order (OfO) packets and decrease network throughput. In this paper, we discuss the main performance based issues of MPTCP. In addition, we provide an in-depth analysis of the most common schedulers such as Default, Blocking Estimation-Based, Earliest Completion First, and Short Transfer Time First. Consequently, we provide a comprehensive overview of related works in MPTCP schedulers which can be a promotion further academic research in this field.

KEYWORDS: MPTCP scheduler, Path utilization, Transport protocol, Asymmetric paths, Wireless networks.

VAPOR PRESSURE REDUCTION OF GASOLINE-ETHANOL AZEOTROPIC MIXTURES BY THE ADDITION OF C3-C5 ISO-ALCOHOLS

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ABSTRACT

Ethanol is a feasible and renewable substitute for gasoline in Spark-Ignition (SI) engines, offering high octane ratings and emissions benefits. However, when ethanol is blended with gasoline, it forms an azeotropic mixture that increases the vapor pressure of the final fuel, which can cause a vapor plug in the fuel system. This causes technical problems such as unstable operation and engine stalling. In this study, the aim was to reduce the vapor pressure of the ethanol-gasoline mixtures by adding C3, C4, and C5 iso-alcohols, namely isopropanol (IP), isobutanol (IB), and isoamyl alcohol (IA), which have lower vapor pressures than gasoline and ethanol. Each iso-alcohol was separately added to ethanol-gasoline blends (E10, E20, and E30) by 5% volume, followed by measuring fuel properties such as Reid vapor pressure (RVP), density, and distillation temperatures. The results revealed that E10 behaved as an azeotropic mixture and yielded the highest RVP (63.2 kPa). Yet, it easily reduced to 61.8 kPa, 61.3 kPa, and 61.1 kPa by adding IP, IB, and IA alcohol to E10. The density of ethanol-gasoline blends was raised when adding iso-alcohol, the highest measured with E30+IA5 by 763.6 kg/m3. In addition, the heating value and distillation characteristics of ethanol-gasoline blends improved by adding iso-alcohols. More importantly, the measured fuel properties were found to be aligned with the specifications of European quality standard EN 228, except for some fuel samples' distilled values of E70 and E100. These results highlight the effectiveness of C3-C5 iso-alcohols in reducing the high vapor pressure posed by ethanol-gasoline azeotrope mixtures, facilitating the greater use of ethanol as a sustainable fuel in SI engines.

KEYWORDS: Biofuel, Ethanol, Gasoline, iso-alcohol, Vapor pressure.

DESIGN OF A DIRECTIONAL COUPLER BASED CSRR MICROWAVE SENSOR TO ENHANCE SENSITIVITY

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ABSTRACT

Knowing the dielectric properties of materials is important in predicting how materials will respond when exposed to an electric field. Therefore, research on sensors that can measure complex electrical permittivities non-destructively has increased rapidly in recent years. This study proposes a new sensor based on directional couplers and uses complementary split ring resonators (CSRR) as resonant elements to characterize the complex electrical permittivities of materials. The proposed sensor operates in the 1.5 - 3 GHz frequency range and is designed on a low-cost FR4 substrate. The designed microwave sensor is comprehensively optimized using CST Studio simulation software. To evaluate the sensing performance of the sensor, materials with dielectric constants (□r) ranging from 1 to 10 were tested in a simulation environment, and sensitivity analysis was performed by monitoring the frequency changes in the S21, S31, and S41 parameters. The relative sensitivity of the designed microwave sensor is in the range of 6.73-3.37.

KEYWORDS: Microwave sensor, Resonator, Directional Coupler, Sensitivity.

SKIP-GRAM ADAPTED FOR SESSION-BASED RECOMMENDATION SYSTEMS

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ABSTRACT

A session-based recommendation system predicts the next click or the sequence of items the user will interact with by considering their previous clicks and interactions. Modeling users' future behavior probabilistically in online transactions is challenging because most behavioral information is not available. Sequence-based recurrent neural networks, which encode a user's past behavior sequence, and graph-based neural models, which encode item relationships, may overlook different time periods in previous sessions. In this study, we propose an adapted skip-gram model to address these challenges in session-based recommendation systems. Our proposed method, skip-gram, not only captures sequential user interest through item-specific sub-sequences within the session but also learns complex interaction patterns between items. By employing the adapted skip-gram approach, our model can address many issues found in sequence-based models and better learn accurate transition patterns between items. Extensive experiments on two large real-world datasets demonstrate that our method outperforms state-of-the-art solutions in terms of the mean reciprocal rank score based on the skip-gram model.

KEYWORDS: Skip-gram, session-based recommendation systems, item-specific subdirectories, contextual connections, recommender system.

APPLICATION AND PERFORMANCE ANALYSIS OF GRADIENT BOOSTING CLASSIFIER FOR WINE QUALITY PREDICTION

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ABSTRACT

The purpose of this research is to assess the Gradient Boosting Classifier model's performance and forecast wine quality. The collection includes characteristics of red wine samples' chemical makeup, such as alcohol percentage, acidity, and sugar content. GridSearchCV was used to optimize the model's hyperparameters; 200 estimators, a maximum depth of 5, and a learning rate of 0.05 were found to be the optimal values. On the test dataset, the model produced an accuracy of 64.38%, a precision of 0.41, a recall of 0.33, and an F1 score of 0.35. These findings show that although there is potential for improvement in terms of lowering erroneous predictions, the model does a respectable job of predicting the quality of wine.

KEYWORDS: Wine, quality, classifier, model, prediction.

INVESTIGATION OF RECOVERY OF VALUABLE FOOD COMPONENTS BY USING SUPERCRITICAL CARBON DIOXIDE EXTRACTION METHOD

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ABSTRACT

Many studies have been conducted to determine the physical and chemical properties of some foodstuffs. As a result of these analyses, it has been determined that some foodstuffs such as walnuts have nutritionally important components. Essential fatty acids and proteins are the basic nutrients in these foods. Walnuts, which are rich in antioxidant phenolic components. Within the scope of the study, it was aimed to evaluate the extracts obtained from walnut shells and walnut testan (walnut membrane) of the walnut plant with supercritical extraction, a green and innovative extraction, in terms of phenolic substance, flavonoid and antiosexidant capacity contents. Supercritical carbon dioxide extraction (SK - CO_2) will be used due to its advantages such as shorter extraction time compared to classical extraction methods, not leaving toxic residues, obtaining extracts without damaging their natural structure and obtaining value-added products. As a result, the study aims to obtain findings on the recovery of functional components from walnut plant waste and their inclusion in the circular economy. Thus, it is aimed to evaluate walnuts and walnut products with high antioxidant capIsotoacity and bioavailability potential in accordance with the zero waste principle and to contribute to the country's economy.

KEYWORDS: Food components, Super critical extraction, Zero waste, Walnut testan, Phenolic substance.

PREDICTING STUDENT DROPOUT IN HIGHER EDUCATION USING MACHINE LEARNING TECHNIQUES: A PREDICTIVE MODEL USING XGBOOST ALGORITHM

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ABSTRACT

One of the biggest challenges facing higher education institutions is student dropout. In this study, we developed a predictive model for students at the risk of dropping out using machine learning technologies. We used an open-source database from one of the higher education institutions in Portugal, containing the data of 4424 students and 35 variables including demographic characteristics, socio-economic factors and academic performance. We used the XGBoost algorithm to build the model due to its high efficiency in processing large and complex data, and its high accuracy in forecasting. The model was able to achieve a high accuracy of 90.08% in identifying students at risk of dropping out. The results confirm the effectiveness of the application of machine learning models in education to identify risk factors, which allows educational institutions to develop an early and effective intervention strategy to support students, reduce dropout rates, enhance academic success, then improving the therapy of education outcomes at the individual and institutional levels.

KEYWORDS: Student Dropout, Machine Learning, Prediction, XGBoost.

OPPOSITION-BASED LEARNING METHODS TO IMPROVE EXPLORATION IN METAHEURISTICS

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ABSTRACT

This paper explores the impact of Opposition-Based Learning (OBL) on the performance of metaheuristic optimization algorithms, specifically focusing on its integration with Particle Swarm Optimization (PSO). OBL enhances the search process by evaluating both the current solutions and their opposite counterparts in the solution space, offering a more diverse exploration and helping avoid local optima. Metaheuristic algorithms, including PSO, are commonly used for solving complex optimization problems where exact solutions are not feasible in reasonable time. However, these algorithms often struggle with premature convergence, especially when trapped in local minima. OBL addresses this challenge by generating opposition-based solutions that expand the search space and improve exploration-exploitation balance. In this study, we assess the effect of OBL on PSO using 23 standard benchmark test functions, each run 30 times independently. The results are statistically analyzed to compare the performance of PSO with and without OBL in terms of solution accuracy, convergence speed, and robustness. The study demonstrates that incorporating OBL into PSO consistently enhances performance, particularly in high-dimensional and complex optimization tasks. The opposition-based solutions lead to faster convergence and better-quality solutions, showing OBL's to improve global search capability significantly. These findings indicate that OBL is a method that allows them to explore the search space more effectively and avoid common pitfalls like local optima. This research contributes to ongoing efforts to improve evolutionary algorithms through hybrid approaches, suggesting that OBL could be integrated with other metaheuristics in future studies to further enhance optimization performance. In conclusion, OBL presents a valuable strategy for improving optimization algorithms and offers new potential for tackling complex, large-scale problems with greater efficiency and accuracy.

KEYWORDS: Opposition-Based Learning, OBL, Metaheuristic Optimization, PSO.

A NOSQL-BASED DATA WAREHOUSE SOLUTION FOR REAL-TIME DATA STREAMING

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ABSTRACT

This study aims to develop a NoSQL-based data warehouse solution for processing real-time data streams. Data warehouses are systems used to store and manage large amounts of data from various sources, facilitating analysis and decision-making within an organization. The study aims to exploit the advantages of NoSQL for real-time data management, such as its flexibility and scalability, which enhances the ability to make quick decisions and detect patterns in data.
The main objective of the study is the application of machine learning to the dataset, which is crucial when integrated with a NoSQL-based data warehouse. Machine learning algorithms can identify patterns and make predictions from large datasets, providing valuable insights for businesses. This deep exploration of data reveals hidden patterns, enhancing strategic decision-making processes and maintaining a competitive advantage.
The study is organized into three principal phases: generation and simulation of real-time data, transfer and storage of data in a NoSQL-based data warehouse, and utilizing machine learning algorithms to make predictions based on the data. The dataset used in this study is the estimation of health insurance costs, which includes patient-specific information. MongoDB, a NoSQL data warehouse, offers several advantages, including its schema-less design, horizontal scalability, and ability to operate in parallel and store data in a distributed manner.
Machine learning algorithms are used to calculate health insurance costs based on patient data, using Apache Spark's machine learning libraries. Spark is an open-source parallel data processing framework that efficiently processes large datasets and simplifies real-time data analysis. Various regression algorithms are used, and error metrics determine the most suitable model for the dataset. This provides valuable insights into how patient factors influence insurance costs.

KEYWORDS: NoSQL DBMS, Data Warehouse Modeling,Real-Time Data Streaming, Machine Learning.

RECONFIGURATION OF BUCK TOPOLOGY INTO BUCK-BOOST CONVERTER WITH THE SAME CONTROL UNIT FOR NEGATIVE VOLTAGE GENERATION

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ABSTRACT

This paper presents a novel approach for reconfiguring a conventional buck converter into a buck-boost converter to generate negative voltage, using the same control unit. The proposed transformation is achieved by strategically relocating the DC voltage source and adjusting the grounding, enabling the converter to operate in a buck-boost mode without requiring additional components or significant modifications to the existing control structure. This method leverages the inherent flexibility of the buck converter topology, ensuring compatibility with both positive and negative voltage generation, which is crucial in applications such as operational amplifiers, sensor circuits, and communication systems that require dual or negative voltage rails. A key advantage of the approach is its ability to maintain the same control system, avoiding complex redesigns and reducing cost while enhancing the converter's versatility. Simulations of the reconfigured converter reveal that switching frequency and resistive load variations have a significant impact on output voltage ripples. Additionally, a critical observation is that the total voltage stress on the controller and switching components is dictated by the circuit configuration, rather than solely the input voltage. This finding highlights the necessity of integrating an input capacitor to ensure stable operation and minimize voltage ripples. The study underscores the importance of these factors in designing reliable reconfigurable converters and provides practical insights for optimizing performance in systems requiring negative voltage generation.

KEYWORDS: Buck converter, buck-boost converter, continuous conduction mode, power stage calculations, pulse width modulation.

A NOVEL HYBRID ALGORITHM: ENHANCING TUNA SWARM OPTIMIZATION WITH CUCKOO SEARCH FOR GLOBAL OPTIMIZATION

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ABSTRACT

Metaheuristic algorithms are general strategies used to solve complex optimization problems with large solution spaces. These algorithms produce effective results in many areas without being restricted to a specific solution method. Tuna Swarm Optimization (TSO) is one of such metaheuristic algorithms inspired by tuna's hunting strategies. TSO is based on the behavior of tuna moving collectively towards food. However, TSO has some disadvantages, especially early convergence and tendency to get stuck in local minimum, which reduces the efficiency of the algorithm. In this study, a new approach called Cuckoo Search-Tuna Swarm Optimization (CSTSO) is proposed to address the aforementioned problems, which is improved with the Cuckoo Search (CS) algorithm. The CS algorithm provides a more efficient search for the global optimum, inspired by the behavior of cuckoos that lay their eggs in other birds' nests. CSTSO, on the other hand, combines the fish swarm behavior of TSO with the powerful search capabilities of CS, providing a powerful and innovative solution to optimization problems. CSTSO has been tested on both single and multi-modal benchmark functions, outperforming the standard TSO algorithm and providing successful results in solving engineering problems. This innovative algorithm aims to provide an effective and fast solution to optimization problems by reaching the global optimum without being trapped in local minimal in large solution areas.

KEYWORDS: Tuna Swarm Optimization, Cuckoo Search Optimization, Hybrid, Engineering Design Problem.

LOCATION AWARE BASKET-BASED COMPARABLE MARKET

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ABSTRACT

It is very important to create a system that includes location-based product listing and basket-based comparison features in order to design and develop a website for online grocery shopping, which has increased with the pandemic process and is increasing day by day. There are factors within the e-commerce experience that require special attention for the grocery vertical and will provide significant benefits to users. The most important of these are variable information such as stock, price, shipping fee, and minimum basket amount that users will see based on location. Cimri A.Ş.'s goals include obtaining location and basket-based price data from markets and companies in various ways, correctly classifying and cataloging this information, and then displaying it to the user in the most accurate and fastest way based on location. In addition, it is aimed to collect these catalogs in a single basket (shopping list) and make a mass comparison. In order to meet the needs mentioned in the grocery vertical, the issues of overcoming technical difficulties in the acquisition method, data storage and cataloging, and presentation to the user have also taken their place among the issues that need to be solved. Cimri has been providing services in the field of e-commerce product and price comparison since 2008. Due to its experience in this field, good relationships with more than 1500 contracted e-commerce companies, and high volume data processing capacity, it has also provided services in this sector, which has become important due to the pandemic. It has carried out many steps including comparing services that provide location information, indexing and recording location information to the database, obtaining product and warehouse information from online markets, calculating and indexing product and warehouse information, product price analysis, logging and metrication in order to create a website and infrastructure that allows location-based listing and basket-based comparison of market products.
As a result; Very fine-grained 1.1 million address data down to city, district, town and street are gathered and stored for location operations. In addition 37 million market product offers provided by merchants and marketplaces are linked with 860 thousand market products. By using radius and polygon points, users are able to compare their baskets with nearest or markets up to certain distances which makes the system unique worldwide.

KEYWORDS: Distributed Systems, Location Data, Geospatial data, Software programming, Data processing.

ANALYSIS OF LIQUEFACTION POTENTIAL OF SOILS BY OBJECT ORIENTED COMPUTER SOFTWARE: 6TH OF FEBRUARY, 2023 KAHRAMANMARAŞ EARTHQUAKE CASE

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ABSTRACT

The soil under dynamic effects such as earthquakes causes great damage to the structure. One of the most important causes of damage caused by earthquakes is liquefaction. Liquefaction is defined as the temporary loss of strength of saturated, cohesionless soil deposits under temporary and cyclic loading due to excessive pore water pressure formation. On the 6th of February 2023 Kahramanmaraş, earthquakes and many others, many people lost their lives in structures damaged due to liquefaction. Turkey Building Earthquake Regulation (2019) explains what should be done about liquefaction. In this study, computer software that calculates the liquefaction potential according to the earthquake code is developed. The software is prepared using MATLAB programming language, which is an object-oriented language. This software calculates the liquefaction potential of soil layers according to possible earthquakes and Standard Penetration Test data. Consequently, it is understood that soils with liquefaction potential should be determined through using the software, and foundation design should be made by the soil conditions.

KEYWORDS: Kahramanmaraş earthquakes, liquefaction, software, Turkey Building Earthquake Code.

MEASUREMENT OF AMPLITUDE PRODUCED BY VARIOUS SIZED PARTICLES IN PIEZOELECTRIC ELEMENT

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ABSTRACT

Piezoelectric elements produce electric voltage when subjected to vibration. As the vibration intensity increases, the electric amplitudes produced increase. The amplitude of the electrical signals generated by particles of various sizes hitting a piezoelectric element was measured. The piezoelectric element with a resonance frequency of 2.4 MHz was placed in the flow tube of a vacuum cleaner. The same amount of semolina particles, the sizes of which were 180-212 μ, 212-355 μ, 355-500 μ, collided with the piezoelectric element at a speed of approximately 10 m/s by operating the vacuum cleaner. The electrical signals produced by the piezoelectric element were amplified with an amplifier circuit and then recorded for half a second at a rate of 1 million samples per second. A program was written to calculate the voltage level and the number of amplitudes in the signals. The highest amplitude values in the signals were measured as 1.08 V, 1.21 V and 1.65 V for 180-212 μ, 212-355 μ, 355-500 μ semolina mixtures, respectively. The total number of amplitudes exceeding the 0.6 V threshold in the signals was measured as 21, 184 and 7905, respectively. The results obtained showed that the material size ranges changed proportionally with the amplitude values and could be used as a scale in material size estimation.

KEYWORDS: Acoustic emission, piezoelectric, particle size distribution, signal processing.

BLUE FLAG AS AN ENVIRONMENTAL MANAGEMENT TOOL FOR SUSTAINABLE COASTS

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ABSTRACT

Today, the importance of environmental protection and management has increased within the scope of sustainable development. Sustainable coastal zone management practices are gaining importance in the national and international environment. This takes the form of implementing environmental management systems such as ISO 14000. It is aimed to evaluate the anthropogenic environmental impacts within the scope of the environmental management system and to address what can be done within the scope of the Blue Flag criteria to ensure sustainability in coastal areas. The most popular way to achieve sustainable coastal zone management and turism is to participate in an eco-labelling scheme and be awarded an eco-label.

It is possible to consider that the environmental label and declaration indicates that a product or service has a sustainable environmental dimension and is one of the relevant management tools in this direction. Within the scope of environmental management practices, which are also included in the Blue Flag criteria, there are headings that include sustainable coastal area management and coastal tourism. It includes a total of 15 criteria within the scope of Environmental Management. Among the criteria, many criteria such as waste management, control and management of wastewater, recycling of packaging waste, management of natural areas, and sustainable use of coastal areas are included in this heading.

In this study, the implementation of environmental management in coastal areas and the necessity and importance of the Blue Flag Criteria in coastal areas were examined.

KEYWORDS: Coastal zone management, environmental management system, blue flag, sustainability.

EFFECT OF NATURAL GAS USAGE ON AIR POLLUTION: THE EXAMPLE OF SINOP BOYABAT

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ABSTRACT

Boyabat district is located in the inner parts of the central Black Sea region, surrounded by the Küre and Ilgaz mountains, in the wide valley created by the Gökırmak River between these mountains. Since the place where the district is established is located in the valley, the atmospheric characteristics of the district are generally calm and windless. The district is the most crowded settlement in the region in terms of population. Fossil fuels (wood, coal, etc.) were widely used for heating purposes in the district. Natural gas was supplied to the district in the last quarter of 2020 and started to be used. As of October 2024, approximately 80% of the district uses natural gas. There are currently over 10,000 natural gas subscribers in Boyabat district. Thus, approximately 35,000 people meet their heating needs through natural gas. For this reason, it has been observed that there has been a significant decrease in the amounts of carbon dioxide (CO_2), sulfur oxide (SO_2), carbon monoxide (CO), and particulate matter (PM) that previously accumulated in the district's atmosphere due to fossil fuels. The air quality measurement station of the Ministry of Environment and Urbanization started to collect data in Boyabat district in mid-2015. In this study, air quality measurement data for the years 2016-2024 were obtained from the relevant institutions and air pollution caused by natural gas use in Boyabat district was examined. When the obtained data were examined, it was observed that emission values such as CO, SO_2, PM10, PM2.5 decreased by approximately half with the use of natural gas. On the other hand, it was determined that there was a significant increase in nitrogen oxide emissions (NO, NO_X and NO_2). As a result, according to the Sinop Boyabat example, it has been observed that the use of natural gas offers significant opportunities for improving air quality and reducing environmental impacts. It has been observed that with the increase in the use of natural gas, the negative effects created by fossil fuels have decreased significantly. Especially in settlements located in valley areas where air pollution is more affected, the use of natural gas is important for the air quality of the region.

KEYWORDS: Natural Gas; Emission; Air Quality; Boyabat; Coal; Environment.

NEUROLOGICAL DISORDERS: TYPES, DIAGNOSIS, AND MACHINE LEARNING AND DEEP LEARNING APPROACHES FOR DIAGNOSIS

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ABSTRACT

Brain tumors, Alzheimer's disease, Parkinson's disease, stroke, and multiple sclerosis are categorized as neurological disorders. These conditions are among the most challenging diseases in medicine and affect more than one billion people worldwide. In addition to having a detrimental impact on the patient's life and the lives of their family members, in certain cases, these diseases can lead to the patient's death. Therefore, it is critical to detect these issues as early as possible in order to slow down or even halt the progression of the disease.

Artificial intelligence (AI), a field of computer science, has demonstrated great capability in analyzing complex healthcare data and identifying key patterns within large datasets in today's modern world. Advances in AI applications in the medical field have shown promising potential in diagnosing and identifying diseases. The subfields of AI, including machine learning (ML) and deep learning (DL), have garnered significant attention from the medical industry. ML and DL are increasingly being employed in medicine to achieve precision treatment and enhance patients' quality of life. Due to their ability to identify complex and abstract patterns, ML and DL methods have proven beneficial in neuroimaging studies of neurological disorders, which are characterized by subtle and scattered changes. These methods are particularly useful for detecting and predicting neurological disorders.

This study provides an overview of the types and diagnostic methods of neurological disorders. It also includes an examination of the applications and techniques of ML and DL, which are among the most impactful fields in computer science, as applied to neurological disorders.

KEYWORDS: Deep Learning, Machine Learning, Neuroimaging, Neurological Disorders, Prediction, Artificial Intelligence.

DEVELOPMENT OF A SKULL PHANTOM FOR ARTIFICIAL EEG WAVE GENERATION AND ANALYSIS

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ABSTRACT

Electroencephalography (EEG) electrodes are special sensors used to measure the electrical activity of the brain. These electrodes are placed on the scalp and provide information about neural activity by recording brain waves. EEG electrodes are usually small metal disks that are attached to the scalp with a conductive gel or adhesive. The development of biomedical devices, such as EEG electrodes, often requires human trials, which are complicated by the variability of EEG signals, their dependence on movement, and ethical concerns. To address these challenges, artificial tissues (phantoms) are used as substitutes for human organs. This study involved the creation of a skull phantom designed to generate artificial EEG waves. Using Fused Deposition Modeling (FDM) with polylactic acid (PLA) and A366/CQ black steel, (beams were placed at three predetermined points inside the PLA skull phantom) beams were placed at three points on the PLA skull phantom. The phantom was tested at motor speeds ranging from 10 to 100 rpm, and EEG waves were recorded using a piezo sensor connected to an Open BCI board. The collected data were simulated using the LORETA program, followed by filtering and classification using Python. For the classification process, the Root Mean Square method, a machine learning algorithm, was utilized. In conclusion, the gamma frequency band is dominant across most channels, indicating a high intensity of high-frequency brain activity (above 30 Hz) in the EEG data. Gamma waves are typically associated with intense cognitive processing, perceptual tasks, and conscious awareness. These waves help us understand the complex and integrated functions of the brain and provide important information about neurological health. Analysis of gamma waves can also be used to diagnose and treat neurological disorders.

KEYWORDS: Skull phantom, EEG, brain waves, piezo sensor, 3D printing

DETECTION OF SURFACE DEFECTS ON COLD-ROLLED GALVANIZED STEEL USING AI-DRIVEN IMAGE FILTERING TECHNIQUES

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ABSTRACT

Steel surface defects caused by mechanical, thermal or chemical factors during production can significantly compromise the structural integrity and performance of the material. These defects are generally categorized into scratches, weld defects, and contaminated or clean surfaces. Early detection and accurate classification of such defects is critical to optimizing production processes, improving final product quality and reducing costs. This study proposes a deep learning-based model for surface defect detection on cold-rolled galvanized steel using noise-free steel surface images. The model operates in two stages: first, noise is reduced from the images using Gaussian and median filters to improve classification accuracy. In the second stage, the denoised images are processed by a pre-trained convolutional neural network. A dataset of 3,400 surface defect images representing scratches, welds, clean and dirty surfaces was used to train the model. The model was then tested on a further 600 images and its performance evaluated using 10-fold cross-validation, achieving an accuracy of 98.78%. This approach, in particular the use of the Gaussian filter, provides a robust solution for the effective detection of surface defects on cold-rolled galvanized steel.

KEYWORDS: Steel surface defects, Deep learning, Image denoising, Convolutional neural network, Gaussian filter.

ANALYZING THE BOOST CONVERTER CIRCUITS AND SWITCHING TYPES

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ABSTRACT

This article provides an overview of boost converter circuits and switching types. In the research, 1-stage hard switching boost converter, 2-stage hard switching boost converter and soft switching boost converter circuits were examined and analyzed. The losses in 1 stage boost converter circuits are higher than the losses in 2 stage boost converter circuits. For this reason, 2 stage boost converter circuits are more efficient circuits. At the same time, soft switching circuits have more reasonable losses than hard switching circuits. In hard switching circuits, the switching element gets very hot and a large-sized cooling unit is needed.
The research methodology of this article is to analyze and demonstrate the differences between the 1-stage boost converter circuit and the 2-stage boost converter circuit. At the same time, it is to examine the advantages and disadvantages of hard switching boost converter circuits and soft switching boost converter circuits by comparing them with various analyzes. The main contribution of this article is to enable optimum circuit selection for electric vehicle charging stations by examining various boost converter circuits.
As a result of the research, it was determined that the efficiency was reduced because the losses in the 1-stage boost converter circuit were high. Therefore, 2-stage boost converter circuits can be preferred. Soft switched circuits provide more stable systems. Thus, optimum circuit topology can be obtained.
As a result of these calculations and analyses, the boost converter circuit is tried to be designed in an optimum way. We are continuing our work to make it suitable for use as an electric vehicle charging station.

KEYWORDS: Boost converter, 1-stage, 2-stage, soft switched, hard switched

SILENT MODE APPLICATION FOR MOBILE DEVICES WITH WIRELESS BROADCAST TECHNOLOGY

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ABSTRACT

As the population continues to grow, societies are becoming more crowded. In environments where people gather collectively, the necessary silence for beneficial activities is occasionally disrupted by the effects of technological devices, particularly mobile phones. This study focuses on efforts made to automatically silence incoming call notifications on mobile phones in places where people congregate, such as places of worship, seminar rooms, cinemas, meeting rooms, libraries, and similar settings. An application has been developed using the Kotlin programming language, and a device capable of broadcasting via Wi-Fi and Bluetooth has been designed to activate this application. The Wi-Fi-Bluetooth broadcasting device is plugged into an electrical outlet and begins to broadcast over an area of approximately 70 square meters. As soon as the application on the mobile phone detects this broadcast, it silences the phone without requiring any connection. When the mobile phone moves away from the broadcast area, it returns to its previous sound mode.

KEYWORDS: Bluetooth, call, meeting, silent mode, Wi-Fi

DEPOSIT AMOUNT ESTIMATION FORMED IN LANDFILL GAS ENGINE COMBUSTION CHAMBER

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ABSTRACT

Deposits have been observed in gas engines used in landfill gas to energy projects (LFGtE). Since this negatively affects energy production performance, the causes and extent of these deposits need further investigation. In this study, the accumulation of SiO_2 metal oxides formed due to the oxidation of siloxanes in the combustion chamber parts of a gas engine (piston head and cylinder head) in LFGtE projects has been estimated. It was determined how much of the SiO_2 accumulated because of comparing the amount of SiO_2 in the total deposit formed during an operating period in the gas engine and the amount of SiO_2 formed by the combustion of siloxanes in the combustion chamber. The distribution of oxides within the mass of engine deposits was determined using Energy-Dispersive X-ray Fluorescence (EDXRF) spectroscopy. This technique enabled the identification and quantification of elemental composition, providing valuable insights into the chemical makeup of the deposits and their potential effects on engine performance and longevity. Moreover, the density analysis required to determine the total amount of deposits was made using the pycnometer method. The chemical composition of LFG was obtained from existing studies in the literature to reveal the oxidation chemistry of siloxanes responsible for the formation of SiO_2. Accordingly, it was observed that not all the silicon oxide formed by the oxidation of siloxanes in the combustion chamber accumulated on the piston head and cylinder head; moreover, a significant amount was found to exit through the exhaust valve. Accordingly, based on the relative accumulated deposit mass of SiO_2 in the combustion chamber, the accumulated fraction of formed metal oxides in the deposit mass is approximately 6-11%, and the remaining part of metal oxides is released to the atmosphere through the exhaust valves.

KEYWORDS: LFG engine, combustion, deposit formation, siloxane, SiO2.

FUEL CELL AND ELECTRICAL PROPULSION OPTIONS OF MILITARY VEHICLES

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ABSTRACT

The defense industry is among the important research topics with the continuous development of different vehicle designs. In this study, the energy used type in different military vehicle types are analyzed. It is assessed that there is a significant fossil dependency. in this point, With the increasing emission effects originating from transportation, renewable energy sources offer significant potential in vehicle technologies, Which the adoption and development of electric drive and fuel cell-attached vehicle technologies have become a necessity. In military applications, vehicle designs compatible with environmental conditions in land, air and sea vehicles, weight, carrying capacity, cost and energy efficiency are interrelated parameters. In line with the research carried out in this context, it is thought that fuel cell applications can provide potential solutions in providing energy needs by optimizing military vehicles. When the technological advances experienced in air, land and sea vehicles in military applications are evaluated in recent years, it is remarkable that all transportation modes need to work integrated with each other. However, it has been determined in the existing literature that rail transportation has insufficient use in military applications. As a result, designs of vehicle modes compatible with each other are needed. In future, increasing the operating performance of vehicle models used in military applications in difficult conditions, reducing cost cycles can be directly associated with the development of hybrid systems with high energy efficiency.

KEYWORDS: Defense industry; emission; fuel cell; hybrid systems; energy efficiency.

A STUDY ON SOLAR-ASSISTED HYDROGEN PRODUCTION AND REUTILIZATION IN RURAL AREAS

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ABSTRACT

Hydrogen is a significant energy source and a strong candidate for energy storage. Solar energy, while clean, is not a continuous energy source. The primary aim of this study is to evaluate, through computer simulation, the feasibility of developing an integrated system for small-scale consumers in rural areas that are disconnected from the electrical grid. In this system, energy generated from solar panels is used both to charge a battery and to produce hydrogen via water electrolysis. The produced hydrogen is stored and can be utilized either as a fuel or converted back into electricity through a fuel cell when needed. A mathematical model was developed for this system, and a theoretical analysis was conducted using computer-assisted solutions. The model utilized data on Sinop City's average monthly solar radiation over the years. Based on the developed mathematical model, a two-stage solution to the problem was implemented using the MATLAB programming language and its auxiliary software package, SIMULINK. Input parameters included water inlet temperature and pressure to the electrolyzer, as well as the efficiency rates of photovoltaic panels. The overall system efficiency and effectiveness, along with the amounts of electricity and hydrogen produced, were obtained as output parameters. The energy density obtained from the fuel cell is closely related to the amount of hydrogen input, the quality of the cell membrane, and the cell pressure. It was found that the inlet temperature is a critical parameter in the amount of hydrogen produced from the electrolyzer. The proposed system can be applied in rural areas of Sinop and in standalone residential regions, such as country houses.

KEYWORDS: PEM fuel cell, PV solar panels, Solar cells, Water electrolysis.

ASSESSING THE PREPAREDNESS OF TURKISH AUTHORITIES FOR NUCLEAR ANOMALIES IN THE CONTEXT OF THE AKKUYU NUCLEAR POWER PLANT

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ABSTRACT

Disasters are defined as natural or human-induced events that negatively impact the natural flow of life. They cause physical, economic, social, and psychological harm to individuals and communities. Nuclear disasters, like the Chernobyl accident in 1986, have had long-lasting effects on regions far beyond their immediate vicinity, including Turkey. Therefore, ensuring a high level of preparedness is critical for mitigating the potential impacts of such incidents. While statistically, nuclear energy is one of the least harmful energy sources, the catastrophic effects of radiation from events such as Chernobyl and Fukushima have led to public concerns. In light of Turkey's collaboration with Russia on the Akkuyu Nuclear Power Plant (NPP), the Turkish public administration must enhance its readiness for potential nuclear incidents. Although Turkey's experience with nuclear energy is relatively new, preparations for nuclear accidents or radioactive emissions are already being handled by Chemical, Biological, Radiological, and Nuclear (CBRN) units.

This study aims to evaluate the preparedness of Turkey's disaster management system in the event of a nuclear accident at the Akkuyu NPP. Using the International Atomic Energy Agency's (IAEA) checklist for emergency preparedness, the study assesses Turkish authorities' readiness and identifies gaps. The checklist covers areas such as authority, command and control, organizational responsibilities, logistical support, training, public information, and long-term protective actions.

The findings reveal significant gaps, particularly in the areas of radiological emergency planning, logistical preparation, and training exercises. Enhancing these areas is critical to ensure effective disaster response and prevent the first nuclear accident from causing irreversible public opinion shifts against nuclear energy in Turkey.

KEYWORDS: Disaster Preparedness, Nuclear Incidents, Akkuyu Nuclear Power Plant, Radiological Emergency Response.

INVESTIGATION OF DIELECTRIC SUPERSTRATE EFFECTS ON SELJUK STAR MICROSTRIP ANTENNA

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ABSTRACT

In this study, the effects of using a dielectric superstrate on the microstrip antenna have been investigated such as operating frequency and gain in the Industrial Scientific Medical (ISM) band. Seljuk Star patch geometry is preferred due to its many advantages in microstrip antenna design and 4.75 mm thick RT-Duroid 5880 LZ dielectric material of Rogers company is used as the substrate material. Simulations by ANSYS HFSS and measurements of the manufactured antenna are performed by stacking three different superstrate layers as woolen felt, FR4 and RT-Duroid 5880-LZ above the patch and the results are compared. The effect of the change in the height of these different superstrate materials on the antenna performance is also investigated with simulations. The results from simulation show that with the addition of woolen felt, FR-4 and RT-Duroid 5880 LZ superstrate, the basic antenna gain is increased by 4%, 5% and 20% when it is 7.92 dB for the basic design, and the frequency is shifted down by 9%, 14% and 8% from 5.5 GHz of the basic design. In addition, when the thickness of the superstrate used increased, the frequency shifted more downward. Therefore, with the down shift of the frequency, a decrease in patch size is obtained for the same target frequency. As seen from these results, the addition of superstrates with different features on the patch is a simple and low-cost method to expand the antenna gains and can be applied in the basic design of the antenna and after manufacturing.

KEYWORDS: Dielectric Superstrate, Gain, HFSS, Microstrip antenna, Resonant frequency, Seljuk star, Woolen felt.

A COMPREHENSIVE OVERVIEW OF MOBILITY PREDICTION MECHANISMS, MODELS AND ARCHITECTURE

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ABSTRACT

Location-based Service (LBS) is presented as one of the most common applications. The LSB is intended to improve mobile services, such as data-driven functions relating to user positions. These capabilities may include forwarding target suggestions, real-time traffic data, and merchant recommendations. Mobility as a key component of wireless networks, creates a number of important issues in networks, including a large volume of offered traffic, handover restrictions, signaling network analysis, client position updates, and enrollment, all of which have an impact on LBS quality. Mobility prediction mechanisms can indicate the next client position. Thus, it is suitable for applications such as handover management, resource management, and LBS. This paper provides an in-depth discussion of state-of-the-art algorithms for predicting mobility by studying and analyzing previous mobile user's movements. In this study, we have explained several prediction models, including the Markov Chain (MC), Hidden Markov Model (HMM), Artificial Neural Networks (ANN), and Bayesian Network (BN). These are the most important methods for mobility prediction systems. These methods not only improve forecast accuracy, but also network performance in terms of user latency, blocking, and dropping probability. This study sets the way for future work, such as the design and implementation of unique LBS-specific mobility prediction techniques to improve network performance even further.

KEYWORDS: Location-based service, Markov chain model, Mobility prediction algorithm, Region of interest parameter, Stay point detection.

BENTHIC MACROINVERTEBRATES IN THE RIVERS OF ÇUKUROVA REGION: AN INDICATOR OF WATER QUALITY

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ABSTRACT

Benthic macroinvertebrates are aquatic communities composed of organisms larger than 0.5 cm and are used as bioindicators to monitor water quality. The responses of benthic invertebrates to environmental pressures such as organic pollution, pH changes, flow rates, and discharge can be measured by the increase or decrease in their composition, abundance, and diversity. This study was conducted in December 2023 on three significant rivers selected from two important water sources in the Çukurova Region: the Seyhan and Ceyhan River basins. Samples were collected according to habitat conditions (macrophytes, mud, sand, hard substrate, debris, etc.) and covered a total area of 2.5 m². After sampling, they were immediately preserved in 70% alcohol and transported to the laboratory. The samples were washed using a multi-sieve system with different mesh sizes (2 cm, 1 cm, and 0.5 cm), and after sorting into taxonomic groups, they were stored in bottles containing 70% ethanol. Identifications were made only on intact individual organisms.

As a result of this study, which aimed to determine the biodiversity of benthic macroinvertebrates distributed in rivers, a total of 1600individuals belonging to 46 taxa and 5 groups (Chironomidae, Copepoda, Hirudinea, Nematoda, and Oligochaeta) were examined. Species belonging to Chironomidae, Copepoda, and Oligochaeta taxa, known to be tolerant to pollution, were identified, and no indicators of clean water were found. While taxon richness, diversity, and evenness are important in assessing ecological quality, the presence of specific groups is equally significant.

The detection of species such as *Baetis rhodani*, *Caenis luctuosa*, and *Hydropsyche fulvipes* is a positive indicator of a healthy ecosystem, whereas the presence of *Asellus aquaticus*, although in low abundance, suggests that the region is not yet polluted but remains under threat.

KEYWORDS: Çukurova Region, benthic, macroinvertebrates, river, water quality.

DYNAMIC ANALYSIS OF 3D-PRINTED ABS, PET-G AND PLA STRAIGHT BEAM

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ABSTRACT

In the modern industrial landscape, while conventional manufacturing techniques such as machining, casting, welding, powder metallurgy, and plastic forming are still predominantly used for metallic, polymeric, composite, and ceramic components, this trend has started to shift in recent years. Three-dimensional (3D) printing technology has emerged as one of the advanced production methods that enables the creation of intricate designs. Moreover, 3D printing offers several advantages over traditional manufacturing processes, including faster production times and reduced material consumption. Therefore, the free vibration analysis of structures made from such materials is of great significance in the design process. The aim of this study is to investigate how variations in parameters such as length, boundary conditions, and thickness influence the vibrational characteristics of 3D-printed straight beams made from PET-G, PLA, and ABS materials. The vibration parameters of the 3D straight beams were determined through modeling using the ANSYS finite element software. To validate the accuracy and feasibility of the proposed model, numerical results were compared with findings in existing literature. The results revealed that changes in material and geometric properties of 3D-printed straight beams significantly affect their natural frequencies.

KEYWORDS: Free vibration; Straight beams; Additive manufacturing; Finite element method, Dynamics.

A COMPREHENSIVE STUDY AND INVESTIGATION OF VANET ROUTING PROTOCOLS IN ITS

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ABSTRACT

In recent years, communication networks play a key role in human life. With the development of science and knowledge, modern technologies have emerged in computer networks. In addition, Internet of Things (IoT) becomes one of the most important technologies in computer science that attracts researchers. The IoT systems are implemented for different applications such as Smart Building Systems (BMSs), fuel management systems, and Intelligent Transportation Systems (ITS). In this article, we focused on ITS as one of the most common applications of the IoT systems. The ITS employs various types of communication technologies according to defined needs, conditions, and applications. Vehicular Ad-hoc Network (VANET) is of the most popular wireless networks that performs ITS communications. With cities development and increased density of vehicles, VANET faced some challenges like scalability, security, routing, and energy efficiency. In this study, we investigated routing mechanisms as one of the main challenges of VANET communication systems. This research offers a comprehensive comparison of three prominent routing protocols: Ad Hoc On-Demand Distance Vector (AODV), Destination-Sequenced Distance Vector (DSDV), and Optimized Link State Routing (OLSR). We focus on the mentioned protocols features, advantages and limitations according to network performance metrics. These insights provide network designers with valuable guidelines for optimizing network performance for specific applications, ensuring efficient and reliable communication across diverse network conditions. This study paves the way for future work, including the design and implementation of a novel routing protocol tailored specifically for VANETs, to further enhance network performance.

KEYWORDS: Internet of things, Vehicular Ad-hoc Network, Mobile network, Wireless communication system, Routing protocol.

PAN-SHARPENING IN SATELLITE IMAGERY

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ABSTRACT

Image fusion combines information from images obtained by different sensors to produce a new image with more advanced information. Image fusion can also be applied to images obtained from satellites. Pan-sharpening, one of the image fusion methods, improves the multispectral image by using the features in the panchromatic image obtained from the sensors. Multispectral images have high spectral resolution and low spatial resolution. In panchromatic images, spatial resolution is high and spectral resolution is low. With pan-sharpening methods, the details in the panchromatic band with high spatial resolution are transferred to the multispectral band image with high spectral resolution to create a new image. In this new image, both spectral resolution and spatial resolution are high. Due to its advantages, pan-sharpening process is preferred by researchers. In this study, pan-sharpening process was performed using Landsat-9 satellite image. Within the scope of the study, IHS, Ehler's, HCS, HPF, wavelet, Brovey and Gram-Schmidt pan-sharpening methods were used. Pan-sharpened images with these methods were visually and statistically evaluated. RMSE, SAM, CC and ERGAS metrics were used for statistical evaluation of pan-sharpened images.

KEYWORDS: image fusion, pan-sharpening, remote sensing.

GOOGLE EARTH ENGINE AND ITS USAGE IN REMOTE SENSING: THE CASE STUDY OF SAPANCA LAKE, TÜRKIYE

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ABSTRACT

From the past to the present, various advances in technology have led to improvements in satellite sensor systems as well. These developments have enabled satellite imagery to be generally high resolution in terms of spatial, spectral, radiometric and temporal resolution. High resolution satellite imagery has a larger size compared to low resolution satellite imagery. In case of applications that require the use of multiple satellite imagery, the data amount becomes even larger. This causes problems in data downloading, storage, utilization and processing. Google Earth Engine (GEE), which was developed to overcome such problems, is a platform that provides simplicity to researchers by providing storage and processing of a large number of big data sets without the need for any downloading process. In recent years, this platform has been preferred by researchers in various remote sensing studies. Within the scope of this study, Sapanca Lake wetland change was investigated using the GEE platform. For this purpose, the annual amount of Sapanca Lake wetland area was determined by using Landsat-8 satellite images between 2014-2024 and by calculation of the Normalized Difference Water Index (NDWI).

KEYWORDS: Google earth engine, remote sensing.

RADIOLOGICAL EVALUATION WITH POSSIBLE ACCIDENT SCENARIO OF SINOP NUCLEAR POWER PLANT

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ABSTRACT

Nuclear power plants are equipped with comprehensive safety measures to mitigate the potential risks associated with accidents during operation. Action plans are developed to address potential accidents and their aftermath, including the determination of optimal evacuation routes for the local population. To prepare for actions to be taken during and after an accident, simulations and calculations are performed annually using data from meteorological conditions, transportation infrastructure, seismic activity, and natural events in the region prior to the construction of the nuclear power plant. Based on the data obtained from these simulations and calculations, a roadmap is established for responding to an accident. This study analyzes the direction of a radioactive cloud that may form in the event of an accident at the Sinop Nuclear Power Plant, which is planned to be commissioned in Sinop province. The dispersion of radionuclides released after the accident is analyzed using the HotSpot simulation program, with data obtained from the nearest weather station to the plant. The results indicate the direction of the radioactive cloud and the radiation dose that the exposed area will receive when meteorological data and nuclear power plant data are entered into the program.

KEYWORDS: Sinop Nuclear Power Plant, Nuclear Accident, Atmospheric Dispersion Model, Gaussian Plume Model, HotSpot.

INVESTIGATION OF MECHANICAL PROPERTIES OF PARTS PRODUCED IN DIFFERENT LATTICE STRUCTURES BY STEREOLITHOGRAPHY (SLA) ADDITIVE MANUFACTURING METHOD

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ABSTRACT

Stereolithography (SLA) is one of the important techniques that can be used for polymer materials, which are now being produced with superior properties. The main advantage of SLA printing technology is the ability to produce parts with high resolution and precision. In addition to the desired accuracy and surface quality in the production of 3D printed polymer parts, mechanical properties are also an important factor for applications. Because for 3D printed parts to be used in industrial applications, their strength in every respect must be similar or close to the part it will replace or the part produced by traditional manufacturing methods. The mechanical properties of SLA additive manufacturing parts can be affected by both material properties and manufacturing method/parameters. The aim of this study is to investigate all aspects of the mechanical properties of parts with different lattice structures produced using the SLA method. As a result of the study, it will be revealed how the structural properties of the manufactured lattice geometries can be improved with SLA technology and which types of lattice structures provide the most suitable mechanical performance for specific applications.

KEYWORDS: Additive manufacturing, lattice structures, stereolithography, mechanical strength, material efficiency.

INVESTIGATING THE IMPACT OF PLUTONIUM ISOTOPES ON DFR$_S$ FUEL CYCLE LENGTH USING $ThCl_4$-$PuCl_3$ FUEL

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ABSTRACT

In this study, $ThCl_4$-$PuCl_3$ fuel was proposed for the Dual Fluid Reactor (DFR) concept, and the effect of plutonium isotopes on the fuel cycle length was investigated using the SERPENT 1.1.7 Monte Carlo code. The composition of plutonium isotopes was modified based on the spent fuel, which had been cooled for a decade after achieving a burnup of 60 GWd/t in a VVER-1200 reactor utilizing 4,95 wt.% enriched UO_2 fuel. The isotopic composition of plutonium in the fuel was adjusted by decreasing the amount of the ^{239}Pu isotope by 5 wt.% and 10 wt.% while replacing the remaining amount with ^{240}Pu and ^{238}Pu isotopes respectively. As a result, both fuel compositions ensured a longer fuel cycle length than the reference (U-Pu)Cl_3 fuel while providing similar k_{eff} values. Therefore, even with less fissile ^{239}Pu isotope, the fuel enriched with ^{238}Pu achieved similar k_{eff} values. These results show that ^{238}Pu plays a significant role in the fission reaction rate. Additionally, the impact of temperature change on fuel has been investigated. Consequently, both $ThCl_4$-$PuCl_3$ fuel compositions could be considered a safe and efficient alternative for DFR applications.

KEYWORDS: DFR, Dual Fluid Reactor, SERPENT, Neutronic Analysis, Plutonium Isotopes.

MALWARE AND THEIR REMOTE CONTROL IN THE CONTEXT OF DETECTION AND PREVENTION OF GLOBAL THREATS

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ABSTRACT

Malware are software designed to harm computer systems, steal data, or manipulate users. These malicious programs can be of various types, including viruses, worms, trojans, spyware, and ransomware. They spread through methods such as email attachments, websites, and social engineering tactics. Malware can be controlled remotely through Command and Control (C&C) servers, Remote Access Tools (RATs), and botnets. C&C servers act as central management points for malware, allowing attackers to direct their actions. RATs enable attackers to gain remote access to target systems, while botnets are used for large-scale attacks.

Malware can be detected using signature-based detection, behavioral analysis, and heuristic analysis. Signature-based detection uses known malware signatures, while behavioral analysis monitors the malware's actions within the system. Heuristic analysis predicts potential threats. To protect against malware, antivirus and antimalware software, firewalls, and regular updates are essential. User awareness and taking security measures play a critical role in mitigating the impact of malware.

Real-world examples demonstrate the dangers of malware. For instance, the WannaCry ransomware affected thousands of systems worldwide, causing significant financial losses. Similarly, in Lebanon, pagers were used to detonate explosives, showcasing another method of remote control and the potential for significant harm. Such attacks highlight the importance of detecting and preventing malware.

KEYWORDS: Malware, Remote Control, Detection, Command and Control (C&C), Security.

AUTOMATIC DETECTION OF COVID19 USING TRANSFER LEARNING

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ABSTRACT

In this study, the performance of EfficientNetB0, DenseNet201, MobileNetV2 and VGG19 deep learning models was evaluated to classify COVID-19, viral pneumonia and normal chest X-ray data. A dataset containing a total of 317 images was used in the study and the dataset was increased to 1800 images by applying data augmentation techniques. The models used with the transfer learning method were supported by data augmentation and hyperparameter optimization. According to the experimental results, the EfficientNetB0 model was the best among all models with an accuracy value of 99.44%. This research highlights that deep learning-based classification models can provide effective solutions in the field of medical image analysis and reveals the potential of artificial intelligence-based systems for rapid and accurate diagnosis of infectious diseases such as COVID-19.

KEYWORDS: Covid19, Deep Learning, Transfer Learning, Detection, Classification.

COOLING RATE EFFECTS ON THE MICROSTRUCTURE OF A380 ALLOY

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ABSTRACT

A380 aluminum alloy is one of the most widely used aluminum alloys in industries such as automotive, electronics, and machinery due to its favorable mechanical properties. This alloy have good strength, corrosion resistance, and thermal conductivity. The mechanical properties of A380 aluminum alloys are influenced by several factors, including macro and micro porosity, elemental composition, secondary phases, and the shape and size of the dendritic structure.

Porosity in aluminum alloys can be reduced or eliminated through the use of various degassing methods, which help to remove trapped gases during the casting process. The formation of secondary phases can be managed by adjusting the chemical composition, controlling the cooling rate, or using inoculants, which promote uniform solidification. The shape and size of the dendritic structure can be controlled through several methods, including grain refinement, heat treatment, modifying the alloy composition, and adjusting both the casting methods and cooling rate during solidification.

In this study, we examine the effect of cooling rate on the microstructure of A380 alloys. The alloy was melted in an electric resistance furnace. The molten A380 alloy was then poured into a preheated step-shaped mold. The cooling rate was controlled by varying the thickness of the steps in the mold. The thicker sections of the mold cool more slowly, resulting in a lower cooling rate. As a result of this study, we observed that with an increase in the cooling rate, the size of the Secondary Dendrite Arm Spacing (SDAS) and Secondary Dendrite Arm Length (SDAL) in the dendritic structure decreased. This suggests that faster cooling promotes the formation of finer dendritic structures.

KEYWORDS: A380 alloy, cooling rate, Microstructure, dendritic structure.

QUANTIFICATION OF REDUNDANCY IN TEXT SUMMARIES

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ABSTRACT

The elimination of redundancy, defined as the repetition of information or ideas, plays a crucial role in text summarization. Evaluating text summarization models is essential for improvement, yet it poses challenges. Human evaluation is widely acknowledged as a reliable method for assessing the quality of summarization; however, it is both expensive and time-consuming. Consequently, the adoption of automated metrics, such as ROUGE and BERTScore, has become prevalent. Despite this, these metrics possess limited capabilities in measuring redundancy. While metrics that directly evaluate redundancy do exist, they heavily rely on N-Gram analysis. However, due to the complexity of language and the potential for diverse expressions, relying solely on N-Gram-based approaches may prove inadequate.
To address this limitation, our study introduces a simple but effective approach that employs semantic similarities between sentences to quantify redundancy. To assess the effectiveness of our approach, we create summaries using TextRank, LexRank, BART, and T5 methods on four benchmark datasets. Various redundancy approaches are employed to assess the redundancy levels within these datasets and their respective summaries. These approaches include ReScore, which leverages semantic similarities between sentences; the ROUGE-L Redundancy Score, based on the ROUGE-L metric; and UniGram, BiGram, and TriGram Ratios, which quantify redundancy through different N-Gram analyses; along with NID, signifying the Normalized Inverse of Diversity. Additionally, automated summary evaluation aproaches, namely ROUGE and BERTScore, are employed for a comprehensive analysis. This analysis examines both the performance of the proposed metric and its relation to redundancy in text summarization, thereby presenting an approach to quantifying redundancy.

KEYWORDS: Redundancy Measurement, BERT, Sentence Similarity , Summary Evaluation, Sentence Embeddings.

EXPLAINABLE DEEP LEARNING FOR SKIN CANCER DETECTION USING DENSENET121 AND GRAD-CAM

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ABSTRACT

This study investigates the use of artificial intelligence and deep learning models in skin cancer diagnosis. Specifically, a classification model was developed using the DenseNet121 deep learning architecture on dermoscopic images from the HAM10000 dataset, and the model's performance was comprehensively evaluated. According to performance metrics, the model achieved high values such as 93.4% accuracy, 100% sensitivity, and 99.39% specificity. Additionally, the Grad-CAM method was used to visualize the regions the model focused on during classification, ensuring the explainability of the decision-making process. This approach breaks the "black box" nature of deep learning models, offering healthcare professionals more reliable and understandable diagnostic processes. The study's results reveal that AI-based diagnostic systems have great potential in the early detection of critical diseases such as skin cancer. These models are anticipated to significantly contribute to the healthcare sector by enhancing the success of early diagnosis and treatment.

KEYWORDS: DenseNet, GradCam, Explainable AI, Deep Learning, Skin Cancer.

AN ENHANCED IMAGE ENCRYPTION MODEL USING CHAOTIC MAPS AND OPTIMIZATION ALGORITHMS

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ABSTRACT

Visual data, one of the most preferred forms of data storage and sharing, has become one of the primary targets for malicious attacks due to advancements in technological capabilities, making image encryption methods crucial for the secure storage and sharing of data. Although traditional encryption methods have successfully fulfilled their duty in protecting data to date, they are unfortunately inadequate in the face of developing technologies today. In this context, many researchers aim to increase the security of visual data with new approaches by combining various encryption methods. In this study, a new approach combining the Chaotic System, Genetic Algorithm and XOR encryption has been proposed in order to eliminate the inadequacy of traditional image encryption methods. At the beginning of the study, the logistic map created with the help of chaotic sequence to be used in the encryption process of the proposed method was transformed into a chaotic key that is quite difficult to predict. Genetic algorithm, which evaluates the quality of encryption keys in each generation using a population-based approach, was used in the optimization process of the encryption key. The fitness value is measured by the Mean Square Error (MSE) between the original image and the encrypted image created by bitwise XOR operation with the current key. Experimental results show that the proposed method is effective and significantly increases the security of encrypted images compared to traditional methods. This study reveals that the combination of chaotic keys and genetic algorithms offers new potential for developing more secure image encryption methods in the future.

KEYWORDS: Image Encryption, Genetic Algorithm, Chaotic Maps, XOR Encryption.

OPTIMIZATION OF RAW MATERIALS, METHODS AND PRODUCTION FACTORS USED IN BIODIESEL PRODUCTION WITH ENSEMBLE LEARNING

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ABSTRACT

The use of alternative fuels in internal combustion engines has become widespread all over the world. For this reason, alternative fuels are one of the most researched topics today. The use of biodiesel as an alternative fuel in diesel engines is widely preferred. In addition to edible and non-edible oils, edible waste frying oils and animal fats are also preferred in biodiesel production. There are many different methods in biodiesel production. However, the applied method and experimental variables directly affect the biodiesel conversion efficiency. As the number of variables increases, the number of experiments increases and the workload, working time and cost increase accordingly. In biodiesel production, considering various inputs (seed types, methanol ratio, temperature, mixing speed, time, catalyst type, etc.) and outputs (conversion efficiency, density, viscosity, thermal value, etc.), optimization algorithms used to determine the optimal process parameters are selected depending on the multidimensional structure and complexity of the problem. Improving optimization with the support of artificial intelligence plays an important role in determining the optimum experimental conditions in biodiesel production. Many optimization methods are used to determine experimental variables. Each method has advantages and disadvantages. In complex systems such as biodiesel production, it is crucial to model the optimization process and accurately estimate the relationships between inputs and outputs. Ensemble learning is used in modeling this process, combining multiple learning algorithms to provide more robust predictions. In this study, we consider the hybrid use of ensemble learning and optimization algorithms to analyze the effect of multiple variables in the biodiesel production process and to improve the prediction accuracy of production outputs. Different machine learning models such as Random Forest, XGBoost and Artificial Neural Networks (ANNs) were used together by collecting inputs such as temperature, methanol ratio, catalyst type and outputs such as conversion efficiency, density, viscosity in biodiesel production. The outputs of these models were optimized with optimization algorithms such as Genetic Algorithm (GA) to determine the optimum conditions in the biodiesel production process. The solution paths found by different optimization algorithms were combined with an ensemble learning model to obtain the final optimum solution. During the results evaluation and fine-tuning process, the accuracy of the parameter combinations optimized by the ensemble model was compared and the biodiesel production process was continuously improved. This approach will contribute to more efficient processes and higher output quality in biodiesel production.

KEYWORDS: Biodiesel production, optimization, ensemble learning, genetic algorithm, artificial neural networks.

APPLICATION OF NANOPARTICLE-DOPED MOF COMPOSITE-EMBEDDED MIXED MATRIX MEMBRANES IN CARBON CAPTURE

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ABSTRACT

Carbon dioxide (CO_2) is released into the atmosphere from both natural sources and human activities. In Turkey, the largest source of CO_2 emissions from human activities is energy, industrial processes and product use, agriculture, and waste. According to the National greenhouse gas (GHG) Emission Inventory Report, which covers the years 1990-2020 submitted under the United Nations Framework Convention on Climate Change, the energy sector accounted for 85.4% of total CO_2 emissions in 2020. Total CO_2 emissions from all sectors have increased by approximately 173% in 30 years. Thus, CO_2 constitutes 86% of total GHG emissions in Türkiye. This situation shows that Capturing CO_2, which is a major contributor to large-scale GHG emissions, requires new technologies and resources that can operate in an economically viable manner. In this context, carbon capture technologies, which are categorized as pre-combustion, post-combustion, oxyfuel combustion, and direct air capture, have been intensively studied by researchers in recent years. According to current studies, post-combustion capture technologies, which involve the separation, capture, and storage of CO_2 from flue gas after combustion, have been an approach explored more. However, it is also unsurprising that the CO_2 capture process, which is complex and energy-intensive, varies depending on specific emission sources. The most common post-combustion capture approaches are cryogenic separation of CO_2 from other gases, the use of selective membranes, electrochemical separation, physical and chemical absorption in liquid solvents, and adsorption on solids. Among these technologies, membrane-based CO_2 separation processes stand out and new studies are required to develop membranes with high CO_2 selectivity and permeability. In this context, metal-organic frameworks (MOFs) are candidates to meet the need for an effective CO_2 capture material due to their superior properties. The mixed matrix membranes (MMM), which will be developed by incorporating nanoparticle-doped MOFs into conventional membranes, will provide CO_2 selectivity in a gas mixture. Thus, an MMM with high porosity, high CO_2 selectivity, economic feasibility, and thermal and water stability can be obtained by incorporating an MOF composite.

KEYWORDS: Greenhouse gases, CO2, carbon capturing, MOF, membrane.

MACHINE LEARNING APPLICATIONS IN THE OPTIMIZATION OF MOTOR PERFORMANCE AND EMISSION DATA

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ABSTRACT

With the increase in the world population and the advancement of technology, transportation networks have expanded. This growth in the transportation sector has been predominantly supported by internal combustion engines. Although the use of electric vehicles is steadily increasing, diesel-powered vehicles still dominate in public transportation and freight transportation. While diesel engines offer certain advantages, their contribution to environmental pollution and the finite nature of fossil fuel resources represent significant disadvantages. Given the risk of fossil fuel depletion and environmental damage, researchers have increasingly focused on alternative fuel options. Additionally, many countries have introduced regulations to reduce vehicle emissions. One of the most effective methods of reducing emissions is to improve engine efficiency, thereby reducing fuel consumption. In recent years, machine learning techniques have gained great importance in the reduction of emissions and the improvement of engine performance. These techniques analyze engine data to develop more effective emission reduction strategies. In this study, a dataset has been created that includes engine power, specific fuel consumption, and exhaust emissions based on different engine loads. Machine learning techniques were employed to optimize parameters such as air-fuel ratio, fuel temperature, fuel type, coolant temperature, injection timing, and pressure, with the aim of increasing efficiency and reducing emissions. Regression analyses, decision trees, and artificial neural networks were used to model the relationships between engine parameters and to determine the optimal values. Through the application of machine learning methods, this study aims to analyze engine performance under various operating conditions and improve fuel efficiency and emission reduction strategies. The proposed approach offers a new solution to minimize fuel consumption and emission values, contributing to a more environmentally friendly and sustainable transportation system powered by diesel engines.

KEYWORDS: Machine learning, optimization, diesel engine efficiency, emission, engine performance analysis.

DESIGN OF A MAXIMUM POWER POINT TRACKING SYSTEM USING A SWITCHED-CAPACITOR WITH A CLASS E RESONANT INVERTER

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ABSTRACT

Resonant power converters have become increasingly preferred in recent years due to their low electromagnetic interference (EMI) and low switching losses. Implementing resonant power converters in maximum power point tracking (MPPT) systems for photovoltaic panels is crucial for achieving high efficiency. In this study, an MPPT system utilizing a switched-capacitor with a Class-E resonant power converter is proposed. The simulation study was carried out at 450 W/m^2 , 250 W/m^2 and 550 W/m^2 irradiation values, respectively. The average MPPT efficiency for all three irradiance values was 99.7%.

KEYWORDS: Class-E resonant inverter, Maximum power point tracking, Switched-capacitor, Soft switching.

ENHANCING CRYPTOCURRENCY SECURITY: A NOVEL HASHING ALGORITHM FRAMEWORK - MIRROR

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ABSTRACT

This paper introduces a comprehensive analysis of the hashing algorithms integral to cryptocurrency systems, with a focus on their security vulnerabilities. A novel model, "Mirror," is proposed to mitigate the risks associated with the potential breakdown of existing cryptographic hashes. The study begins by detailing the fundamental concepts of hashing, including its structure, purpose, and critical applications in cryptography and blockchain technology. A simplified example of the modulo operation, commonly used in hashing, is visualized to explain collision handling, alongside the role of hash tables in efficient data retrieval. The cryptographic nature of hashing algorithms used in cryptocurrencies is then examined, highlighting key characteristics that define a secure cryptographic hash. Popular algorithms like SHA256, Ethash, Scrypt, Equihash, RandomX, X11, Lyra2Z, and Lyra2REv2 are evaluated in terms of their creation, design, functionality, and specific roles in various cryptocurrencies. Drawing on this analysis, the proposed "Mirror" model addresses the inherent uncertainties of current hashing mechanisms by presenting an enhanced, forward-looking approach to cryptocurrency security. The findings of this study suggest significant improvements in the resilience and reliability of cryptographic systems, ensuring robustness against future threats.

KEYWORDS: Mirror, Cryptography, Hashing Algorithms, Cryptocurrency, Blockchain.

OPTIMIZING CUSTOMER PREDICTION USING APACHE SPARK: A COMPARATIVE ANALYSIS OF MACHINE LEARNING ALGORITHMS

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ABSTRACT

This paper explores the application of machine learning techniques on Apache Spark to identify potential customers, leveraging the Bank Marketing Data Set. Four widely recognized methods—Decision Tree Classifier, Random Forest Classifier, Gradient-Boosted Tree Classifier, and Deep Learning Classifier—were employed to build individual predictive models. Each model's performance was evaluated and compared, highlighting the Random Forest Classifier (RFC) as the most accurate, achieving an 89% success rate in customer prediction. Additionally, the study emphasizes the value of integrating multiple machine learning models when designing personalized marketing campaigns. The findings provide a robust software framework that can enhance call center efficiency by reducing time and operational costs.

KEYWORDS: Apache Spark, Big Data, Machine Learning, Customer Prediction, Random Forest.

INTERFACE OPTIMIZATION OF $MASNI_3$/$FASNI_3$ BASED PEROVSKITE SOLAR CELLS

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ABSTRACT

Global paradigms have changed in the current technological era to favor the use of green energy. The most remarkable environmentally friendly energy source is solar energy, which can be captured with the aid of photovoltaic cells. Perovskite solar cells have demonstrated exceptional photovoltaic performance. However, a notable obstacle is their reduced stability under various environmental conditions. Although perovskite solar cells have shown impressive efficiency, they face challenges related to stability and toxicity, primarily due to the widespread use of lead-based and hybrid organic-inorganic materials. In this context, SCAPS-1D has performed a numerical simulation of an all-perovskite bilayer solar cell. The structure employs FASnI3 as the top absorber, which has a reasonably large bandgap of 1.41 eV, and MASnI3 as the bottom absorber, with a narrower bandgap of 1.3 eV. Two processes are involved in ensuring the viability of the proposed design. Firstly, two solar cells are simulated and calibrated in standalone settings to align with previously published state-of-the-art results, validating this work. To enhance performance, a bilayer configuration assembled with $MASnI_3$ and $FASnI_3$ is evaluated. It is demonstrated that utilizing bilayer structures can readily extend the absorption spectrum into the near-infrared range and significantly improve performance, which is largely determined by the interface trap density between perovskite layers and the bulk defect density of $FASnI_3$. The optimized all-perovskite bilayer solar cell, with thicknesses of 500 nm for $MASnI_3$ and 250 nm for $FASnI_3$, achieves a power conversion efficiency of 29.10%, a fill factor of 83.7%, an open-circuit voltage of 1.078 V, and a short-circuit current density of 32.24 mA/cm² at an interface trap density of 10^12 cm². These findings provide theoretical guidance for enhancing the performance of perovskite solar cells constructed with a bilayer of $MASnI_3$ and $FASnI_3$.

KEYWORDS: Perovskite Solar Cells, $MASnI_3$, $FASnI_3$, SCAPS 1D.

APPLICATION STAGE ENGINEERING APPROACHES TO PROJECT DAMS AND RESERVOIRS

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ABSTRACT

The implementation of dam projects is a very complex operation in terms of engineering, and many different disciplines are involved in this process.The implementation of dam projects is a very complex operation in terms of engineering, and many different disciplines are involved in this process. This study focused on the engineering geology approaches followed in the implementation phase of the dam design. In the master plan phase, issues such as the water retention capacity of the dam, the hydraulic load to which the ground in the lake area will be exposed, and the hydraulic conductivity of the ground are examined in detail. The quality of the engineering studies carried out especially in the implementation phase is of great importance in terms of the longevity of the dam and ensuring its safety. However, some potential problems that are not considered at all in the project design phase can reach very serious dimensions in the implementation phase and even directly affect the feasibility of the project. For this reason, the correct assessment of the ground conditions in the design of dams is of great importance in terms of the profitability of the dam while the implementation project is being realized. In this context, ground studies determine the bearing capacity of the ground, allowing possible hazards to be foreseen in advance and necessary precautions to be taken. This step is very important as it ensures that the foundation of the dam is safely placed on solid ground. In addition, understanding how the hydraulic conductivity of the soil changes under the constantly increasing hydraulic load is important in terms of preventing potential water leaks in the future. Thanks to all these analyses, the movement of water and the forces acting on the dam are examined and thus the economic life of the dam and water management strategies can be developed. In this study, the engineering geological problems encountered during the implementation project phase of the dams and the engineering solutions applied to these problems with today's technology are examined in detail.

KEYWORDS: Engineering geology, Geotechnical applications in dam projects, Hydraulic conductivity.

IMPORTANCE OF ARTIFICIAL INTELLIGENCE APPLICATIONS IN FOOD INDUSTRY

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ABSTRACT

The use and utilization of the magnifical possibilities of artificial intelligence technology in many areas of the food industry provides significant advantages. AI technology includes theory and computation to perform tasks such as sensory observation and decision-making that imitate human intelligence. Experts refer to the ability of machines to perform cognitive tasks such as seeing, learning, reasoning and problem solving as artificial intelligence. It is possible to perform various activities such as determining food quality, classifying foods, making predictions, and providing control mechanisms with artificial intelligence applications in the food industry. Food preparation, processing, palletizing, packaging and serving methods can change completely with AI-enabled technologies. In addition, new products can be developed by predicting consumer preferences with artificial intelligence applications. Foods can be produced in a healthier, more efficient and less waste-generating way with artificial intelligence-supported systems. In this study, scientific studies on the use of artificial intelligence technology in the food industry are evaluated and its inevitable importance in future safe and sustainable food development and processing is emphasized.

KEYWORDS: Food Industry, Artificial Intelligence.

REMOTE CONTROL OF MICROCONTROLLER BASED ELECTRICAL DEVICES USING DTMF SIGNALLING OVER FIXED TELEPHONE LINE

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ABSTRACT

Today, developments in technology bring along the ease of use of devices and tools directly related to daily routine functions in human life. Depending on the developments in telecommunication technology, it has become possible to control electrical devices far away thanks to the telephone lines surrounding our world with Dual Tone Multi Frequency (DTMF) signals. This system is used in our country Turkey with radio frequency method in areas such as centralised call to prayer in mosques, preaching, etc. In this study, electrical devices are remotely controlled with DTMF signals over a fixed telephone line and an algorithm is proposed to overcome the security vulnerability highlighted in the literature with microcontroller based encryption.

KEYWORDS: DTMF, CM8870, Remote control, Microcontroller, 16F84A.

A SIMPLIFIED RULE-BASED EXPERT SYSTEM DESIGN FOR EVALUATION OF NEPHRITIS RELATED PATIENT SYMPTOMS

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ABSTRACT

The human kidney system consists of pairs of kidneys that act as primary filtration organs in the body. Each kidney contains approximately 1 million filtration units known as nephrons, which are responsible for the filtration of wastes and excess fluids from the blood. The nephron is the smallest functional unit of the kidney and consists of various components such as glomeruli, proximal tubules, hemp stalks, distal tubules, and collecting ducts. Nephritis, an inflammatory condition of the kidney, is characterized by the proliferation of inflammatory cells within the glomerular structure. There are two main types of nephritis: acute and chronic; chronic nephritis can lead to kidney failure if left untreated. This study focuses on the development and use of a Medical Expert System (MES) for the diagnosis of nephritis. In collaboration with experts in the field, 128 rules were initially formulated using 7 different risk factors associated with the disease. These rules were then streamlined and simplified using Boolean Function Simplification methods, resulting in a final set of 6 rules that form the basis of the MES rule base. The effectiveness of MES was evaluated using a dataset of 120 patient cases and the results indicated a 100% success rate in nephritis diagnosis. This study demonstrates the potential of using advanced technologies such as expert systems in the medical field, especially for nephritis diagnosis.

KEYWORDS: Expert System, Boolean Function Minimization, urinary system, nephritis.

DEVELOPMENT OF A DEEP LEARNING METHOD USING MAGNETIC RESONANCE IMAGES FOR THE DIAGNOSIS OF MULTIPLE SCLEROSIS

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ABSTRACT

Multiple Sclerosis (MS) is a chronic neurological disease characterized by the formation of plaques in the white matter of the central nervous system. It is usually diagnosed by cerebrospinal fluid and brain imaging techniques. Magnetic Resonance Imaging (MRI) is a neuroimaging method commonly used to diagnose MS. In recent years, advances in deep learning (DL) techniques have been widely used in detecting and diagnosing MS. In this study, a novel DL-based artificial intelligence model is proposed to detect MS using MRI images. In the proposed model, a richer feature map is created by extracting features from the intermediate layers of pre-trained network architectures. Furthermore, attribute integration is achieved by applying deeply adjustable convolution layers to these attributes. After these attributes, Global Average Pooling was applied to vectorize the attributes and finally, these attributes were merged and transferred to the fully connected layer and SoftMax layer. Pre-trained network architectures such as VGG16, ResNet101, and DenseNet121 were used in the study. In the experimental studies, a dataset of axial and sagittal brain MRI images collected from 72 MS patients and 59 healthy individuals at Turgut Özal University Faculty of Medicine in 2021 was used. In this dataset, axial images (n = 1652) and sagittal images (n = 1775) were evaluated separately and the model produced highly effective results. The highest accuracy scores were 98.78% with DenseNet121 for axial images and 99.32% with VGG16 for sagittal images. These results show that deep learning-based systems can be used in MS diagnosis.

KEYWORDS: Multiple Sclerosis, Magnetic resonance, Deep Learning, DenseNet121, VGG16.

COMPUTATIONAL METHODS FOR DYE-SENSITIZED SOLAR CELL MATERIALS

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ABSTRACT

In this study, computational methods are presented for the performance of Dye Sensitized Solar Cells consisting of semiconductor thin film layers between the photo sensitive anode and the electrolyte. Structural and electronic properties of the selected sensitizers have been investigated and their compatibility with the operating performance of dye-sensitized solar cells is evaluated. The frontier orbital energy levels obtained by computational methods are compared with the energy level of the iodide electrolyte and the conduction band energy level on the titanium dioxide surface. In addition, optical effects, which are important in the development of optoelectronic properties for the materials, have been investigated.

KEYWORDS: Photovoltaics, sensitizers, optical properties.

A FOUR-WAY STRIPLINE POWER DIVIDER DESIGN WITH INCREASED ISOLATION IN THE 500-1000 MHZ FREQUENCY BAND

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ABSTRACT

In this work, a four-way stripline power divider with improved isolation between ports is presented. The main power divider and isolation circuits designed for this purpose are connected to each other using vias on a multi-layered structure. The isolation circuit is formed by the combination of broadside coupled lines used as baluns to ensure high isolation for each output port. The proposed power divider covers the frequency range of 500–1000 MHz. EM simulation results show that the insertion loss is less than 0.68 dB, while the return loss is greater than 14.7 dB. It has also been observed that the designed power divider exhibits a good performance with more than 14 dB of isolation between output ports, less than 0.56 dB of amplitude imbalance and less than 4° of phase imbalance.

KEYWORDS: four-way power divider, isolation, stripline, balun, coupled lines.

THERMAL BEHAVIOR OF A POWER TRANSFORMER UNDER NONLINEAR LOAD CONDITIONS: AN IMAGE PROCESSING STUDY

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ABSTRACT

In recent years, electrical loads with rectifiers such as electric vehicle charging units, industrial motor drives and modern lighting systems have been increasing. Such loads flow currents containing harmonic components from the grid and cause higher than expected temperature increases in transformers in the supply systems. In this study, a 2000 kVA, 34.5/0.4 kV, 50 Hz, Delta-Star connected power transformer is modeled using finite element analysis (FEA) under nonlinear loading conditions. Visual temperature distributions of the thermal behavior of this power transformer are obtained by means of FEA simulation studies for core and winding losses under loads containing harmonic components. Thus, a data set of the thermal behavior of the power transformer designed and manufactured for linear loads for different nonlinear load types is obtained. A basic preliminary estimation study for the temperature increase depending on the load profile is performed using image processing technique and deep learning algorithms on this data set. The process of determining thermal behavior based on FEA simulations with artificial intelligence techniques before prototype manufacturing is extremely important in determining the performance of transformers under non-linear loads and the approach proposed in this study provides useful information for modern transformer design.

KEYWORDS: Power transformers, thermal behavior, FEA simulation, image processing, deep learning.

SELECTION AND APPLICATION OF ROBOTICS PROCESS AUTOMATION IN A MEDIUM SIZED MANUFACTURING COMPANY

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ABSTRACT

Digitalization has been on the agenda of many companies in Europe and the US. In recent years, the digitalization topic has shown itself in the company agendas in Turkey as well. Generally, in large companies that mass produce, the digital implementations move rapidly however, in medium and small sized companies these applications come to life only partially. The digitalization of software technologies that are being used more and more with industry 4.0 and their application areas will be shown, and the applications, examples and classification of RPA applications in the production process. As a case study purchasing will be about replacement of repetitive processes by Robotics Process Automation (RPA) and its pre-requisite of needed digitalization of purchasing applications in a medium sized company, developing the methodology to be used and showing the implementation steps, yields and costs of a sample project. Based on the need of RPA in the purchasing department of medium-sized company, RPA software and its application area at production will be discussed.

KEYWORDS: Robotic Process Automation (RPA), Industry 4.0, Production Processes, Business Process Management, Purchasing.

ENHANCING AUTOMATED AND EARLY DETECTION OF ALZHEIMER'S DISEASE USING IMAGE PROCESSING AND MACHINE LEARNING

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ABSTRACT

Alzheimer's disease is a common type of dementia and progressive neurological disorder that causes the brain atrophy and brain cells to disappear. Early diagnosis is very important in the treatment of the disease and controlling it. Technological developments such as image processing and machine learning have a very important place in the medical industry, as they eliminate the difficulties experienced by doctors in diagnosing Alzheimer's disease using MRI and contribute to the early diagnosis and classification of this disease. The goal of this research is to apply feature extraction and classification techniques to build a system for the early diagnosis of Alzheimer's disease. In 4 classes, the brain tissue region was segmented after applying the necessary filter and pre-processing steps to the MR images. Then, different features related to the segmented images were extracted using various feature extraction methods. These features were reduced with different feature selection techniques. Different classification techniques were applied to the selected features. An accuracy value of 95.97% was obtained with the K-Nearest Neighbors technique, which is one of these classification methods.

KEYWORDS: Alzheimer's disease, MRI, machine learning, image processing, biomedical imaging.

IMPROVING SYNTHETIC DATA GENERATION IN FINANCE WITH FEATURE SCALING AND OUTLIER REMOVAL

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ABSTRACT

Synthetic data generation has become an essential tool for creating realistic datasets that maintain the statistical properties of real-world data, especially in fields like finance where data sharing is limited due to privacy and regulatory constraints. Synthetic data not only helps overcome these limitations by offering a privacy-safe alternative to real data but also enables data-driven innovation where access to large datasets is restricted. This study addresses the challenge of generating high-quality synthetic tabular data by proposing a comprehensive evaluation framework and two preprocessing strategies designed to improve the effectiveness of Generative Adversarial Network (GAN)-based approaches. The evaluation framework assesses synthetic data quality across five key aspects: fidelity, privacy, utility, outlier management, and feature relationship preservation. To enhance the synthetic data generation process, we introduce two methods: a preprocessing layer that automatically selects the most suitable scaling technique for each feature, and an outlier elimination layer that detects and removes extreme values using the Interquartile Range (IQR) method. The framework and methods were applied to two financial datasets, one from a corporate source and one public dataset from Kaggle, using three GAN architectures—standard GAN, Wasserstein GAN with Gradient Penalty (WGAN-GP), and Conditional Tabular GAN (CTGAN). This study lays the groundwork for improving synthetic data generation in finance, offering a flexible approach that can be adapted to different datasets and data characteristics.

KEYWORDS: Synthetic data generation, Generative Adversarial Networks (GAN), evaluation framework, financial tabular data.

INDUSTRY 4.0 BASED CUSTOMER-ORIENTED UNMANNED PRODUCTION SYSTEM

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ABSTRACT

This study presents an Industry 4.0-based unmanned, customer-oriented automated production system. Automation systems are manufacturer-managed systems initially set once in mass production manufacturing processes and continue production by meeting only maintenance requirements. Product design and ordering systems can be unmanned like automation systems to increase production speed and product efficiency. Customized manufacturing can also be added to this system to reduce waste. In this study, as a case prototype, an automatic nuts-filling machine (ANFM) design and implementation was realized. This prototype produces unmanned products based on the order received from the customer. It lists the order received with Google Form (GF) in Google Sheets (GE-T) and creates a data bank. Each order has its unique number so the machine knows when it needs to work. In the prepared ordering interface, the required information is obtained from the customer thanks to a simplified order form that serves a certain range. The design for ANFM is a linear conveyor belt with six units at one station. Each unit has its own hardware for each nuts. As a result, the Industry-4.0-based production automation system increased the potential to provide customized solutions for customer demands. The developed system made production processes more flexible and scalable by increasing customer engagement.

KEYWORDS: Industry 4.0, Internet of Things, automatic production system, customer-oriented system, conveyor

SAFETY CRITERIA FOR THE LICENSING OF MOLTEN SALT REACTORS

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ABSTRACT

The safety criteria for nuclear power reactor designs such as pressurized water reactor (PWR) and boiling water reactor (BWR), which are among the 2nd generation nuclear power reactors in the commercial use today, are well known and get off the ground. However, the technological features of the 4th generation nuclear power reactor designs are quite different from the 2nd generation. Therefore, the safety criteria set forth for 2nd generation nuclear power reactors are insufficient for 4th generation nuclear power reactor designs. The safety, efficiency and standardization is the most important considering parameters in the development of IV. generation reactor designs. Addition to the factors such as waste minimization, high energy density, high-capacity factor and minimum greenhouse gas emissions are also vital importance. Six reactor designs, can easy issue in the commercial in the near future, were chosen in the Generation IV Form. Among these reactors, Molten Salt Reactor is considered that the one of the more safety designs because of using molten fuel. MSR based thorium fuel also create fission products have small half-life than based uranium fuels. The purpose of determining the safety criteria for the licensing of molten salt reactors (MSRs), is multifaceted; it is one of the parameters to minimize the risks to public health and safety. Another one is to ensure that nuclear power technologies, which are seen as one of the low-carbon energy production technologies, are carried to a commercial dimension.
Safety analysis plays a crucial role in the licensing of molten salt reactors by assessing risks, ensuring regulatory compliance, enhancing public confidence, promoting design improvements and facilitating effective emergency preparedness and response planning.

KEYWORDS: II. Gen. NPPs, IV. Gen. NPPs, Molten salt reactor, Safety analysis, Licensing.

INVESTIGATION OF THERMOPHYSICAL PROPERTIES OF SALT COMPOUNDS USED IN MOLTEN SALT REACTORS (MSR)

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ABSTRACT

The nation's aim is to provide reliable and sustainable energy supplies while safeguarding the environment globally to raise living standards. However, sustainable energy needs the development of new systems for more effectively producing, delivering, and utilizing energy. The Paris Climate Agreement places additional responsibilities and obligations on the energy sector. Developing low carbon emitting energy generation systems utilizing nuclear and renewable energy sources can address these issues. Nuclear energy is one of the alternatives that can prevent climate change. After the Fukushima Daiichi Nuclear Power Plant accident on March 11, 2011, strengthening nuclear safety has become a requirement. Requirements for safety, sustainability, economic, and proliferation resistance have forced nuclear technologies to develop next generation nuclear reactor types. The molten salt reactor is one of the six reactor types selected for fourth generation nuclear reactor. Developing next generation MSRs is based on the accurate knowledge of the thermophysical properties of the molten salt systems used as coolant/fuel. These thermophysical properties of coolant/fuel/salt system consist of density, viscosity, thermal conductivity, and heat capacity. Most of the experimental research on the thermophysical properties of salt systems was performed between the late 1960s and early 1980s. Generally, these data are poorly accurate and have large margins of error. The significant differences between the data found in the literature indicate that experimental measurements of thermophysical properties of molten salt systems at high temperature are complex procedures.

The development of experimental measurement methods that can provide high accuracy and low measurement uncertainty for determining the viscosity and density of MSR salt systems at high temperatures was investigated in this study. The study aims to resolve technical issues concerning the thermophysical properties of eutectic salt mixtures used as heat transfer and fuel systems. In this study, the thermophysical properties of LiF, NaF, BeF2, KF, ThF4, UF4 salts and different ratios of LiF/NaF/KF, NaF/BeF2/LiF, LiF/BeF2 salt systems and fuel salt mixtures of these salt systems containing 2%-3% ThF4/UF4 by mass will be determined by using selected analytical methods.

KEYWORDS: Molten Salt Reactor (MSR), thermophysical properties, Fuel/salt system, Coolant/salt system.

ANTENNA AND FREQUENCY SELECTIVE SURFACE DESIGN FOR 3.1 GHZ DETECT AND AVOID RADAR SYSTEM ON UNMANNED AERIAL VEHICLE

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ABSTRACT

This study focuses on the design of an antenna and frequency selective surface (FSS) for a Detect and Avoid (DAA) radar system operating at a center frequency of 3.1 GHz. The designed antenna is a PCB-type circular patch antenna with pin-fed linearly polarized characteristics, utilizing TMM13i dielectric material with a dielectric constant of 12.2 for a minimum size design. The FSS is a band pass type with square ring slot structure. This FSS has been optimized to achieve less than 1 dB insertion loss within the frequency band of the antenna while suppressing signals in the X band by more than 15 dB. The operational bandwidth of the design is determined to be 500 MHz. The antenna and FSS have been designed in accordance with the SWaP (Size, Weight, and Power) concept for use on an UAV platform. The DAA radar system will be established on the AD9361 SDR transceiver, which has a maximum instantaneous bandwidth of 56 MHz. With the obtained 500 MHz bandwidth, a DAA radar system can be designed within the limits of the chip and antenna for the desired frequency bands.

KEYWORDS: Detect and avoid radar, Circular patch pin-fed antenna, Square ring slot frequency selective surface, Radar cross section, TMM13i, Size Weight and Power, AD9361, Software defined radio, Unmanned aerial vehicle.

FOUR YEARS UPDATE OF LPG CONVERSION FIELD STATUS OF A SPARK IGNITION INTERNAL COMBUSTION ENGINE PASSENGER VEHICLE

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ABSTRACT

Previously, a report on four years field operation of a LPG converted gasoline spark ignition internal combustion engine passenger vehicle was published. The report lays out four years data of gasoline and LPG fuel consumption, alongside with price data of the fuels and some periodic maintenances. The present paper updates the previously presented data by adding another four years by the period between 2020 and 2024. This latter period includes a specific heavy maintenance incidence that sheds light to long term beneficences assessment of the LPG conversion via a solid example from real-world operation. This work utilizes net present value and net future value approaches to evaluate LPG conversion investment whether it is beneficial in terms of economic terms. Also, the gross exhaust emissions by LPG combustion are approximated and compared to gasoline combustion emissions in order to evaluate environmental impacts. Future maintenance issues are laid down and general literature on LPG conversion and other fuel conversion types are evaluated.

KEYWORDS. Economic analysis, Fuel conversion, Liquid petroleum gas, Net present value.

THE MODAL AND DYNAMIC ANALYSIS OF SPRAYER BOOMS WITH DIVERSE STRUCTURAL GEOMETRIES

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ABSTRACT

In spraying agricultural areas with a sprayer boom, the vibrations on the boom due to irregularities and variable speeds in the agricultural land directly affect spraying performance. Vibrations on the system disrupt the spraying pattern and cause agricultural yield to decrease. In addition, it may be subject to deformations due to structural strains caused by vibration, which may cause performance losses and long-term failures. In this study, the modal analysis of a sprayer boom with the same working width but a different geometric structure, which is widely used in agricultural spraying, was performed with the finite element method its natural frequencies and mode shapes were obtained, the dynamic responses of the system under harmonic strains were examined, and the obtained simulation results were evaluated comparatively. Firstly, the solid model of the system was obtained, transferred to the finite element program, and its modal properties were simulated. Afterwards, the sprayer was fixed to the body connection and forced with a harmonic acceleration input determined by considering the irregularities in the fields. The obtained results are presented in detail with graphs. From the simulation results, it is understood that the structural geometry affects the mode shapes and natural frequencies of the system. It is thought that the results can be useful in the structural optimization of the system, in the control of vibration dynamics and can contribute to the development of new design strategies.

KEYWORDS: Sprayer boom, Vibration, Modal Analysis, Dynamic Analysis.

AN EXPERIMENTAL STUDY ON THE EFFECT OF COLEMANITE CONCENTRATOR WASTE ON GAMMA-RAY BEAMS, SETTING TIME, AND COMPRESSIVE STRENGTH PROPERTIES IN CEMENT-BASED MORTARS

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ABSTRACT

The current study presents the effects of colemanite concentrator waste (CW) substitution in cement-based mortars on the gamma-ray shielding performance, setting time, compressive strength, and pulse velocity properties. Cement mortars were prepared to substitute different proportions of CW particles, up to 4-weight percent of cement. The gamma-ray (Cs-137-662 keV) shielding performance was investigated with an experimental study. Increasing CW substitution causes a decrease in compressive strength and an increase in setting time. It was found that the lead equivalent levels of materials with CW added and control specimens with a similar thickness differ significantly from one another. The incorporation of CW contributed to the attenuation of ionizing radiation including gamma rays.

KEYWORDS: Colemanite concentrator waste, radiation shielding, gamma-ray shielding, compressive strength, cement-based mortar.

DETECTION OF PLANT DISEASES WITH DEEP LEARNING FOR PRODUCTIVITY AND SUSTAINABILITY IN AGRICULTURE

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ABSTRACT

This study aims to develop a plant disease detection system based on deep learning to address the critical problem of early detection and prevention of plant diseases in the agricultural sector. Recent literature reviews show that traditional machine learning algorithms are widely used; however, there is an increasing interest in deep learning models that show superior performance compared to conventional methods. While developing the application of this study, Betel Leaf Image Dataset, which contains one healthy and three unhealthy plant classes obtained from Bangladesh, was used. VGG, MobileNet, CNN deep learning models, widely used for image analysis and classification, were selected and trained. The developed models analyze plant images with 89%, 83%, and 87% accuracy rates respectively, and distinguish healthy and diseased plants with a high success rate. Thus, diseases will be detected more quickly and the necessary reactions will be provided. This project has the potential to contribute positively to national income and employment by improving automation and productivity in the agricultural sector.

KEYWORDS: Deep Learning, CNN, VGG, MobileNet.

CHARACTERIZATION OF AA2024/CNT NANOCOMPOSITES AS A FUNCTION OF MILLING TIME AND CNT CONTENT

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ABSTRACT

The dispersion of carbon nanotubes (CNTs) in AA2024 alloy matrix nanocomposites is a critical stage in evaluating the CNT distribution, mechanical, and physical properties of the composites. In this study, the ultrasonic dispersion technique (15 min) was used to attain a more homogenous distribution of CNT particles. CNT particles were added to AA2024 alloy powders at four different rates (0.125, 0.25, 0.5, and 1 wt.%), and the composite powders were mechanically milled in three different time periods (0.5, 1.5, and 3 h). The AA2024/CNT nanocomposites were produced by hot pressing process of ball milled AA2024/CNT powders. All of the nanocomposite materials were subjected to hardness and tensile tests. The morphologies of the nanocomposite samples were analyzed by using SEM. Results show that milling time has an important effect on the distribution of CNTs within the AA2024 alloy matrix and the mechanical properties of the nanocomposites. The density of the nanocomposites decreased with increasing CNT content at constant milling time, but it increased with increasing milling time at the same CNT content. With the increase in CNT concentration, the nanocomposites exhibited gradual increases in hardness and tensile strength, reaching their highest value for 0.5 wt.% CNT-reinforced AA2024 alloy matrix nanocomposites. However, at a reinforcement concentration of 1 wt.%, the mechanical properties decreased due to CNT agglomeration and inhomogeneous distribution.

KEYWORDS: AA2024 alloy, Carbon Nanotube, Metal Matrix nanocomposites, Ultrasonic Dispersion, Ball Milling.

APPLICATION OF DEEP LEARNING ALGORITHMS IN CRACK DETECTION AFTER MAGNETIC PARTICLE TESTING

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ABSTRACT

In today's metals and materials industry, crack detection critical to structural integrity and safety. Magnetic Particle Testing (MPT) is a widely used method to identify surface defects in metal parts. Analyzing materials with the right methods is vital for material life and safety. If the right methods are not used to detect invisible internal structural damage to materials, quality assurance and long-term durability can be negatively affected. Traditional MPT techniques rely on human-based interpretation and manual analysis, making it difficult to detect cracks accurately and quickly. This study examines the use of deep learning models in magnetic particle testing images. Deep learning algorithms, especially models such as convolutional neural networks, have been successful in recognizing and classifying complex patterns due to their ability to learn from large data sets. The main objective of this study is to evaluate and apply the performance of deep learning models for MPT. In the study, a dataset containing two different classes of images, cracked and non-cracked, was prepared. This dataset has been tested with a well-known deep learning algorithm, such as the customized Convolutional Neural Network (CNN) have been scientifically evaluated. Furthermore, results will provide a foundation for automating crack detection process in industrial applications and minimizing human error. Various factors such as the number of epochs, the number of parameters, and the number of layers in the model were evaluated to investigate their impact on the performance of our CNN model. For the available sample dataset, experiments were conducted by gradually increasing the number of epochs up to 20. A high test accuracy of 83.12% was achieved with the deep learning model we tested.

KEYWORDS: Magnetic Particle Testing, Deep Learning, Crack Detection, Industrial Applications, Convolutional Neural Network.

FLIGHT CONTROLLER DESIGN FOR A FOLLOWER UNMANNED AERIAL VEHICLE BASED ON LONG SHORT-TERM MEMORY

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ABSTRACT

Unmanned aerial vehicles (UAVs) are increasingly being used in military, civilian, and commercial applications such as surveillance, environmental monitoring, disaster management, search and rescue, agricultural operations, transportation, and entertainment. Besides single usage of the UAVs, these tasks may also require multiple UAVs to operate in a coordinated manner. At this point, development of mechanisms for efficiently tracking and following one another UAV becomes very crucial. For this purpose, this study aims to develop a follower flight controller for quadrotor UAVs utilizing a Long Short-Term Memory (LSTM) deep learning model. Focusing on the challenge of tracking a leader UAV, the control system is designed to learn from the leader's past movements and predict future actions based on these patterns. As sensing medium, we utilize solely visual input taken from fixed monocular camera mounted on the follower assuming no communication is available between the UAVs. We prepared a comprehensive dataset within the Microsoft AirSim simulation environment by flying two quadrotors in leader follower formation in an open obstacle-free environment. We collected images from the camera mounted on the follower and as well as the velocity control inputs given to the follower. Employing 80% of our dataset for training, and the rest of it for testing, we trained an LSTM based model and obtained a flight controller for the follower. During this model training and testing, TUBITAK ULAKBIM, High Performance and Grid Computing Center (TRUBA) is utilized as the computing platform to handle computational challenges. Then, to assess its performance, we evaluated our flight controller in test scenarios where the leader flew on straight and non-straight paths with a velocity around 1m/s. The follower UAV successfully tracked the leader UAV over a straight distance of 100 meters. On this straight path, the follower maintained a maximum deviation of 1.26 meters and a median deviation of 0.25 meters. On a non-straight path involving 10 meters to the left and right maneuvers, the follower achieved effective tracking with a maximum deviation of 1.5 meters and a median deviation of 0.378 meters. Results demonstrate that our LSTM-based controller accurately predicts the velocity in the X, Y and Z axis of the leader UAV, confirming its effectiveness in maintaining precise formation control. This study contributes to the literature by presenting a successful application of LSTM to UAV leader-follower task utilizing only visual sensory information and without any communication between the robots.

KEYWORDS: Unmanned Aerial Vehicles, Long Short-Term Memory, Flight Controller, Leader-Follower Formation.

EXPERIMENTAL WORKS ON POLYMERIC MEMBRANE USED IN PEM FUEL CELL

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ABSTRACT

The biggest obstacle to the effective use of Proton Exchange Membrane (PEM) Fuel Cells, which is an important element of hydrogen technology, which is seen as the savior of the deepening climate crisis and the energy deficit of countries, is that its main element, the membrane, still does not have sufficient durability and life. In this study, the operating conditions of the nafion membrane, which is the main component of PEM fuel cells; A series of DTA-TG experiments were carried out using samples at different temperatures, different heating rates, different durations and different environments and the damages occurring in these samples were detected. As a result, it has been observed that the thermal resistance of Nafion at high temperatures is low, as the heating rate increases, the mass loss increases and the mass loss in the material decreases. Moreover, Experimental curves show that mass loss increases slowly up to 200 C, after which it increases excessively. The results showed more mass loss compared to materials heated in nitrogen environment due to the burning property of oxygen. In addition, in the examinations, disintegration rather than weight loss occurred in the samples in nitrogen environment. Normal weight losses were observed in the materials up to 250C, and an extreme level of material loss was observed after 250C. In addition, from the data obtained as a result of the experiments, it has been seen that increasing the heating rate reduces mass loss, and it can be evaluated that the life of the material can be extended by adjusting the initial operating temperature, which will be emphasized in future studies.

KEYWORDS: PEM Fuel Cell, Hydrogen, Experimental Works, Climate Change, Energy.

ANALYZING THE RELATIONSHIP BETWEEN TOLERANCE CLEARANCES AND CENTRIFUGAL PUMP PERFORMANCE

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ABSTRACT

Centrifugal pumps play a significant role in both domestic and industrial applications, holding a substantial share in global energy consumption. In this context, energy efficiency in centrifugal pumps is of critical importance. The primary factors influencing energy efficiency in centrifugal pumps include the design characteristics of the pump, selection in accordance with the intended piping system, operation without experiencing cavitation, suitability for operation at varying capacities, and regular maintenance. From a design perspective, various design parameters related to the impeller and casing of the centrifugal pump are considered.

In centrifugal pumps, a certain clearance is maintained between the stationary and rotating components. This clearance leads to leakage flow, known as slip flow, which directly contributes to hydrodynamic losses that affect the pump's efficiency. This study numerically investigates the impact of clearance size on the hydraulic performance of a pump produced by Sempa Pump, using computational fluid dynamics (CFD) methods. Numerical analyses were conducted using the Ansys-Fluent software, employing the Scalable k-ε turbulence model.

In the study, the pump's performance was evaluated under conditions where there was no clearance, as well as with five different clearance sizes ranging from 0.1 mm to 0.5 mm. The results indicated that as the clearance size increased, the pump head and hydraulic efficiency decreased, while power consumption increased. Specifically, at the operating point, the pump's efficiency was approximately 90% with no clearance, whereas it was calculated to be 85% when the clearance was 0.5 mm.

KEYWORDS: tolerance clearance, centrifugal pump, hydraulic performance, hydraulic efficiency.

AGRIVOLTAIC TECHNOLOGY IMPLEMENTATION ON SOYBEAN FARMS IN NIGERIA

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ABSTRACT

Agrivoltaic (AV) technology has become popular in the last decade since it efficiently allows both crop production and PV electricity generation on the same land. While AV technologies have made significant advances in Europe and North America, their implementation in Africa, despite the continent's great potential for solar energy, has been limited due to a lack of comprehensive research and pilot studies. This study investigates the feasibility of implementing agrivoltaic (AV) technology on existing soybean farms in Nigeria by assessing its potential. The methodology involves simulating an AV pilot system using Revit software to analyze how PV panel shading affects the crop surface area. The simulation results show that the shaded area under PV panels ranges from 25.67% to 31.29% of the total area. Additionally, we developed an empirical model for soybean crop yield based on the percentage of available light, indicating that yields decrease as shading increases. Nevertheless, our proposed system design ensures that 70% of the yield remains unaffected at all levels of shading. The advantages of the system were assessed using the land equivalent ratio (LER), which consistently equaled one, showing that the dual-purpose system is just as effective as single-purpose land in terms of productivity.

KEYWORDS: Agrivoltaic, AV system, Simulation, Soybean, Africa, Shading, LER.

ENHANCING DEVICE AUTHENTICATION THROUGH RF FINGERPRINTING: EVALUATING THE PERFORMANCE OF VARIOUS MACHINE LEARNING MODELS

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ABSTRACT

The Smart Grid (SG) presents a vital solution to power-related challenges in the energy sector, incorporating internet-connected smart meters, data collectors, generators, and sensors for the production, distribution, transmission, and utilization of electrical power. However, it remains highly vulnerable to cyberattacks, such as spoofing, traffic analysis, eavesdropping, data tampering, stack smashing, and denial of service (DoS) attacks, which pose serious operational challenges. In response, cryptographic techniques have been widely employed, though issues like the slow operation of public key infrastructure (PKI) and the management of large certificate revocation lists (CRL) persist. Radio Frequency Fingerprinting Identification (RFFI) offers a promising non-cryptographic alternative. To maximize its potential, both effective signal preprocessing techniques and advanced deep learning architectures are necessary. While recent research has largely focused on Convolutional Neural Networks (CNNs) as the deep learning framework, further improvements are needed. This study introduces the XGBoost and Random Forest classifiers. After data preprocessing and spectrogram generation, both classifiers were tested, with XGBoost achieving the highest accuracy of 97%.

KEYWORDS: Smart Grid (SG), Cyber Attack, Radio Frequency Fingerprint Identification (RFFI), Carrier Frequency Offset (CFO), XGBoost Classifier, Random Forest Classifier.

A REVIEW OF THE DEVELOPMENTS AND APPLICATIONS OF ARTIFICIAL HUMMINGBIRD ALGORITHM IN OPTIMIZATION

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ABSTRACT

With the development of artificial intelligence approaches day by day, different nature-inspired algorithms are emerging in problem solving stages. Taking as an example the intuitive behaviors exhibited by living beings in nature, these algorithms aim to solve complex problems and find an acceptable solution that is closest to the optimal result. One of these metaheuristic algorithms, The Artificial Hummingbird Optimization Algorithm (AHA), a newly introduced metaheuristic method from 2022, begins with an initial random set of solutions and applies iterative techniques along with adjustments to the hummingbirds' positions to effectively balance exploration and exploitation, guiding the search toward optimal solutions. In this review, current studies in the literature on the artificial hummingbird algorithm and its varieties were examined and the data was examined through the use of descriptive analysis to assess the performance. Also advantages and disadvantages of AHA have been revealed. It was seen that the artificial hummingbird algorithm has a wide range of applications and is widely used in solving continuous functions. According to many studies, modifying AHA and combining it with other algorithms increases the efficiency of the algorithm.

KEYWORDS: Optimization, Metaheuristic Algorithms, Artificial Hummingbird Algorithm, Hybrid Algorithms.

AUTOMATED PRESSURE CONTROL SYSTEM FOR ENHANCED SAFETY AND ENVIRONMENTAL PROTECTION IN LIQUID TRANSPORTATION

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ABSTRACT

In the liquid transportation sector, the risk of pressure build-up in wire-reinforced hoses can lead to serious safety and environmental hazards. When pressures exceed 16 bar in liquid transportation systems, hoses can rupture, releasing chemical fluids into the environment and posing significant safety and environmental risks. In this sector, the potential for pressure build-up in wire-reinforced hoses has frequently led to severe safety and ecological incidents. Typically, these hoses connect vehicle collector valves to customer tanks and are engineered to withstand up to 10 bar pressure. However, when customer tank valves remain closed, product accumulation within the hose can cause pressure levels to rise, leading to ruptures at hose connections. Such incidents compromise workplace safety and threaten environmental integrity through accidental chemical spills. In response to these risks, a novel automated pressure control system has been developed. The system detects excessive pressure and initiates automatic corrective actions, such as closing the valve or stopping the pump, effectively mitigating risks associated with human error and mechanical malfunctions. The system is enhanced by a mobile communication module, facilitating real-time remote monitoring and alert notifications to relevant personnel. This solution seamlessly integrates essential components—pressure sensors, audible alarms, and automatic shutoff mechanisms—into existing liquid transport equipment. A dedicated software platform has been created to monitor pressure levels and activate alarms when necessary precisely. Rigorous testing has validated the system's effectiveness across various chemicals, including Styrene Monomer and TDI, ensuring its reliability under varied real-world conditions. The system offers user-defined alarm thresholds, providing adaptability, and incorporates a durable protective structure to withstand outdoor environments. The benefits of this solution are extensive, significantly reducing potential leak incidents by up to 90%, thus supporting environmental safety and compliance with industry standards. The automatic shutoff mechanism prevents spills and conserves natural resources by limiting environmental contamination. Furthermore, the system enhances operational safety and improves customer satisfaction by minimizing risk, offering companies a competitive edge, cost savings, and a reliable, regulatory-compliant solution for liquid transportation.

KEYWORDS: Automated Pressure Control, Liquid Transportation Safety, Environmental Protection, Overpressure Detection System.

TIME, FREQUENCY, AND TIME-FREQUENCY FEATURE SETS FOR DEEP LEARNING METHODS IN EPILEPTIC SEIZURE PREDICTION

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ABSTRACT

Epilepsy is a chronic neurological disorder marked by abnormal neuronal activity that leads to sudden seizures, potentially causing loss of consciousness, convulsions, involuntary movements, and communication difficulties. These seizures can significantly impact patients' quality of life and social relationships, and more importantly, they can lead to accidents or fatalities. Consequently, predicting epileptic seizures in advance to implement preventive measures is crucial. In studies on epileptic seizure prediction, EEG datasets are commonly utilized. However, to utilize these datasets effectively with deep learning algorithms, which have become increasingly prevalent in seizure prediction research, data processing steps are often required. These transformations are typically achieved using traditional signal analysis techniques, creating a specialized feature space. Signal analysis approaches are generally categorized into three domains: time, frequency, and time-frequency. In this study, features were extracted from raw EEG data using methods from each of these domains, and the results were analyzed by classifying them with deep learning algorithms. A standardized approach was aimed for in the classification process. This study aims to explain the contribution of feature sets derived from these three distinct domains in predicting epileptic seizures.

KEYWORDS: STFT, PSD, Time Series, CNN, LSTM.

LYAPUNOV-BASED DEEP NEURAL NETWORK ROBUST TRAJECTORY CONTROL FOR A ROBOT MANIPULATOR SYSTEM

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ABSTRACT

In this study, trajectory tracking of a robotic system was investigated. A Lyapunov-based robust deep neural network algorithm was designed to obtain the control aim. The proposed control algorithm design involves a neural network algorithm and robust disturbance rejection for the unknown system under disturbance signals. The Neural network algorithm has 3 hidden layers, and the activation function of the network is a rectified linear unit. The system's trajectory tracking performance was investigated under the variable unknown parameters and unknown disturbance signals. The proposed approach has shown a remarkable performance in trajectory control.

KEYWORDS: Neural Networks, Robot Control, Learning Algorithm, Robust Control, Trajectory Control.

MODELING AND ANALYSIS OF A RADIAL GRID WITH ETAP PROGRAM: LOAD FLOW, SHORT CIRCUIT CALCULATIONS AND RELAY COORDINATION WITH PSO ALGORITHM

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ABSTRACT

Protection systems are very important for the continuity and reliability of energy in power systems. In order to provide the best protection, the power system must be simulated and protection states must be determined according to possible situations. This study focuses on the coordination of overcurrent relays to ensure safe and continuous energy flow in power systems. A model was created in ETAP software using non-directional overcurrent relays to quickly isolate the faulty area and protect the system. Load flow analysis, short circuit analysis and relay coordination calculations were performed. Particle Swarm Optimization (PSO) method was applied to minimize relay operation times, thus providing a reliable and fast response time to fault scenarios. As a result of the study, it was seen that the PSO algorithm provides an effective result by reducing the total operation time in relay coordination.

KEYWORDS: Relay coordination, Load flow analysis, Short circuit analysis, Particle swarm optimization, ETAP.

CONTROLLED MORPHOLOGY TRANSFORMATION IN $NICO_2O_4$ VIA HYDROTHERMAL SYNTHESIS

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ABSTRACT

In this study, we synthesized $NiCo_2O_4$ particles with distinctive urchin-like and hollow urchin-like morphologies using hydrothermal method with varying reaction times, followed by heat treatment. X-ray diffraction (XRD) analysis confirmed the high crystallinity and cubic spinel structure of all samples, consistent with $NiCo_2O_4$ reference data (JCPDS: 01-073-1702). Electron microscopy analyses revealed that morphology evolved from urchin-like particles to hollow urchin-like structures as reaction time increased, a transformation attributed to dissolution-recrystallization mechanisms. Images further showed an increase in particle and needle sizes with reaction time, with average particle diameters of 3.17 μm, 3.95 μm, and 6.04 μm, and needle lengths of 0.832 μm, 1.22 μm, and 1.53 μm for 90, 150, and 210 min, respectively. These findings demonstrate the effectiveness of time-dependent hydrothermal synthesis in tailoring $NiCo_2O_4$ structures, providing insight into controlled morphological evolution for potential applications in catalysis, energy storage, and environmental remediation.

KEYWORDS: Nickel cobaltite, cubic spinel, hydrothermal synthesis.

SPEED CONTROL OF BLDC MOTORS VIA SARSA-SUPPORTED ADAPTIVE PI CONTROLLER

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ABSTRACT

The PID (Proportional-Integral-Derivative) controller is one of the most widely applied control strategies in industrial and technological applications due to its simplicity and rapid computation capability, making it a preferred choice for control tasks across various engineering fields, including DC motor speed control. However, achieving precise speed control of BLDC motors is challenging due to their high nonlinearity and susceptibility to external disturbances. Additionally, tuning PI and PID controllers requires accurate mathematical models or precise system responses, which are often difficult to obtain for BLDC motors due to their complex dynamics. However, even with well-tuned parameters, conventional PID controllers frequently struggle to maintain optimal performance in dynamic environments. This limitation arises because PID parameters are fixed once set and cannot adjust in real time to changing system parameters or operating conditions, making PID control less effective in handling time-varying or time-lag systems. Additionally, the sensitivity of PID controllers to system uncertainties can lead to substantial performance degradation when system parameters vary. For highly nonlinear systems, conventional PID control often struggles with gain sensitivity, slow response to load changes, overshoot, and excessive settling times. These factors underscore the limitations of classical PID control in achieving robust performance under variable and complex operating conditions. To address these challenges, a SARSA (State-Action-Reward-
State-Action)-supported adaptive PI controller was designed that does not require a system model and adjusts the coefficients in each control cycle based on various state variables, such as load, acceleration, and current. Simulation results demonstrate that the proposed SARSA-supported adaptive PI controller offers improved performance over conventional PI controller. Compared to the conventional PI method, the proposed controller achieves a faster transient response and smaller total absolute error under different load and reference speed conditions.

KEYWORDS: Adaptive PI Controller, SARSA, Reinforcement Learning, PID Controller

OFFLINE SIGNATURE VERIFICATION OF GENUINE SIGNATURES: A SIAMESE CNN-BASED MAJORITY VOTING METHOD

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ABSTRACT

Signatures are used in various fields including banking, government services, and e-commerce to indicate approval, obligation, or knowledge. The use of signatures in digital environments has led the research in signature verification and forged signature detection. Signature verification is a type of biometric verification, which has many advantages over password-based verification techniques. Signature verification can be mainly categorized into offline signature verification or online signature verification.

Forged signatures are imitations of another person's handwritten signature, typically forged for criminal purposes. Detection of forged signatures is crucial for preventing security breaches and illegal activities in signature verification systems. Therefore, the objective of this paper is to propose a novel method for writer-independent offline signature verification.

The proposed method uses deep learning architecture Siamese Neural Network (SNN) along with three different Convolutional Neural Network (CNN) architectures. The SNN uses two identical CNN subnetworks with a contrastive loss function for training. The proposed method utilizes CNN architectures AlexNet, VGG19, and ResNet50 individually in the SNN subnetworks. The individually trained methods are combined at the decision level with the Majority Voting method, aiming to utilize the individual strengths of each architecture.

The proposed method is tested on BHSig260 (Bengali), BHSig260 (Hindi), and CEDAR datasets. The experimental results achieved an accuracy of 86.42% on the Bengali dataset, 88.11% on the Hindi dataset, and 100% on the CEDAR dataset. The proposed method generally indicates stronger performance than individual methods and it is also competitive with some state-of-the-art methods. In addition, FAR and FRR values indicate that the proposed method is good at recognizing genuine signatures, but struggles with detecting forged signatures. Future work should focus on reducing the FAR value.

KEYWORDS: Offline signature verification, deep learning, writer-independent verification, majority voting.

WATER CONTENT CLASSIFICATION FROM VIS/NIR SPECTROSCOPIC DATA

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ABSTRACT

Visible and Near-Infrared (Vis-NIR) spectroscopy is a technique used to determine the chemical and physical properties of matter by analyzing electromagnetic radiation across a broad wavelength range, specifically from 400 to 2500 nm. In this application the aim is to assess the quality attributes of six Cucurbitaceae family fruits, namely zucchini, bitter melon, ridge gourd, melon, chayote, and cucumber, using a single classification model for all fruits rather than individual models. This classification model is predict whether it exceeds 90% according to fruits based on water content. Samples with water content above 90% are labeled as high water content, while those below are categorized as low water content.
For preprocessing, Standard Normal Variate (SNV) and Neighborhood Components Analysis (NCA) methods were employed to optimize the feature space. The model was trained using a Support Vector Machine (SVM) classifier. Without feature extraction, the accuracy ranged from 90% to 92.5%; however, with feature extraction, the accuracy increased to 95%-97.5%. This classification model successfully predicts high water content, an essential indicator of product quality and productivity, across the dataset with high precision.
By integrating comprehensive data processing and machine learning techniques, this study demonstrates a reliable method for assessing product quality, contributing significantly to the field of agricultural and food industry quality control.

KEYWORDS: Machine learning, Water content classification, Vis/NIR spectroscopy, Cucurbitaceae.

A LIE DETECTION: VIA SPECTRAL FEATURES USING "BAG OF LIES"

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ABSTRACT

In the last decade, the major development of technology has made information sharing easier, but it has also facilitated the spread of misleading information and lies. Lie detection plays an important role in preventing fraud, protecting security, ensuring justice and in daily communications. Traditional lie detection methods are typically time-consuming and based on personal assessments, whereas machine learning techniques have the potential to automate this process. Speech is a rich data source that reflects human behavior and emotional states. Elements such as tone, speed, and pitch of speech can provide information about whether an individual is lying.
In this application, a lie detection system is developed based on spectral features using the "Bag of Lies" dataset. This dataset contains a wide collection of video recordings from various scenarios, including both lying and non-lying situations. In the application, features are extracted from speech recordings, and Artificial Neural Network (ANN) are applied. The goal of this study is to develop a model that can effectively and accurately detect lies through speech analysis. This model aims to speed up the process. The methods used in this project cover the entire process, from data processing to model training and testing, and the model's performance has been evaluated using various metrics.

KEYWORDS: Lie Detection, Feature Extraction, Spectral Features, Bag of Lies, ANN.

APPLICATION OF DEEP LEARNING-BASED TRANSFER LEARNING MODELS IN MONKEYPOX DIAGNOSIS

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ABSTRACT

In recent years, the potential for monkeypox to spread again worldwide has increased the need for early diagnosis methods. In this context, deep learning-based artificial intelligence methods stand out as an important tool in the diagnosis of infectious diseases. The aim of this study is to perform automatic diagnosis of the disease using different transfer learning models on images of monkeypox-specific skin lesions.

In the study, five different transfer learning models were evaluated, namely DarkNet19, AlexNet, NASNetMobile, SqueezeNet and InceptionV3. The accuracy performances of the models were compared and the average success rates of 78.00%, 78.44%, 81.11%, 81.77% and 83.33% were achieved, respectively. The results show that the InceptionV3 model offers a higher accuracy rate compared to the other models.

The findings of this study highlight the potential to assist specialist doctors in early diagnosis of infectious diseases, especially monkeypox. In addition, this technology can contribute to diagnostic processes in regions where specialist doctors are not available. The study is considered an important step in preventing a potential pandemic by demonstrating the effectiveness of AI-based deep learning methods in the field of medical imaging.

In conclusion, strong evidence has been provided that deep learning methods can be used as a reliable diagnostic tool in measures to be taken against the risk of a wider spread of monkeypox on a global scale.

KEYWORDS: Monkeypox, Virus, Deep Learning, Transfer Learning.

ELECTRONIC PROPERTIES OF ORGANIC FIELD EFFECT TRANSISTOR MATERIALS

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ABSTRACT

Rapid developments in technology, the decrease in traditional energy sources and their environmental damages increase the interest of the energy industry in renewable and clean energy sources. The use of these structures, which are important materials of organic electronics, in photonic areas also provides diversity to research methods. The interest in modeling methods and quantum mechanical calculation methods, which make significant contributions to experimental research and development studies in this field, is constantly increasing. The aim of this study is to investigate the working principle and electronic properties of the structures used for organic field effect transistors, which are the basic structure of electronic devices with imaging function.

KEYWORDS: Organic electronics, electronic features, density functional theory.

INVESTIGATION OF RADIATION SHIELDING PERFORMANCE OF BORON CARBIDE REINFORCED HIGH-DENSITY POLYETHYLENE (HDPE) COMPOSITES

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ABSTRACT

Radiation is a type of interaction that spreads through particles carrying energy or electromagnetic waves. The interaction of this energy with matter holds significant importance in various fields, including nuclear energy, medical imaging, industrial processes, and space technology. Protecting against the potentially harmful effects of radiation is a critical requirement for radiation safety. For this purpose, materials that are resistant to radiation and can effectively shield against it are needed. Therefore, polymers materials composed of high molecular weight macromolecules, typically of organic structure are increasingly utilized today due to their lightness, durability, and workability. To enhance the usability of polymers in radiation shielding, they are reinforced with additives like boron, barium, and lead. These additives enable polymers to provide more effective shielding against gamma rays, neutrons, and even cosmic rays.

Polymers such as high-density polyethylene (HDPE) stand out as radiation shielding materials, as HDPE has the ability to absorb radiation due to its density, while also offering advantages in terms of lightness and mechanical strength. When combined with materials like boron carbide that possess neutron-absorbing properties, HDPE enhances neutron shielding performance and acts as an effective barrier against gamma radiation.

In this study, boron carbide-reinforced high-density polyethylene (HDPE) composites are investigated as effective shielding materials against gamma and neutron radiation. The gamma shielding properties of boron carbide-reinforced HDPE composites were experimentally examined, and the results were compared with data obtained from simulation tools WinXCOM and Geant4 for gamma and neutron shielding properties. The WinXCOM program was used to calculate gamma radiation absorption coefficients, while Geant4 played an essential role in evaluating the reliability of results by performing detailed simulations of neutron and gamma interactions. HDPE composite samples with varying boron carbide ratios were analyzed for their efficiency in gamma and neutron shielding. The results demonstrated that the addition of boron carbide enhances the radiation shielding performance of HDPE polymers and that the simulation results align with experimental findings. This study reveals the potential of boron carbide-reinforced HDPE composites as cost-effective and high-performance radiation shielding materials.

KEYWORDS: High-Density Polyethylene (HDPE), WinXCOM and Geant4.

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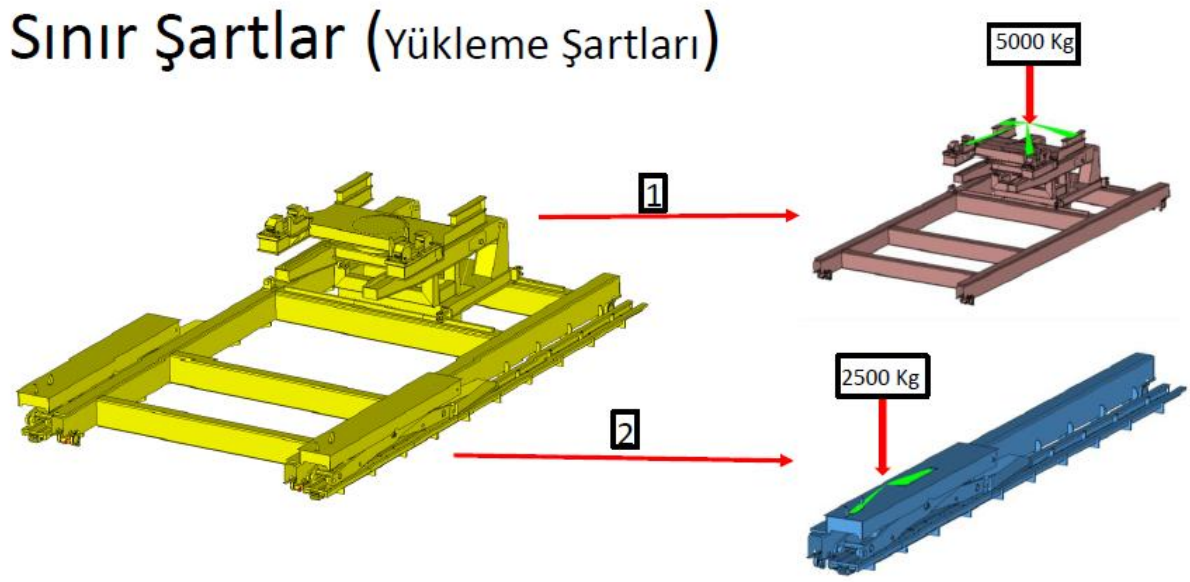
DESIGN AND STRUCTURAL ANALYSIS OF A MECHANISM FOR POSITIONING HEAVY VEHICLE CHASSIS

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ABSTRACT

Proper and secure positioning of heavy vehicle chassis is crucial in ensuring efficiency and safety, particularly in painting, manufacturing, and maintenance processes. This study focuses on the structural analysis and prototype production of a positioning system capable of rotating heavy vehicle chassis across three axes and setting them in an upright position. To achieve this, a scissor platform was developed to facilitate three-axis rotation, and a dedicated mechanism was designed for upright positioning. Initially, a 3D model of the system was created, and structural strength was evaluated through Finite Element Analysis (FEA), assessing stress distribution under load and deformation during rotation. The analysis revealed a maximum stress value of 190.2 MPa in the chassis tilting mechanism and 204.2 MPa in the scissor platform, with a maximum displacement of 3.1 mm observed in the scissor platform. Following optimization based on these results, a prototype was produced and tested under real working conditions. The findings validate the system's durability and functionality, demonstrating a reliable and effective solution for the positioning of heavy vehicle chassis.



KEYWORDS: Finite Element Analysis (FEA), Structural Optimization, Three-Axis Rotation, Machine Design.

A PRACTICAL EVALUATION OF VANET ROUTING PROTOCOLS IN MODERN TRANSPORTATION SYSTEMS

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ABSTRACT

The new technology known as Vehicular Ad-hoc Network (VANET) is compatible with contemporary automobiles. The incorporation of VANET is a revolutionary force in the ever-changing field of contemporary transportation, holding promise for improvements in vehicle communication, traffic efficiency, and road safety. In the larger framework of Machine 2 Machine (M2M) and Internet of Things (IoT) systems, which form the basis of intelligent settings, this study investigates VANETs. VANETs are essential parts of Intelligent Transportation Systems (ITS) that improve passenger experience, traffic efficiency, and road safety. With an emphasis on the most widely used routing protocols, this study thoroughly examines the foundations, difficulties, and possibilities present in the VANET environment. VANETs are essential for promoting vehicle connectivity and communication, streamlining traffic, and resolving issues with urban mobility. In particular, the paper offers a summary of VANET routing protocols made for parking systems, which helps to maximize the use of parking spaces. Based on many parameters, including the size of the safety message, the application data rate, the number of sinks, the number of nodes, and the node speed in the networks, we established a few network scenarios. We assess a variety of network performance indicators, such as average throughput, MAC/PHY overhead, missed packets, and average goodput. Comparative examination of routing protocols, including AODV and OLSR, is a crucial component for ensuring dependable VANET operation in a variety of traffic circumstances. Other researchers working in this field may find this research to be a useful reference.

KEYWORDS: Network traffic, Intelligent Transportation Systems, M2M systems, wireless Networks, AODV routing protocol.

STRUCTURAL ANALYSIS OF A ROPE SLEWING SYSTEM FOR LOADS WITH A VARIABLE CENTER OF GRAVITY

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ABSTRACT

Adjustable sling cranes are specialized lifting systems equipped with adaptable sling mechanisms to enhance operational flexibility and efficiency. These systems are particularly advantageous in construction and industrial applications, where adjustable sling tension significantly affects weight distribution and safety. This study presents the design and structural analysis of a rope slewing system for loads with a variable center of gravity. First, the upper and lower lifting groups were designed, and profiles with fixing points according to the load position were mounted on the rails. A sling apparatus was used between the upper and lower groups. For structural analyses, boundary conditions and material properties were defined according to the loads to be carried in the system. Inclined conditions that may occur during transportation were taken into account in the analyses. Loading was performed under transportation conditions with a maximum inclination of 6° and accordingly, the safety of the system according to the material types was observed. According to the Finite Element Analysis (FEA) results, the maximum stress values were obtained as 267.5 MPa in the upper carrying group, 113.4 MPa in the lower carrying group and 66.1 MPa in the sling apparatus. As a result, the structural analyses performed show that the design and material selections of the rope slewing system remained within safe limits during operation. Considering loading conditions and inclined positions, the system's safety and efficiency demonstrate that it provides a practical and safe solution for industrial applications.

KEYWORDS: Sling Cranes, Lifting Systems, Finite Element Analysis, Mechanical Design.

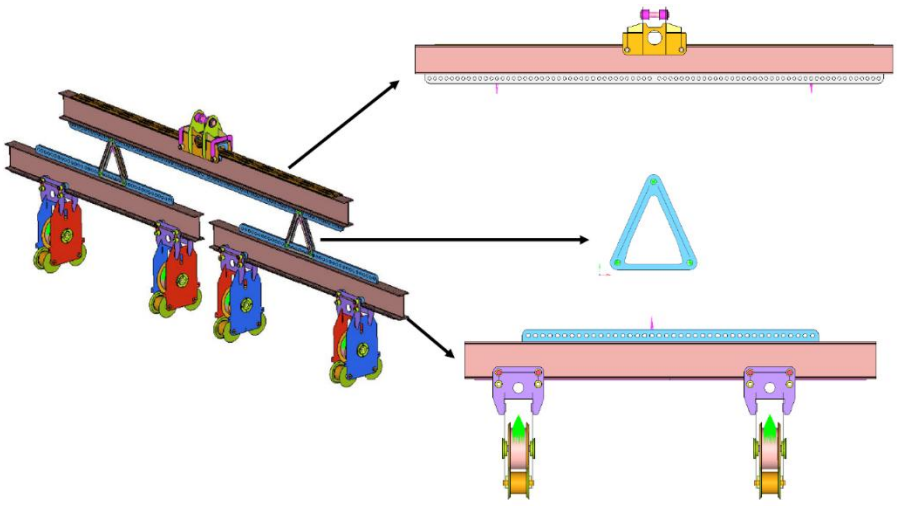


Figure 1. The design of the rope slewing system

A PERFORMANCE COMPARISON OF DIFFERENT MACHINE LEARNING ALGORITHMS TO FORECAST WIND ENERGY IN TÜRKIYE

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ABSTRACT

Wind energy is a prominent alternative among sustainable energy sources and it is highly important to determine the energy production potential employing accurate measurement and analysis techniques. In this paper, the researchers developed a model utilizing decision trees, k-Nearest Neighbor (KNN) and Random Forest (Random Forest) algorithms using wind data from Konya Airport, Sinop, Batman, Antakya and Çanakkale wind measurement stations in Turkey, between 1995-2000 and tested on 2001 data. They evaluated the model taking Mean Square Error (MSE) values into account, and the Random Forest algorithm was the one with the lowest MSE value. The results evaluate the accuracy and applicability of wind forecasting models by comparing the performance of different algorithms. This paper is expected to contribute to the determination of the most efficient algorithm for wind forecasting and provides valuable information for sustainable energy investments.

KEYWORDS: Green energy investments, Machine learning, Metaheuristic algorithms, Sustainable energy, Wind forecasting.

ALTERNATIVE DISTRIBUTIONS IN WIND SPEED FORECASTING AND A COMPARISON

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ABSTRACT

In this paper, the researchers, using daily wind speed data gathered from five different regions of Türkiye between 1998 and 2002, made wind speed forecasts for the year 2003. In addition to the Weibull distribution, which is frequently used in the literature, they have also used Rayleigh and Gamma distributions. They compared the Least Squares (LS) forecasting performance of the distributions and their Mean Square Error (MSE) values. The results indicate that, the Rayleigh distribution gives a lower error rate compared to the Weibull distribution, and performs better in wind speed forecasting. The findings reveal the advantages of using the Rayleigh distribution in the planning and optimization processes of wind energy projects.

KEYWORDS: Gamma distribution, Least squares method, Rayleigh distribution, Weibull distribution, Wind speed forecasting.

STATIC ANALYSIS OF AXISYMMETRIC THIN CYLINDRICAL SHELLS USING THE COMPLEMENTARY FUNCTIONS METHOD

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ABSTRACT

In this study, the static analysis of axisymmetric thin cylindrical shells is conducted using the Complementary Functions Method (CFM). The research examines the static behavior of axisymmetric thin cylindrical shells made of homogeneous and isotropic materials under various loading conditions. The governing differential equations for the static behavior of these structural elements are derived based on thin shell theory through the principle of minimum total potential energy. The resulting equations were solved using CFM, an effective numerical solution method. To confirm the accuracy and validity of the proposed method, the results obtained are compared with those of the present literature, demonstrating a demonstrating high agreement.

KEYWORDS: Cylindrical shell, Thin shell theory, Complementary Functions Method.

WEB APPLICATION OF THYROID DISEASE DETECTION WITH MACHINE LEARNING

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ABSTRACT

Effective diagnosis of thyroid disorders require innovative solutions to enhance accuracy and efficiency. This study presents the development of an artificial intelligence-based system for the detection of thyroid disease, accompanied by a user-friendly web interface for healthcare professionals. The primary objective of this application is to facilitate efficient and accurate diagnosis, while ensuring compatibility across different operating systems through a platform-independent web interface. By leveraging artificial intelligence, the solution aims to enhance diagnostic accuracy, improve the efficiency of healthcare services, and reduce the workload of medical practitioners.

The proposed system employs the Python programming language and associated libraries to implement a machine learning model. The dataset, sourced from the Kaggle platform, comprises 27 features and is categorized into three classes: Negative, Hyperthyroidism, and Hypothyroidism. Preprocessing steps were applied to convert all categorical data into numerical values, creating a fully numerical dataset. Feature selection techniques were used to reduce the dataset to eight key features. The data was subsequently split into equal training and testing sets (50% each) to evaluate model performance. Several machine learning algorithms were tested, and the model with the highest test accuracy was selected for deployment.

The decision tree algorithm demonstrated superior performance, achieving an accuracy exceeding 95%. Consequently, this model was integrated into the web application for real-time prediction of thyroid conditions based on new patient data.

In conclusion, this study successfully developed a highly accurate machine learning model for thyroid disease detection and implemented it in a web application suitable for use by healthcare professionals. The resulting system aims to enhance diagnostic processes, save time, and alleviate the burden on doctors by leveraging the capabilities of artificial intelligence.

KEYWORDS: Thyroid disease detection, Machine learning, Decision tree, Web application, Diagnosis accuracy.

EXPERIMENTAL INVESTIGATION OF THRUST AND FLOW CHARACTERISTICS IN TERMS OF GROUND-BODY INTERACTION OF REUSABLE VERTICAL TAKE- OFF/LANDING ROCKET

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ABSTRACT

This experimental study investigates the effect of a fixed nozzle geometry on the ground-body interaction of vertical take-off and landing rockets on the changes in flow field and thrust due to varying distance from ground and yaw angles under constant pressure. In this context, the effects of nozzle geometry on flow dynamics are studied in detail. Axial thrust measurements in the downstream direction were carried out with 10 kg capacity load cells used in the experimental setup. Velocity distributions in the radial direction were analyzed by means of flow visualization using TiO2 surface oil technique. The obtained measurements were performed using the H/D ratio (i.e. the ratio between the axial distance (H) and the diameter (D) of the body). Among the parameters investigated, a comprehensive analysis of the relationship between ground effect, altitude and yaw angle for vertical take-off and landing rockets was carried out. The core region thrust obtained at H/D = 0.5 mm is more pronounced compared to the thrust data obtained at higher H/D ratios. Under constant pressure, at H/D = 11, it is observed that the geometry no longer interacts with the ground effect and similar results were obtained in the visualization and thrust data. After a certain distance, out-of-ground effect starts up to a certain level of H/D ratios enter and the effects of the geometric shape are lost. When the flow visualization and thrust results are examined, it is observed that H/D = 0.5 and 0-degree angles show better performance and that the rocket nozzle geometry plays an important role in determining the thrust performance in the ground-body interaction for various yaw angles. In conclusion, the findings of this study suggest that reusable rocket systems used in space exploration can be useful in terms of making them more efficient and potentially contributing to other sectors.

KEYWORDS: Reusable vertical takeoff/landing rocket, Thrust measurement, Flow characteristics, Rocket design, Surface oil imaging.

INNOVATIVE END EFFECTOR DESIGN FOR ROBOTIC DNA EXTRACTION APPLICATIONS

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ABSTRACT

In this study, an innovative and modular end effector design for robotic DNA extraction applications is presented, addressing the challenges of traditional DNA isolation methods. The proposed system is compatible with standard hand-held pipetting devices, offering flexibility and cost efficiency through its modular structure. The design leverages magnetic bead technology for DNA isolation, incorporating a customizable magnetic field mechanism to enhance precision and efficiency during the extraction process. Detailed descriptions of the mechanical, electronic, and software components are provided, alongside experimental validation using Escherichia coli DNA samples. Results demonstrate the device's ability to achieve high precision and speed in DNA isolation while maintaining cost-effectiveness. Future developments, such as image processing capabilities, are also discussed, underscoring the system's potential for integration into advanced laboratory workflows. This study represents a significant step toward accessible, scalable, and automated DNA extraction in biotechnology applications.

KEYWORDS: End effector, DNA extraction, robotics, magnetic bead technology, modular design.

MODELING AND SOC ESTIMATION OF LITHIUM-ION BATTERIES USED IN ELECTRIC VEHICLES

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ABSTRACT

With advancing technologies, energy demand is increasing worldwide. However, it is impossible to find enough fossil fuels to meet this energy demand. For this reason, studies on energy storage technologies have increased. Along with these studies, battery technology has also developed. In this way, electric vehicles have increased their popularity. Modeling is very important to define the battery correctly in electric vehicles. In this study, the thevenin model is taken as a reference for the lithium-ion battery. A lithium-ion battery is charged under constant current. Voltage values were taken as a function of time. A time dependent voltage graph was created using Excel. The thevenin equivalent circuit of the battery was extracted from the charge graph. Using the obtained thevenin model, the charge curve was extracted in MATLAB/Simulink. Finally, an exponential curve connected to the SoC was created using the least squares method from the numerical analysis methods.

KEYWORDS: Energy Storage, Electric Vehicles, Lithium-Ion Batteries, Battery Modeling.

LOCAL ANOMALY DETECTION WITH MACHINE LEARNING IN EMBEDDED SYSTEMS: HIGH FREQUENCY DATA PROCESSING

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ABSTRACT

Embedded systems today play critical roles in a wide range of applications, from the Internet of Things (IoT) devices to industrial automation. Their use in applications that require real-time and high-frequency data processing directly affects the efficiency of tasks such as anomaly detection, which has an important place in the operation of systems. Considering the limited processing capacity and energy requirements of embedded systems, the need to develop efficient solutions for such data-intensive applications has emerged. In this study, an optimized method for high-frequency data processing and anomaly detection is proposed for data simplification on embedded systems. High-density data collected from various sensors are analyzed by an artificial intelligence model running on the embedded system; only data evaluated as abnormal or important are transmitted to the central system. This approach reduces the central processing load and increases energy efficiency by optimizing the amount of data transmitted over the network. The methods used for anomaly detection include the K-Means Clustering algorithm to determine data groups and the Local Outlier Factor (LOF) algorithm for local anomaly detection. The accuracy, processing speed and data reduction performances of these two algorithms are compared experimentally. The results show that the proposed method effectively reduces the data density, improves the data management of embedded systems and optimizes the system performance by reducing energy consumption.

KEYWORDS: Embedded systems, machine learning, anomaly detection, data reduction, real-time analysis, data management.

IMPLEMENTATION OF EARNED VALUE ANALYSIS FOR CONSTRUCTION COST AND DURATION CONTROL

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ABSTRACT

Construction projects are prone to cost overruns and delays due to the disruptive factors at the construction site and external factors such as material suppliers. Earned Value Analysis (EVA) is utilized by the corporate construction companies to maintain control on the project budget and duration. EVA provides important benefits to corporate construction companies but the small scale construction companies are deprived of the benefits of EVA since they cannot employ talented employees which utilize advanced project planning software to implement EVA. In this study, a spreadsheet application is developed to implement EVA. The estimated and actual activity costs and durations are entered to the spreadsheet application. The activity predecessor relationships and daily spendings are formulated to the corresponding data cells. The application can compute the cost performance and schedule performance indexes according to the actual activity cost and duration values entered by the user. The developed application is tested on a small scale construction project. The cost and schedule performance indexes as well as cost estimations for the project completion are done successfully by the developed application. The developed spreadsheet application can be beneficial for the small scale contractors to provide control on the cost and duration of their construction projects.

KEYWORDS: Earned Value Analysis, Cost Control, Schedule Control, Contruction Schedule.

HEURISTIC ALGORITHM FOR THE SOLUTION OF DISCRETE TIME COST TRADE-OFF PROBLEM

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ABSTRACT

Time cost trade-off problem aims to minimize the total project cost by crashing the critical activities. This problem is solved by mathematical programming and meta-heuristic algorithms. However, construction sector has minimum priority on the theoretical knowledge. For this reason aforementioned optimization algorithms can be hardly implemented for the private construction companies. The nature of the time cost trade-off algorithm is not challenging and can be solved heuristically. In this study, a spreadsheet application is developed by utilizing excel functions to identify the critical activities of the project and the paths of the project. The construction schedule is entered to the spreadsheet application as acticity on arrow diagram and the logical relationships between the activities are defined. Forward and backward pass computations are given as formulations which includes the actual activity durations. The developed application calculates the crashing costs of the critical activities and highlights the activities with the cheapest crashing costs. The user can easily execute the proposed or user selected crashing alternative and the schedule is updated according to the selection. The application is tested on 6 activity project and the optimum solution is obtained by crashing the activities sequentially.

KEYWORDS: Time cost trade-off problem, optimization, heuristic algorithm, scheduling.

DIGITAL TWIN IMPLEMENTATION OPPORTUNITIES FOR CIVIL ENGINEERING APPLICATIONS

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ABSTRACT

Digital Twin offers important opportunities to the construction sector. Decreasing the operating and maintenance costs of the facilities and prolonging the useful and economic life of the assets can be given as the most important two benefits. However, construction sector is reluctant to revolutionary changes within its working habits. Therefore, Digital Twin developments and implementations are condensed. In this study, a scoping literature review is conducted on digital twin in order to address the literature gap and to raise awareness on the construction sector. The concept of digital twin is presented and important contributions are briefly mentioned. Barriers on the digital twin including the cost of implementation, technical knowledge, and complexity are discussed. Then a framework for the construction of digital twin of buildings that are exposed to earthquake tremor is proposed. The proposed framework can provide important savings in heating costs and maintenance costs.

KEYWORDS: Digital twin, IT in construction, Internet of Things, cyber-physical systems.

ASSESSMENT OF SCHEDULE VARIANCES BY MONTE CARLO SIMULATION

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ABSTRACT

Duration of construction projects undergoes variations due to internal and external disruptive events. Delayed construction projects cause liquidated damages and cost overruns for the contractors. Therefore, assessment of schedule variances has vital importance to measure the magnitude of the risks of the construction schedule. Construction schedules are usually prepared by critical path method which makes implementation of error propagation law based uncertainty analysis techniques difficult. In this study schedule variance of a construction schedule prepared by critical path method is estimated by Monte Carlo Simulation. A hypothetical construction schedule is prepared by critical path method and activity probability distributions are assigned to the construction activities. Software is generated for the execution of Monte Carlo Simulation by C++ programming language. Software executes the simulation by generating random numbers for each construction activity according to the assigned probability distribution. Software generates user defined number of trials and reports the expected project completion duration and its variance. The executable software performs the analysis significantly faster than the spreadsheet applications.

KEYWORDS: Monte Carlo Simulation, construction schedule, critical path method, uncertainty.

DEVELOPMENT OF A BATTERY MANAGEMENT SYSTEM WITH IOT-ENABLED DATA TRACKING FOR AUTONOMOUS LOAD ROBOT

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ABSTRACT

Battery Management System (BMS) with Internet of Things (IoT) monitoring capability for an autonomous payload robot. The popularity of autonomous vehicles in industrial and commercial areas increases the importance of battery systems. Balancing of cells is one of the critical parameters that must be monitored in such systems and, being able to access battery data at any time is important to increase the security level. This developed Battery Management System (BMS) aims to provide the user with access to battery system data at any time. In the design of this Battery Management System, the BQ76952 integrated circuit from Texas Instruments was used to measure voltage, current, and temperature accurately and quickly. After the necessary balancing calculations, an STM32G431 microcontroller was used to keep the battery cells balanced and to run security protocols. This microcontroller is also responsible for transmitting data to the ESP32 controller, which enables the data to work with the Internet of Things (IoT) technology. In other words, an ESP32 module was used to communicate with Firebase, which allows cloud-based data transmission. In this way, users will be able to view the necessary data of the batteries remotely, both from mobile devices such as phones and from their computers. The advantage here is that the entire decision structure allows monitoring of the data, when necessary, without being connected to the controller. In addition to using Visual Studio in the desktop interface for easy user follow-up, MIT App Inventor was used in the development of the mobile application. These interface programs aim to provide user-friendly formats for reading battery data using graphical indicators such as progress bars and line charts to monitor the State of Charge (SoC), cell voltages, temperature values, and more.

KEYWORDS: Battery Management System (BMS), Internet of Things (IoT), Real-Time Monitoring, Smart Battery Systems.

TIME-FREQUENCY ANALYSIS OF BIOMEDICAL SIGNALS IN SLEEP APNEA

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ABSTRACT

This study aims to investigate biomedical signals associated with sleep apnea, focusing on ECG and SpO2 signals, through time and frequency domain analyses. Data were sourced from the PSG-Audio dataset available on scidb.cn, containing signals sampled at 200 Hz (ECG) and 1 Hz (SpO2). The statistical analysis in the time domain revealed an SpO2 mean of 94.64% with a standard deviation of 1.44%, and an ECG mean of 40.94 mV with significant variability. Frequency domain analyses employed Fast Fourier Transform (FFT) to identify dominant frequencies, while Short-Time Fourier Transform (STFT) analysis, utilizing a 256-point Hamming window and 75% overlap, captured transient frequency changes. Results indicate a dominant frequency of 0 Hz for SpO2, reflecting stable oxygen saturation, and 0.0125 Hz for ECG, associated with bradycardia during apnea episodes. These findings provide essential biomarkers for real-time detection and monitoring of sleep apnea, contributing to the development of automated diagnostic tools for improved patient care.

KEYWORDS: Sleep apnea, biomedical signals, polysomnography (PSG), short-time fourier transform (STFT), fast fourier transform (FFT), time-frequency analysis.

DESIGN AND IMPLEMENTATION OF A SOLAR-POWERED IRRIGATION SYSTEM: A CASE STUDY FROM ELAZIĞ/PALU

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ABSTRACT

This study examines a support program for individual irrigation systems aimed at supporting the development of the agricultural sector, increasing the income levels of producers in rural areas, and promoting the use of modern irrigation systems. In this context, the "Communiqué No. 2021/7 on Supporting Individual Irrigation Systems" published within the framework of Rural Development Supports has been taken as the basis. The study evaluates the installation costs, other technical and economic analyses of an off-grid facility implemented in the Palu district of Elazığ province with the support for the "Establishment of a solar-powered irrigation system" under the scope of the aforementioned Communiqué.

KEYWORDS: Photovoltaic system, Solar irrigation system, off-grid solar energy system.

COUNTER-MEASURING MISSILE THREATS FOR NAVAL PLATFORMS: A MACHINE LEARNING APPROACH

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ABSTRACT

Missiles posing a threat to naval platforms have become a significant danger today, especially considering advancements in IR or RF-guided missile seeker technologies. These threats render platforms open targets for hostile forces. Chaffs and flares can be launched from naval platforms as soft-kill countermeasures against such threats within Electronic Warfare (EW) framework. Chaffs are effective against RF-guided missiles while flares are effective against IR-guided missiles.

This paper attempts to develop effective countermeasure deployment strategies along with platform maneuvers against RF and IR guided seekers by means of machine learning and artificial intelligence techniques. Simulated datasets are acquired by a commercial simulator, providing most effective countermeasures for realistic threat engagements. The simulator incorporates parameters for the ship, missile, and chaff/flare. The launcher configurations are also incorporated within the considered ship model. Datasets representing extensive scenarios were created by the simulator, and a Multilayer Perceptron (MLP) machine learning model is utilized firstly. Some preliminary results regarding performance analysis were presented with test data. Improvements were made on the proposed model by tuning model parameters such as number of hidden layers, number of neurons and activation function. In counter-measuring chaff and flares, the targeted parameters were the tube number of the launchers, the ship's course along with its speed. Moreover, the miss distance is also estimated. As a nature of the problem, estimation of the tube number was a formulated as a classification problem whereas all other parameters were formulated in the form of regression problem.

The preliminary performance results of the proposed model are quite promising. For the tube number, an accuracy of 0.7654 was achieved while the F1 Score was 0.7647. For the ship's course, the R^2 was 0.6335, Mean Absolute Error (MAE) was 27.5032 while Root Mean Square Error (RMSE) was 49.2825. On the other hand, The R^2 was 0.6577, MAE was 1.0634, and RMSE was 1.9903 for the ship's speed. The miss distance has also been estimated with an R^2 of 0.9660, MAE of 138.3707, and RMSE of 309.7109.

The authors believe that the proposed model could be further improved, and can be incorporated into existing countermeasure techniques.

KEYWORDS: Artificial Intelligence, Multilayer Perceptron, Electronic Warfare, Countermeasure, Naval Platforms, Anti-Ship Missiles.

ANDROID PERMISSION ANALYSIS AND MALWARE DETECTION USING MACHINE LEARNING METHODS

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ABSTRACT

The Android operating system, being one of the most widely used mobile platforms globally, has also become a primary target for malware. This study analyzes various types of Android malware and the machine learning methods used to detect them. By employing a large dataset, we examine the characteristics of malware application and develop effective detection techniques. The dataset includes permissions used by malware applications, aiding in classification for malware detection. The findings provide significant insights into enhancing the security of Android devices and suggest security strategies to be developed. This study aims to offer valuable information to researchers and software developers working in mobile security through data analysis and machine learning methods applied to the dataset.

KEYWORDS: Android, Malware Detection, Data Preprocessing, Machine Learning.

The International Conference on Engineering Technologies (ICENTE 24) was successfully held online from November 21-23, 2024, 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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