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Review Process

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Aims & Scope

Engineering, technology and basic sciences are closely related fields. Developments and innovations in one of them affect the others. Therefore, the focus of the conference is on studies related to these three fields. Studies in the fields of engineering, technology and basic science are accepted to the conference even if they are not associated with other fields. The conference committee thinks that a study in only one field (for example, mathematics, physics, etc.) will contribute to other fields (for example, engineering, technology, etc.) in future studies, even if it is not associated with the presentation at the conference. In line with this perspective, studies in the following fields are accepted to the conference: Biology, Chemistry, Engineering, Mathematics, Physics and Technology.

The aim of the conference is to bring together researchers and administrators from different countries, and to discuss theoretical and practical issues in all fields of Engineering, Technology and Basic Sciences.

DETERMINATION OF FRACTURE PARAMETERS OF LIME-PUMICE COMPOSITES USING THE DOUBLE-K FRACTURE MODEL

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Experimental studies on concrete beams have demonstrated that there are three distinct phases of crack development in cement-based materials: the initiation of cracks, stable crack growth, and unstable fracture. In light of these phases, the Double-K model necessitates two fracture parameters, specifically the unstable stress intensity factor and the initiation stress intensity factor, to effectively simulate the fracture-dominated failure of concrete structures. Particularly, the initiation fracture toughness is crucial in the assessment of certain structures, including nuclear power plants, reservoirs, and water-resource facilities. Roman mortars are considered the initial type of concrete, made from lime, water, sand, and volcanic tuff, enabling the construction of structures that have lasted for nearly two millennia, with prominent examples such as the Pantheon and the Colosseum. The Pantheon temple remains in use as an exhibition hall in the present day. In this study, beams and square prismatic samples featuring three different initial crack lengths were created to determine the fracture characteristics of lime-pumice mixtures containing various aggregate sizes (4 and 16 mm) and subjected to three-point bending tests at fracture test days (28 and 90). The two-parameter model and the double-K fracture model were employed for simulating the results of the fracture test.

Keywords: Double-K fracture model, Lime, Pumice, Two-parameter model

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MID-INFRARED (FTIR) SPECTROSCOPY FOR URINARY STONE IDENTIFICATION: CLINICAL RELEVANCE IN AN INDUSTRIAL REGION

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Accurate identification of urinary stone composition remains a key challenge in the management of urolithiasis, particularly in industrial regions characterized by complex environmental and metabolic influences. This study aimed to evaluate the clinical utility of mid-infrared (FTIR) spectroscopy and to improve the identification of urinary stones in patients from an industrial region. A comparative analysis of the chemical composition, morphology, and structural characteristics of 85 urinary stones obtained from patients residing in the Dnipropetrovsk region was performed using an integrated FTIR system with μ-FTIR microscopy and the NICODOM spectral database. Spectral matching demonstrated that 55% of stones exhibited semi-quantitative composition, while the remaining samples were characterized by qualitative identification only. The overall agreement with reference spectra was satisfactory, with a mean correlation coefficient of 82.7 ± 5.3%. However, significant overlap of absorption peaks in mixed-composition stones, particularly in the <1800 cm^{-1} region, and the influence of the broad O–H stretching band (2700–3700 cm^{-1}) may lead to misclassification due to masking of minor components by dominant mineral phases. μ-FTIR mapping enabled visualization of the spatial distribution of organic and mineral components, revealing microstructural heterogeneity and layered growth patterns associated with protein-rich matrices. The findings demonstrate that FTIR spectroscopy, combined with spatial analysis, provides a powerful tool for accurate stone identification. This approach enhances understanding of lithogenesis, supports personalized treatment strategies, and offers significant potential for early diagnosis and prevention of recurrence in patients with urolithiasis.

Keywords: urinary stones, infrared spectrometry, spectral monitoring

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3D PRINTING IN SHIPBUILDING AND SHIP REPAIR INDUSTRY: CHALLENGES AND OPPORTUNITIES

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In the article, the possibilities and challenges of using 3D printing in the shipbuilding and ship repair industry are discussed. This technology enables the fast and efficient production of spare parts, elements, and components required for these industries. To a certain extent, this leads to reduced repair time, faster deliveries, and lower dependence on maintaining permanent warehouse stock. The technology also allows the production of lighter, more efficient, and relatively complex structures. In addition, it helps reduce the generated carbon footprint. The challenges facing the shipbuilding and ship repair industry in the use of 3D printing are related to several aspects. The first is purely technological and focuses on integrating components produced by this method into the ship's hull structure. The second aspect is related to the certification of the parts and their durability throughout the ship's life cycle. The third aspect concerns the economic factors associated with equipment, consumables, and maintenance. Nevertheless, the method of 3D printing cannot completely replace traditional shipbuilding and repair processes, but it can support and facilitate these industries to a certain extent.

Keywords: shipbuilding, ship repair, printing, 3D, challenges

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MULTIPLE GSM DEVICE EXCHANGE PROCESS PARAMETERS IN GSM AND IOT NETWORK

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The new needs and directions in the development of the fourth industrial revolution, the so-called industry 4, define the tasks and solutions that electronics must fulfill. Regardless of whether it is a problem related to the so-called green energy, i.e. energy from renewable sources or healthy and quality food industries, the so-called green agro-industry, electronics solutions must ensure the integration of the process parameters of the industrial plant into the so-called smart technology. This technology implies that the process parameters are not only measured on site but also collected, stored and distributed at a remote location. In this processing of process parameters, it is essential that users have timely and accurate information about the measurement data in their industrial complex. Modern electronic systems provide the ability to process and store measurement data on-site and transfer it to the IoT and GSM SIM network. We witness daily tribunes and panel discussions sponsored by companies and even governments for the introduction of the terminology of digital agriculture, i.e. the introduction of smart electronic solutions in agriculture. In addition to the commitment to so-called green energy, i.e. obtaining energy from renewable sources, the development of digitization in agriculture is an area in which an enormous application of smart electronic systems is expected in the future. Also, smart electronic systems are often integrated into a complex RF, GSM and IoT network complemented by visualization and storage systems such as LCD displays, SCADA, HMI interfaces. The paper provides a solution for an electronic system that provides integration into a GSM network of process parameters from two remote agro-industrial facilities and their distribution to a SIM mobile device and IoT network. The solution enables the visualization of process parameters locally on LCD displays and remotely on an mobile device in GSM network and cloud in IoT.

Keywords: Electronic System, Agro-industrial Facilities, Process Parameters, GSM Network

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INTEGRATING MEAN WEIGHT DIAMETER AND ENVIRONMENTAL SENSITIVITY INDEX FOR MODELING SOIL EROSION RISK AND LAND DEGRADATION IN SOILS UNDER DIFFERENT AGRICULTURAL LAND USES

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University of Mosul

The study area is located between latitudes (36°42′24.52″ N – 36°24′38.40″ N) and longitudes (43°38′14.98″ E – 43°22′14.58″ E), covering an area of 1245 km². The elevation ranges from 283 to 1015 m above sea level. The climate is classified as a transitional zone between semi-arid and Mediterranean climates. Twenty-five sites were selected within the study area. Approximately 2 kg of soil was collected per site, with samples carefully selected to ensure homogeneity. The samples were then transported to the laboratory, air-dried, gently crushed using a wooden hammer, and sieved through a 2 mm mesh sieve. Subsequently, they were stored in plastic containers for further physical and chemical analyses. Laboratory analyses included the determination of soil organic matter, calcium carbonate ($CaCO_3$) content, and particle size distribution. In addition, Mean Weight Diameter (MWD), porosity, and environmental sensitivity index equations were applied.The results indicated that the dominant soil textures in the study area ranged from clay to clay loam. The Mean Weight Diameter (MWD) values ranged between 0.616 and 0.919 mm, showing clear spatial variability among sampling sites. This variability is primarily attributed to differences in soil organic matter content and calcium carbonate levels, which reached maximum values of 2.28% and 37.2%, respectively. Furthermore, the results revealed relatively uniform sorting values across most sites, indicating a generally homogeneous particle size distribution, except for one site, which exhibited a high sorting value of 2.420, reflecting poorer sediment uniformity. The study demonstrates that both water and wind erosion processes in the region are controlled by a complex interaction of natural and anthropogenic factors acting simultaneously, which significantly influence soil stability and susceptibility to detachment and transport.

Keywords: Erosion, MWD, ESAe, Sorting, Landuse

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EFFICIENCY OF NANO AND MINERAL IRON IN SUSTAINING FABA BEAN (VICIA FABA L.) PRODUCTIVITY WITHIN DIFFERENT SOIL ORDERS IN NINEVEH GOVERNORATE

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The decline in agricultural production rates necessitates the advancement of this sector by enhancing production efficiency through various modern technologies. Among these technologies in the field of fertilizers and fertilization is nanofertilizer technology. To achieve this goal, a biological experiment was conducted in the greenhouse of the Department of Soil Sciences and Water Resources, College of Agriculture and Forestry, University of Mosul, during the winter season of 2024/2025. The study aimed to evaluate the response of Broad Bean (Vicia faba L., Mornash cultivar) to the interaction between nano and mineral iron in two different soil orders within Nineveh Governorate.Significant differences between treatments were evaluated using the Least Significant Difference (LSD) test at a significance level of 0.05. Key Results,Foliar Application: The foliar application of iron (both nano and mineral) had a clear impact on the growth of the broad bean plant. It resulted in a significant increase in growth indicators compared to the control treatment, including: plant height (cm), number of branches (branch plant^{-1}), leaf area (cm^2 plant^{-1}), chlorophyll concentration (SPAD), and shoot dry weight (g plant^{-1}). Yield Components, components, including seed dry weight, seed fresh weight (g plant^{-1}), and biological yield (g plant^{-1}). Optimal Concentrations, Foliar applications of 100 mg Fe L^{-1} and 1.5 g L^{-1} outperformed other treatments, recording the highest values across all growth and yield indicators. Soil Application, Soil application at rates of 15 kg Fe ha^{-1} and 4 kg Fe ha^{-1} excelled over other concentrations in all studied growth and yield traits. combination of 100 mg Fe L^{-1} (foliar) + 4 kg Fe ha^{-1} (soil) (N2 + M3) significantly outperformed all other interactions in growth indicators and yield components.

Keywords: Faba bean, Nano-fertilizer, Mineral iron, Soil orders

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RESPONSE OF POTATO (SALANUM TUBEROSUM L.) AND GREEN BEAN (PHASEOLUS VULGARIS L.) CROPS TO MYCORRHIZAL ,NPK AND SHEEP MANURE FERTILIZATION IN SOIL FROM NINEVEH GOVERNORATE

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A field experiment was conducted in the Al-Qubba region, north of Mosul, to evaluate the effects of mycorrhizal inoculation, NPK compound fertilization, and sheep manure on the growth parameters and yield components of potato and green bean. The study was carried out in a calcareous Silty Clay soil characterized by low organic matter content and a deficiency in plant-available nitrogen and phosphorus. The experiment followed a Randomized Complete Block Design (RCBD) with three replicates, comprising 18 experimental units resulting from the interaction of the studied factors .The results indicated that all treatments significantly enhanced the growth of both crops, leading to marked increases in growth indicators (plant height, shoot dry weight, and number of branches). Furthermore, there was a significant improvement in yield components: tuber weight, number of tubers, and yield per plant for the potato crop; and number of pods per plant, number of seeds per pod, and total yield for the green bean crop. Additionally, nitrogen and phosphorus concentrations in potato tubers and green bean pods were increased. The integrated treatment (Mycorrhiza + NPK) significantly outperformed all other treatments across all vegetative growth parameters, yield components, and nutrient concentrations (N and P) for both crops

Keywords: mycorrhizal, Randomized Complete Block Design, characterized

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ASSESSMENT OF THYMUS NUMIDICUS AND LAVANDULA STOECHAS ESSENTIAL OILS EFFECTS ON DELTAMETHRIN-INDUCED TOXICITY IN FEMALE RABBITS

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Thymus numidicus and *Lavandula stoechas* are aromatic and medicinal plants belonging to the *Lamiaceae* family. They are widespread in Algeria and used in traditional medicine and in the culinary arts. Deltamethrin is a chemical compound belonging to the pyrethroid family. It is mainly used as an insecticide and repellent for insects or snakes due to its neurotoxic properties. This study aims to evaluate the protective effects of *Thymus numidicus* (TNEO) and *Lavandula stoechas* (LSEO) essential oils against deltamethrin-induced toxicity in female rabbits. The chemical composition and biological activities of these two essential oils were assessed beforehand. The GC/MS analysis revealed that both essential oils are rich in monoterpene hydrocarbons and oxygenated monoterpenes. In TNEO, the major compounds identified were thymol and carvacrol, whereas in LSEO, fenchone and camphor. The antibacterial activity results showed that TNEO exhibited strong inhibitory effects against Gram-positive bacteria, while its activity was lower against Gram-negative strains. On the other hand, LSEO demonstrated moderate antibacterial activity against both Gram+ and Gram- bacteria. The administration of deltamethrin at 1.28mg/kg/day for 14 days induced significant hematological, biochemical, and histopathological damage in both the liver and kidneys of female rabbits. The combination of Thymus numidicus and Lavandula stoechas essential oils exhibited a remarkable protective effect against the biochemical and histopathological alterations caused by deltamethrin exposure.

Keywords: Thymus numidicus, Lavandula stoechas, essential oils, Deltamethrin, Toxicity, histopathological, liver, kidneys

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PEDOGENIC DEVELOPMENT AND MINERALOGICAL CHARACTERISTICS OF SEDIMENTARY SOIL PEDONS IN NORTHERN NINEVEH, IRAQ

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The study focus on determining the pedogenic development, mineralogical and micromorphological characteristics of sedimentary soils in northern Iraq. Four soil pedons had been selected around Mosul Dam Lake in northern Nineveh province, to represent these soils. The main objective of this study was to determining some of the mineralogical and development characteristics of sedimentary soils in these sites. The process involved a morphological description of soil pedons in the sites, laboratory analyses to determine the physical and chemical properties of soil samples, XRD analysis of clay minerals, and thin section analysis for soil micromorphology. The results indicated That the soil textures were clay, silty clay and clay loam, with the variations in physical and chemical and morphological characteristics of studied sites. whereas, thin section analysis revealed carbonate and gypsum nodules, clay masses, and dissolution voids, indicating transmission and accumulation processes. XRD analysis identified a mixed mineral assemblage consisting of chlorite, illite, palygorskite, montmorillonite, and gypsum. The occurrence of palygorskite under alkaline and moisture-deficient conditions reflects pedogenic processes typical of semi-arid environments (Azimi et al, 2025). Therefore, these findings provide new insights into soil genesis and mineral transformation in northern Iraq and contribute to the sustainable management and conservation soil resources in semi arid zones.

Keywords: Sediment soils, XRD analysis, Micromorphological characteristics

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DIGITAL TRANSFORMATION, COCOA DOWNSTREAMING, AND EXPORT COMPETITIVENESS OF INDONESIA IN THE GLOBAL SUSTAINABLE ECONOMY

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Gadjah Mada University

The global cocoa industry is undergoing a major transformation due to supply chain crises, climate change, sustainability regulations, and increasing demands for technology-based downstream processing. In this context, Indonesia faces the challenge of enhancing export competitiveness by developing the cocoa processing industry and increasing product value-added. This research aims to analyze the competitiveness and dynamics of Indonesia's cocoa export market within the framework of global economic transformation and the strengthening of the sustainable agro-industry. This research uses a descriptive quantitative approach by utilizing international trade data from UN Comtrade and the International Trade Center. The analysis is conducted using the Revealed Comparative Advantage (RCA) and Export Product Dynamics (EPD) methods. Research findings indicate that Indonesian cocoa beans (HS 1801) have a lower RCA value than processed cocoa products. These findings indicate a shift in trade structure from the export of raw materials to value-added products thru the process of downstreaming and the application of post-harvest processing technology. In addition, several processed cocoa products show a more competitive market position compared to raw cocoa in major export destination countries. The research results also show that the transformation of the global cocoa industry toward sustainability, supply chain efficiency, and environmentally friendly processing technology affects the dynamics of Indonesia's export competitiveness. This research emphasizes the importance of technology-based downstream processing and the development of sustainable agro-industries in strengthening Indonesia's position in the global cocoa trade in the digital economy era.

Keywords: cocoa downstreaming, export competitiveness, revealed comparative advantage, export product dynamics, digital economic transformation

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LOW-TEMPERATURE FATIGUE PERFORMANCE OF POLYMER-MODIFIED ASPHALT MIXTURES EVALUATED BY CYCLIC SCB TESTING

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Fatigue cracking is one of the most critical deterioration mechanisms affecting the service life of asphalt pavements. This study investigates the fatigue crack propagation behavior of asphalt mixtures modified with styrene-butadiene-styrene (SBS), Enprene 611, Enprene 701, and crumb rubber (CR) under low-temperature conditions. Semi-Circular Bending (SCB) specimens with notch depths of 10, 20, and 30 mm were subjected to cyclic loading at −20°C. Static SCB tests were first conducted to determine the reference load levels, and the resulting values were used to establish the loading protocol for the cyclic experiments. The deformation–load cycle relationships obtained from the cyclic SCB tests were analyzed to evaluate fatigue resistance and crack propagation characteristics. The results showed that all modifiers improved fatigue performance compared with the virgin and control mixtures by reducing deformation accumulation and delaying crack growth. Among the additives, Enprene 611 exhibited the highest fatigue resistance, particularly at a dosage of 4%, providing the greatest number of load cycles and the lowest deformation growth rate. SBS also significantly enhanced fatigue performance, while Enprene 701 and CR provided moderate improvements. Increasing notch depth accelerated crack propagation and reduced fatigue life for all mixtures. Based on the overall performance, the mixtures were ranked as Enprene 611 > SBS ≈ Enprene 701 > CR > Control > Virgin mixture. The findings indicate that polymer modification, particularly with Enprene 611, is an effective approach for improving the low-temperature fatigue crack resistance of asphalt mixtures and extending pavement service life..

Keywords: Asphalt mixture, Fatigue cracking, Cyclic SCB test, Fracture mechanics

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THE ROLE OF PARTICIPATORY AGRICULTURAL EXTENSION IN MITIGATING THE ADVERSE EFFECTS OF CLIMATE CHANGE ON AGRICULTURE PRODUCTION.

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Climate changes poses significant challenges to agricultural production systems, necessitating the adoption of the effective extension approaches that enhance farmers` adaptive capacity. This study evaluated the role of participatory agricultural extnesion in addressing the adverse impacts of climate change on agricultural production from farmers` perspective. Data were collected through a structured questionnare and analyzed using descriptive and inferential statistical methods to examine the relationship between farmers characteristics and their perception of participatoty agricultual extension.Data were collected from simple random sample of 128 farmers (25% of the target population of 512 farmers) distributed across 12 villages in Sulaymaniyah Governorate.The findings revealed a limited implementation of participatory agricultural extension within agricultural extension centers in the centers in the study area, with 56.3% of respondents reporting low levels pf participatory communication. Correlation analyses(pearson and spearman) indicate significant positive relationships between participatory agricultural extension and farmers` age, education level, farm size, farm type, farming experience, participation in training programs, and level of communication with information sources. In contrast, no significant relationship was found between farmers` attitudes toward climate change and their perceptions of participatory agricultural extension. Despite the weak implementation of participatory extension appraoches, respondents demonstrated moderate to high adoption levels of climate-smart agricultural practices, accounting for 62.5% and 32.0% of the sample, respectively. Farmers indentified three major constraints hindering the effective the effective implementation of participatory agricultural extension. The predominance of conventional extension approaches among extension(92.29), prevailing social and cultural norms (92.45%). And insufficient governmental support for participatory extension programs(92.19%).The study highlights the urgent need to stengnthen participatory agricultural extension systems through capacity bui;ding, modernization of extension methodologies, and increase institutional and financial support, enhancing participatory appraoches can improve farmers resi;ience and adaptive capacity, thereby contributing to more sustainable agricultural systems under chanign climatic conditions.

Keywords: participatory agricultural extension, Climate Change adaptation, climate-smart agricultural, farmers perceptions

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EVALUATION OF THE CRACK RESISTANCE OF HOT MIX ASPHALT MIXTURES MODIFIED WITH ENPRENE 611 ELASTOMER

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In this study, the crack resistance of Hot Mix Asphalt (HMA) mixtures prepared using neat bitumen and bitumen modified with Enprene 611 elastomer was experimentally investigated through the Semi-Circular Bending (SCB) test. Asphalt mixtures were produced by incorporating 2%, 3%, and 4% Enprene 611 elastomer, by weight of the binder, into B70/100 penetration-grade bitumen. The compacted cylindrical specimens were cut into two equal halves, and artificial notches with depths of 10, 20, and 30 mm were introduced at the center of each semi-circular specimen to obtain SCB test samples. The SCB tests were conducted at 20°C and 40°C to evaluate the combined effects of temperature and notch depth on the fracture behavior of the asphalt mixtures. The experimental results demonstrated that the mixtures containing 4% Enprene 611 consistently exhibited the highest maximum fracture load (P_{max}) at all notch depths and test temperatures, significantly outperforming both the neat and the other modified mixtures. Furthermore, increasing the Enprene 611 content considerably enhanced the deformation resistance, cohesive bonding strength, and crack propagation resistance of the asphalt mixtures. Overall, the findings indicate that Enprene 611 is an effective polymer modifier for improving the fracture performance and mechanical durability of hot mix asphalt mixtures.

Keywords: Hot Mix Asphalt (HMA), Enprene 611 elastomer, Semi-Circular Bending (SCB), Crack resistance

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EFFECT OF HOLLOW GEOMETRY ON THE DAMAGE MECHANISM OF REINFORCED CONCRETE SLABS UNDER NEAR-FIELD BLAST LOADING

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BİTLİS EREN UNİVERSİTY

This study investigates the dynamic behavior of hollow-core reinforced concrete slabs subjected to blast loading, with a focus on internal void geometry. As an alternative to the circular voids common in the literature, the performance of square and hexagonal cross-section designs under near-field blast loading (R=0.5 m) was compared using SPH-based numerical simulations.The analysis results indicate that the hexagonal void geometry has a higher capacity for attenuating shock waves compared to circular and square sections. In slabs with square cross-sections, 90-degree corner points were observed to lead to premature crack formation and concrete crushing due to stress concentrations. This study demonstrates with numerical data that the hexagonal form is the most suitable void geometry for resisting near-field blast effects

Keywords: Hollow-Core Slabs, Blast Loading, SPH Method

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PERFORMANCE EVALUATION OF MACHINE LEARNING MODELS FOR GAS CLASSIFICATION UNDER SENSOR DRIFT ON ESP32-S3

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Machine learning has become an effective approach for electronic nose systems used in gas classification applications. However, most previous studies evaluate classification performance using randomly partitioned datasets, which often fail to represent the long-term sensor drift encountered in practical deployments. Furthermore, embedded implementation of different machine learning models on resource-constrained microcontrollers has received limited attention. In this study, the Gas Sensor Array Drift Dataset from the UCI Machine Learning Repository was used to investigate both classification performance and embedded deployment efficiency. Four supervised machine learning algorithms, namely Multi-Layer Perceptron (MLP), Support Vector Machine (SVM), Random Forest (RF), and Extreme Gradient Boosting (XGBoost), were evaluated under both random stratified and chronological batch-based data partitioning strategies. The chronological evaluation was designed to simulate realistic sensor drift conditions by separating the training and testing data according to acquisition time. Experimental results showed that all models achieved approximately 99% accuracy under random evaluation, whereas chronological testing produced substantially lower accuracies, highlighting the impact of sensor drift on real-world performance. Among the evaluated models, MLP achieved the highest chronological classification accuracy while demonstrating superior robustness against distribution shifts. To investigate practical applicability, all trained models were deployed on an ESP32-S3 microcontroller. Their average inference latency, flash memory usage, RAM consumption, and total firmware size were experimentally measured and compared. Among the evaluated models, the MLP achieved the highest chronological classification accuracy while also exhibiting the lowest inference latency and smallest firmware footprint on the ESP32-S3 platform.

Keywords: Electronic Nose, TinyML, ESP32-S3, Gas Classification, Sensor Drift, Machine Learning

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DBSCAN-BASED SPATIAL HOTSPOT DETECTION OF MOTORCYCLE AND THREE-WHEELED VEHICLE CRASHES IN BAGHDAD

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Because of the lack of physical protection and the often complex interaction between motorcycles and 3-wheelers and the other components of urban transportation systems, motorcycles and 3-wheelers are among the most vulnerable road users. Therefore, it is important to determine spatial crash hotspots to enable evidence-based road safety management and targeted interventions. The purpose of this study is to detect crash hotspot areas of motorcycles and three-wheel vehicles for the Rusafa district in Baghdad using the density-based spatial clustering of applications with noise (DBSCAN) algorithm and the Haversine distance measure. There were 802 crash records that were georeferenced and analyzed to identify areas that have been more prone to crashes. We used a Ball Tree nearest-neighbor search algorithm to implement DBSCAN and preprocessed the geographic coordinates before we applied DBSCAN, converting them to radians. We did a sensitivity analysis and selected the optimal clustering parameters (eps = 0.5 km, min_samples = 5). Three spatial indicators (Zone_Label, Zone_Count, Hotspot_Flag) were then calculated to describe the identified hotspot regions. The framework recommended 37 spatial clusters, with 656 (81.8%) of these crashes being identified as a hotspot and 146 crashes (18.2%) as spatial noise. The greatest number of crashes recorded occurred in the largest hotspot (Zone 8) with 116 crashes, or 14.46% of all crashes recorded. Results also indicate that the most common crash locations are not necessarily the most severe, suggesting that, in addition to severity, crash frequency should be taken into account when assessing road safety. The framework proposed here may assist transportation agencies in determining persistent crash locations, prioritizing engineering and enforcement measures, and combining with machine learning methods to forecast crash severity.

Keywords: DBSCAN, Spatial hotspot detection, Haversine distance, GIS, Road safety

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THE IMPACTS OF CAPITALISM ON THE TRANSFORMATION OF CULTURAL IDENTITY: THE CASE OF THE CLOCK TOWER IN MAKKAH

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The research discusses the influence of globalized capitalism presented by the construction of the Royal Makkah Clock Tower that mimics London's Big Ben. It explores the project's impact on the historical context of the city, as a sacred site with spiritual significance, and its cultural cityscape. A qualitative research method was employed to collect data from 50 participants who travelled between Makkah and London, through a questionnaire and semi-structured interview. Documentary photographs and available research studies from the relevant literature were used to support the findings of the study, which indicate that the Clock Tower initiated economic revitalization initiatives as well as touristic advancements, while it violates Makkah's identity and heritage. The findings also confirm that the Tower represents global interests while damaging the spiritual lure of the site, which had a profound emotional and cultural impact on visitors who felt more worried about the extinction of the traditional Islamic architectural spirit. This research exhibits the necessary relationship between economic development and cultural heritage preservation when planning religious and historic sites.

Keywords: Makkah Clock Tower, cultural identity, capitalism, economic development

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DESIGN AND IMPLEMENTATION OF A LOCATION-BASED CAMERA RESTRICTION SYSTEM IN ANDROID OS

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Protecting company data while respecting employee privacy is a delicate balance. When employees bring their mobile devices into company premises, the device camera poses a significant data leakage risk. This project aims to develop an MDM system in which the cameras of employees' phones are automatically blocked upon entry to company premises and released upon exit from the company. Inside the company, employees may submit camera-unblock requests subject to administrative approval. Outside the company, camera blocking/unblocking controls are restricted to protect the employee's rights. The system consists of an Android MDM application that enforces camera policies via Knox SDK, a server layer that processes heartbeats, and a web portal that provides administrators with approve/reject capabilities. For inter-layer communication, the Android application sends periodic heartbeats to the server via HTTP requests; the server creates a violation record if the camera is released inside the company or the device administrator is disabled, and notifies the administrator via e-mail. FCM push notifications are sent from the server to the device via Google Firebase. The web portal communicates with the server via REST API calls. A scheduled service generates HTML reports every 30 minutes classifying devices and sends them to the administrator via e-mail. The MDM system provides a balanced approach between data protection and employee privacy. By automatically blocking cameras inside company premises and releasing them on exit, it protects confidential company data without infringing on the employee's rights outside the workplace. Future work includes machine learning integration for violation prediction and a portal application enabling system management from mobile devices.

Keywords: Mobile Device Management, Android, Heartbeat Monitoring, Samsung Knox, Camera Blocking, Device Administrator, Violation Detection, Employee Privacy

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VALUE-ENHANCED OAT BREEDING FOR HIGH-QUALITY BISCUIT PRODUCTION

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Oat (Avena sativa L.) has emerged as a strategically significant cereal, distinguished by its exceptional nutritional density and multifunctional bioactive profile. Its grains provide high-quality protein, beneficial lipids, several minerals, dietary fiber, and functional constituents such as β-glucan and avenanthramides. These compositional attributes make oat a particularly promising raw material for biscuit manufacturing, where it imparts a distinctive coarse, fibrous texture and a characteristic nutty flavor that clearly distinguish oat-based products from conventional wheat-based alternatives**.** Beyond sensory differentiation, oat-based biscuits serve as efficient delivery matrices for bioactive β-glucans, which reduce cholesterol and modulate glucose absorption, conferring cardiovascular and metabolic benefits; concurrently, their prebiotic properties support beneficial gut microbiota. The elevated fiber content further enhances satiety, rendering oat-based biscuits particularly appealing to consumers managing diabetes or obesity-related conditions. Contemporary breeding strategies therefore seek to harmonize industrial processing requirements with nutritional functionality. In addition to nutritional superiority, optimal genotypes must exhibit high yield, disease resistance, and climate adaptability to ensure agronomic viability. From a technological standpoint, biscuit production requires a low hull ratio, reduced oil and starch content, coupled with favorable physical and nutritional attributes such as dietary fiber, β-glucan, milling yield, hectoliter weight, sieve retention, and thousand-grain weight. Ultimately, biscuit quality is contingent upon achieving an optimal balance of protein content, texture, and sensory properties to guarantee consumer satisfaction. Consequently, expanding the cultivation and utilization of purpose-grown, regionally adapted biscuit-type oats through integrated breeding and food technology approaches constitutes a strategic priority for securing a reliable and sustainable raw material pipeline and meeting evolving consumer demand for nutrient-dense functional snacks without compromising industrial productivity.

Keywords: oat, biscuit, functionality, breeding, technological quality

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GCD MATRICES ASSOCIATED WITH NATHANSON'S TOTIENT FUNCTION

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Let $\Phi(n)$ denote Nathanson's Euler-type function for subsets of $\{1, 2, \ldots, n\}$, defined as the number of nonempty subsets A satisfying $\gcd(\gcd(A), n) = 1$. We introduce the second Möbius transform $\Psi = \mu * \Phi$, derive explicit formulas for Ψ, prove that $\Psi(n) > 0$ for every positive integer n, and establish lower bounds and asymptotic estimates. We then investigate the Nathanson GCD matrix $G_\Phi(S) = [\Phi(\gcd(x_i, x_j))]_{i,j=1,\ldots,r}$, associated with a finite set $S = \{x_1, \ldots, x_r\}$ of distinct positive integers. Using divisor-incidence factorization and the positivity of Ψ, we prove that $G_\Phi(S)$ is positive definite for every finite set S, derive exact determinant formulas, and obtain an explicit inverse formula when S is factor-closed.

Keywords: Nathanson's totient function, GCD matrix, Möbius inversion, Dirichlet convolution, positive definite matrix, factor-closed set

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WHY TWO'S COMPLEMENT BECAME THE STANDARD: A COMPARATIVE ANALYSIS OF UNSIGNED, SIGN-MAGNITUDE, ONE'S COMPLEMENT, AND TWO'S COMPLEMENT REPRESENTATIONS

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Binary number representation is a fundamental concept in computer architecture that directly influences arithmetic operations, data representation, processor design, and hardware implementation. Although several methods have been developed for representing signed integers, modern computer systems predominantly employ two's complement representation. This paper presents a comparative analysis of four binary number representation methods: unsigned, sign-magnitude, one's complement, and two's complement. The analysis examines their numerical ranges, number of distinct representable values, zero representation, binary encoding, bit-width expansion procedures, sign extension techniques, overflow and underflow behavior, and suitability for hardware arithmetic. A unified comparative framework, supported by mathematical formulas, illustrative examples, conversion cases, and comparative tables, is used to systematically identify the similarities, differences, and architectural trade-offs among the four representations.The results show that each method applies a different strategy for encoding values and preserving numerical meaning during bit-width expansion. Unsigned representation relies on zero padding, while Sign-Magnitude preserves the sign bit and inserts additional zeros between the sign bit and the magnitude bits. In contrast, One's Complement and Two's Complement employ classical sign extension by replicating the most significant bit. The comparison further demonstrates that sign-magnitude and one's complement suffer from duplicate zero representations and additional arithmetic complexity. Two's Complement, however, provides a unique representation of zero, fully utilizes all available binary combinations, supports efficient sign extension, and enables addition and subtraction using simplified binary arithmetic circuitry. The analysis also highlights numerical limitations and overflow characteristics associated with fixed-width representations. These technical advantages explain why two's complement has become the dominant standard for signed integer representation in modern computer systems. The proposed framework provides a structured reference for understanding design trade-offs and practical implications in computer architecture and digital systems.

Keywords: binary number representation, Two's Complement, unsigned representation, sign-magnitude, one's complement

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TETRA NEUTROSOPHIC ALPHA STAR GENERALIZED #Ψ MAPPINGS IN TETRA NEUTROSOPHIC TOPOLOGICAL SPACES

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In 2026, R. Radha, R. Princy, and Arokia Pratheesha S. V. introduced Tetra Neutrosophic Sets and investigated their fundamental properties. In 2024, S. Pooja, M. Vignashwaren, and L. Vidyarani introduced the concept of α*g#ψ-closed sets in topological spaces. In the same year, they further investigated α*g#-continuous and irresolute maps. Motivated by these developments, we introduce the concept of Tetra Neutrosophic α*g#ψ-closed sets in Tetra Neutrosophic topological spaces and investigate their fundamental properties. Based on this new class of generalized closed sets, we introduce Tetra Neutrosophic α*g#ψ-continuous, α*g#ψ-irresolute, α*g#ψ-open, and α*g#ψ-closed mappings. Their basic properties and characterizations are established. Furthermore, Tetra Neutrosophic α*g#ψ-homeomorphisms are introduced, and some of their fundamental properties are investigated. The obtained results extend the theory of generalized mappings to the Tetra Neutrosophic topological setting and provide a systematic framework for studying generalized transformations between Tetra Neutrosophic topological spaces.

Keywords: Tetra Neutrosophic (TN) Set, TN Topological Space, TN α*g#ψ-Closed Set, TN α*g#ψ-Continuous Mapping, TN α*g#ψ-Irresolute Mapping, TN α*g#ψ-Closed Mapping, TN α*g#ψ-Open Mapping, TN α*g#ψ-Homeomorphism.

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A MULTIPHYSICS NEURAL NETWORK FRAMEWORK FOR MICRODAMAGE EVOLUTION WITH A SHADOW PLASTICITY OBSERVER

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Microdamage evolution in ductile solids is governed by coupled multiphysics interactions between plastic deformation, stress redistribution, and material degradation. Simplified damage models may not preserve the history effects required for reliable crack initiation and propagation predictions. This study presents a hybrid computational framework combining gradient damage mechanics, neural networks, and a mechanically inactive auxiliary plasticity observer, here termed shadow plasticity. The finite element model retains the governing balance equations and original constitutive damage corrector, while this observer provides descriptors of the evolving plastic history. Neural networks use these temporal descriptors to identify when correction is required and estimate the corresponding modification of damage resistance. Recurrent neural networks recognize the sequence dependent onset of microdamage before irreversible damage develops prematurely and are compared with multilayer perceptron and temporal convolution approaches. The methodology is assessed using a single edge notched specimen under nonlinear loading. The results demonstrate the potential of the proposed multiphysics framework to reproduce the influence of plastic deformation on damage initiation and crack evolution without replacing the underlying physical model. The approach provides an interpretable and computationally efficient basis for data assisted simulation of fracture and material degradation in engineering structures.

Keywords: Microdamage, multiphysics modeling, neural networks, shadow plasticity, finite element method

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BIM TECHNOLOGIES AT STRUCTUAL DESIGN

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Building Information Modeling (BIM), also referred to as the digital twin of a building, is a widely used methodology for digitalizing building properties and parameters throughout the entire building lifecycle, from the planning stage to demolition. This process enables the effective management of information, thereby increasing profitability and productivity while saving time. Compared with conventional design approaches, BIM coordination during the preliminary design stage has been shown to provide significant savings during construction and throughout the subsequent stages of a project. Recent BIM software has increasingly incorporated algorithm-assisted design tools to automate repetitive tasks. These tools perform a series of analyses based on constraints defined by the user and subsequently identify the most suitable solution. In addition, BIM models can be connected to external software through Application Programming Interfaces (APIs). Data transfer to SAP2000 can be achieved through the use of genetic algorithms within Grasshopper and Dynamo. Structural design under seismic loading requires considerable experience and time. Reinforced concrete shear walls are commonly used in buildings because of their substantial stiffness against lateral forces. The aim of this study is to obtain an optimum shear wall layout by utilizing Building Information Modeling (BIM) technologies. The optimization of the shear wall arrangement is formulated as a topology optimization problem that aims to minimize cost, provide accurate analytical results, and reduce the time required from the engineer. In a typical project, the arrangement of shear walls is generally determined during the preliminary design stage through a coordination process involving architectural, mechanical, and electrical (MEP) disciplines. The main workflow of this study consists of identifying potential shear wall locations from architectural models and subsequently performing a series of structural analyses using different wall layout alternatives. Genetic algorithms and finite element software APIs are employed iteratively until an optimum solution is achieved.

Keywords: Shear Wall Optimization, Computational Design, Earthquake and Structural Engineering

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DEEP LEARNING-BASED CLASSIFICATION OF ARCHAEOLOGICAL ARTIFACTS USING IMAGE PROCESSING

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The increasing availability of digital archaeological collections provides new opportunities for applying artificial intelligence to archaeological research. Image processing and deep learning techniques can support the automatic classification of archaeological artifacts and facilitate the analysis of digital collections. In this study, the ArchaeoMind dataset, consisting of 1,349 archaeological artifact images, is used for multiclass image classification. ResNet50, VGG16, and MobileNetV2 models are employed using transfer learning to classify archaeological artifacts. The performance of the models is evaluated using accuracy, precision, recall, and F1-score. The experimental results demonstrate the effectiveness of deep learning-based image classification for the automatic recognition of archaeological artifacts. The proposed approach can support digital documentation and systematic analysis of archaeological collections and contribute to the use of artificial intelligence in archaeological research.

Keywords: Image Classification, Deep Learning, Archaeology, Archaeological Artifacts, Image Processing, Transfer Learning

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MACHINE LEARNING-BASED POLLUTION RISK CLASSIFICATION IN INDUSTRIAL WASTEWATER TREATMENT

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Effective monitoring of industrial wastewater treatment processes is essential for controlling pollution risks, protecting water resources, and supporting the safe reuse of treated wastewater. Identifying high-risk conditions during wastewater treatment is important for reducing environmental pollution and improving the management of treated water. In this study, a machine learning-based classification approach is presented to assess pollution risk in an industrial wastewater treatment process. The study is conducted using the Melbourne Eastern Industrial Wastewater Plant dataset, which contains 600 observations collected between 2023 and 2024. The dataset includes physicochemical and operational parameters such as pH, temperature, conductivity, flow, production load, effluent flow, daily output, and system load. The pollution risk variable is used as the classification target, representing normal and high-risk treatment conditions. Before model development, the data are preprocessed and the variables directly associated with the construction of the target label are excluded to provide a more reliable classification framework. Four machine learning algorithms, namely Random Forest, Support Vector Machine, XGBoost, and LightGBM, are employed to classify wastewater treatment conditions. The models are compared using accuracy, precision, recall, F1-score, and ROC-AUC metrics. The analysis focuses on determining whether routinely measured operational and physicochemical parameters can be used to distinguish normal treatment conditions from high-risk conditions. The study is expected to demonstrate the potential of machine learning for pollution risk assessment in wastewater treatment plants. Such classification can support continuous monitoring and timely intervention when unfavorable treatment conditions occur. In addition, reliable identification of pollution risk can contribute to better management of treated wastewater and support future water reuse applications. The proposed approach provides a practical connection between machine learning, wastewater treatment, environmental protection, and sustainable water resource management within the circular economy framework.

Keywords: Wastewater treatment, industrial wastewater, pollution risk, machine learning, classification, environmental monitoring, water reuse

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AN IN SILICO STUDY ON POTENTIAL INHIBITORS OF THE SPPV14 PROTEIN OF THE SHEEP POX VIRUS

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This study aimed to investigate the binding properties of ursolic acide, resveratrol, rosmarinic acide, and ABT-737 compounds in the active site of the sheep pox virus SPPV14 protein and their ADME/T criteria using in silico. The target protein SPPV14 (PDB ID: 6XY4) was obtained from the RCSB Protein Data Bank, while the 3D structures of he selected compounds were retrieved from PubChem. Molecular docking was performed using AutoDock, ADME/T properties were predicted using SwissADME and pkCSM, and protein–ligand interactions were visualized with Discovery Studio. When the binding scores were examined, it was observed that ursolic acide possessed the highest binding energy (-7,8 kcal/mol), followed by ABT-737, rosmarinic acide, and resveratrol (-7.5 kcal/mol, -6.4 kcal/mol, and, -6.1 kcal/mol), respectively. However, ADMET predictions revealed considerable differences among the compounds in terms of pharmacokinetic and toxicological characteristics. Ursolic acid showed a high bioavailability score (0.85) and favorable Caco-2 permeability; nevertheless, its high lipophilicity (LogP = 7.08), predicted CYP3A4 substrate status, and potential hepatotoxicity indicate possible limitations. Resveratrol, on the other hand, exhibits a more balanced ADMET profile due to its moderate lipophilicity, high Caco-2 permeability, and the absence of predicted hepatotoxicity. Hepatotoxicity was also not predicted for rosmarinic acid, and the compound was not classified as a CYP3A4 substrate. However, its low Caco-2 permeability and limited blood-brain barrier penetration were assessed as characteristics that could pose disadvantages in terms of absorption and distribution. Overall, while ursolic acid stood out as the most notable compound in terms of binding affinity to the target protein, resveratrol and rosmarinic acid demonstrated more favorable safety and ADMET properties. These findings indicate that these natural compounds warrant further evaluation in future studies and that experimental validation studies, particularly using molecular dynamics simulations for ursolic acid, will be important.
Keywords: Sheep pox, Ursolic acide, Resveratrol, Rosmarinic acide, Molecular docking

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LENGTHWISE FRACTURE ANALYSIS OF A MOVING THIN-WALLED ELLIPTICAL CYLINDER

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This paper is devoted to the problem of lengthwise fracture in moving thin-walled elliptical cylindrical shell structures with non-linear elastic behavior. Elliptical cylinders have continuous material inhomogeneity in height. The parameters of the non-linear constitutive law and the bulk density of the material of the cylinder wall change continuously in height. The lengthwise crack represents an elliptical surface whose location coincides with the middle surface of the cylinder. Two types of cylinder motion are considered (translational motion with constant upward acceleration and uniform rotation around the longitudinal axis). The cylinders are loaded with their own weight and with inertial forces from both types of motion. Strain energy release rate (SERR) solutions are obtained for both cylinder motions. In this regard, expressions for the complementary strain energy stored in both arms of the lengthwise crack and in the intact portion of the elliptical cylinder are obtained. A check was made with an existing approach in the scientific literature.
Keywords: motion, material inhomogeneity, cylinder

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