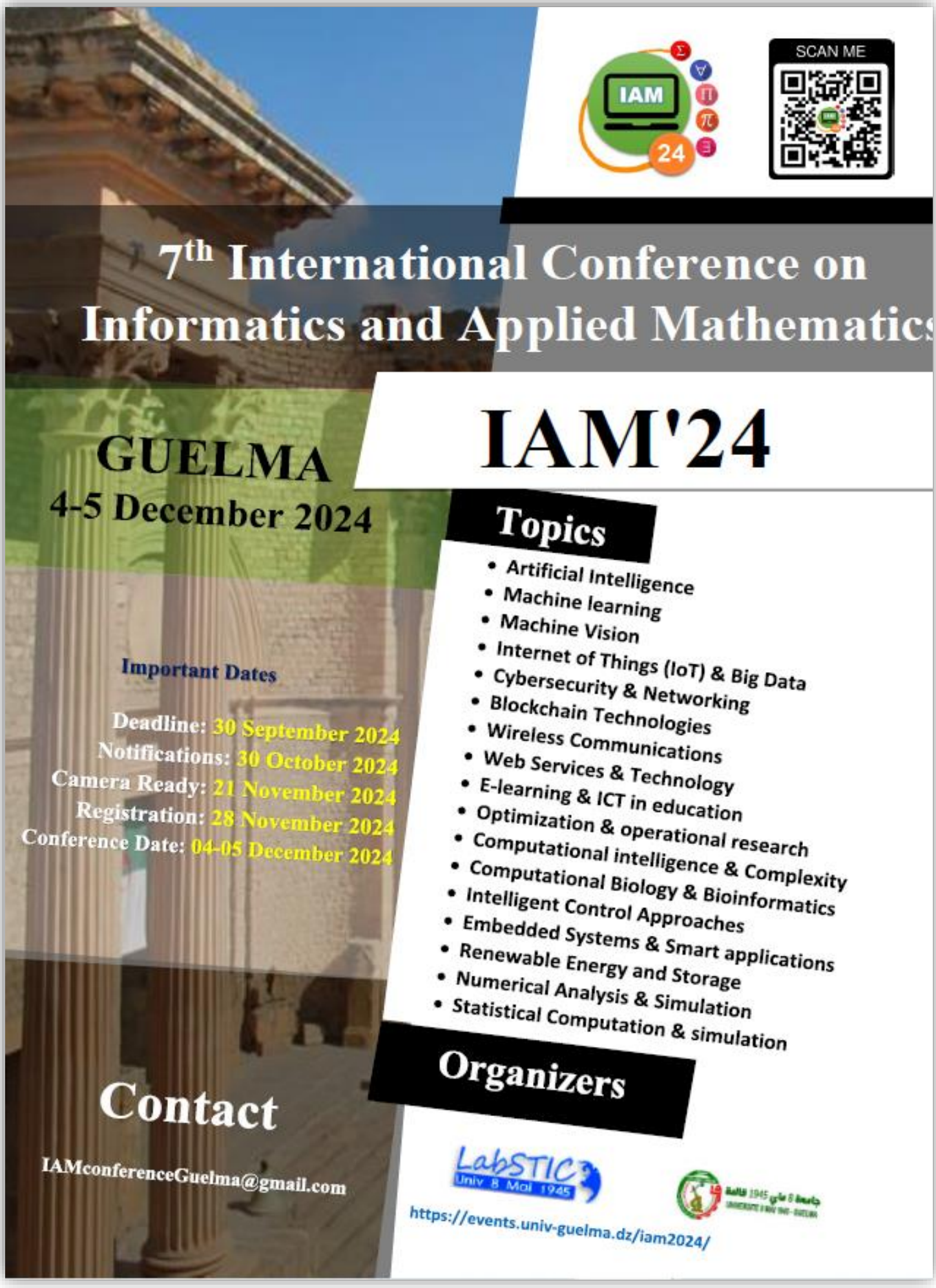
SCAN ME
7th International Conference on Informatics and Applied Mathematics
IAM'24
GUELMA
4-5 December 2024
Important Dates
Deadline: 30 September 2024
Notifications: 30 October 2024
Camera Ready: 21 November 2024
Registration: 28 November 2024
Conference Date: 04-05 December 2024
Topics
• Artificial Intelligence
• Machine learning
• Machine Vision
• Internet of Things (IoT) & Big Data
• Cybersecurity & Networking
• Blockchain Technologies
• Wireless Communications
• Web Services & Technology
• E-learning & ICT in education
• Optimization & operational research
• Computational intelligence & Complexity
• Computational Biology & Bioinformatics
• Intelligent Control Approaches
• Embedded Systems & Smart applications
• Renewable Energy and Storage
• Numerical Analysis & Simulation
• Statistical Computation & simulation
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IAMconferenceGuelma@gmail.com
https://events.univ-guelma.dz/iam2024/

Preface

The IAM conference stands as a premier platform for advancing research in Informatics and Applied Mathematics. The 7th edition, organized and sponsored by the LabSTIC Laboratory, is hosted at the University of 8 Mai 1945 in Guelma, Algeria. Continuing the legacy of its predecessors—IAM'18, IAM'19, IAM'20, IAM'21, IAM'22, and IAM'23—IAM'2024 offers a distinguished international forum that fosters collaboration among early-career and seasoned researchers, scientists, and practitioners. This event serves as a venue for proposing innovative ideas, presenting research contributions, and exchanging experiences and insights on a wide array of topics within the domains of Informatics and Applied Mathematics.

In addition to facilitating scholarly discourse, IAM'2024 provides an exceptional platform for researchers, educators, and industry professionals from diverse fields to explore foundational roles, examine recent innovations, discuss emerging trends, and address practical challenges. Topics of discussion include, but are not limited to:

- Artificial Intelligence
- Machine Learning & Big Data
- Image & Video Processing
- Internet of Things (IoT)
- Cloud Computing & Networking
- Information Security & Cryptography
- Mobile Computing
- Web Services & Technology
- E-learning & ICT in Education
- Computational Biology & Bioinformatics
- Optimization & Operational Research
- Information Theory
- Computational Intelligence
- Computational Complexity
- Numerical Analysis & Simulation
- Statistical Computation & Simulation

The program for the 7th edition features a mix of theoretical research and practical applications, encompassing techniques and methodologies from the conference's diverse thematic scope. Each submitted paper underwent rigorous evaluation by at least two reviewers, culminating in the selection of twenty-six articles for oral presentations (delivered in-person and online) and seven articles for poster presentations, with an overall acceptance rate of 35%.

We extend our heartfelt gratitude to all the authors for their contributions, the invited speakers for their valuable insights, the program committee members for their diligent reviews, and the organizing committee for their unwavering commitment to the success of this event.

IAM 2024
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Pr Zineddine KOUAHLA

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List of Papers

Sensor Fault Detection Based on New Symbolic Covariance PCA

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Abstract. Principal Component Analysis (PCA) is commonly employed technique in industrial systems for process monitoring and fault diagnosis, owing to its capability to efficiently process large datasets.
Traditionally, it is applied to single-valued variables, where critical information can be lost in real scenarios with data uncertainties. Interval-valued PCA methods like Symbolic Covariance PCA (SCPCA) and Complete Information PCA (CIPCA) have been developed to enhance fault detection by incorporating data uncertainties in the PCA model. This paper presents a novel adaptation of SCPCA for detection uncertain sensor faults, marking the first correct implementation of SCPCA for fault detection and isolation (FDI). It aims to compare the performance of the new SCPCA with that of CIPCA, evaluating its reliability and accuracy in detecting sensor faults in greenhouse prototype system.

Keywords. Fault Detection, Symbolic Covariance PCA, Complete Information PCA, Interval Data.

BoostSecurityDB: a new vulnerability scanning tool for online SQL databases

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Abstract. We are now witnessing an excessive flow of information that has touched all individual and societal systems and devices. This explosion has made our systems vulnerable to penetration and theft, especially those that contain sensitive information, such as military, government, banking, and healthcare systems. As a result, attention to cybersecurity and the mastery of its technologies have become necessary for our societies. For this purpose, we suggest a cybersecurity solution called BootsecurityDB. This tool can detect certain vulnerabilities that allow access to database information. This study begins with an in-depth review of network security concepts and cybersecurity principles. Furthermore, we present a detailed description of the development activities of BootsecurityDB. Finally, the proposed tool was subjected to a series of experiments to evaluate its effectiveness.

Keywords. Cybersecurity, vulnerability, database security, Python.

A Survey on Dataset Development Techniques for QA Systems

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Abstract. Question-answering (QA) systems are pivotal in natural language processing, driving advancements in conversational AI, virtual assistants, and automated knowledge retrieval. The quality and structure of datasets play a critical role in the performance, reliability, and adaptability of these systems. This paper presents a comprehensive review of dataset development techniques for QA systems. We classify these techniques into three categories: manual techniques, which are based on expert domain and crowdsourcing, and automatic techniques, which are divided into two classes: knowledge-based methods and machine learning, and innovative techniques by using the data augmentation methods. We introduce a comparison of some important datasets for QA systems according to different criteria with special focus is given to evaluation metrics used to assess dataset quality. The study can guide practitioners in developing robust, high-quality datasets for future QA systems.

Keywords. QA systems, Dataset development, Metrics, survey.

Unveiling the Power of CycleGAN: A Comprehensive Survey on Image Processing

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Abstract. This paper provides an overview of the CycleGAN algorithm, Driven by the significance of unpaired data for image transformation tasks in image processing. Unlike Generative Adversarial Networks (GANs) CycleGAN can perform style transfer without the need, for paired data. One key aspect highlighted is cycle consistency, which ensures that the relationship between styles is maintained during image translation. The components of the CycleGAN model including generators and discriminators are examined in depth from angles. The article also showcases uses of CycleGAN, in image style transformation demonstrating its ability to turn ordinary images into realistic and visually appealing ones. Conversations have been held about enhancing and adjusting the CycleGAN algorithm discussing the challenges and opportunities they present for research. The emphasis is, on enhancing reliability promoting results and perfecting the precision of image transformations.

Keywords. CycleGAN, GANs, Image synthesis, Image-to-image translation, style transfer, Image processing.

Detection and classification of Emotion Recognition System for TESS and Crema-d Audio Datasets Using Hybrid Deep Learning Architecture

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Abstract. Humans communicate their desires through spoken language, which expresses various emotions. This process has led to the development of speech recognition systems, where machine learning enables computers to recognize and analyze vocal cues to interpret emotions, resulting in application creation focused on human-machine interaction. Advancements in technology, the evolution of artificial intelligence, and the influence of deep learning via CNN architectures have propelled research in emotion recognition systems forward. In this paper, we evaluated our method for detecting and classifying emotions in two architectural models (Model-A and Model-B) that utilized Mel-frequency cepstral coefficients to extract features from audio files. The experiments were conducted using the TESS and Crema-d audio file databases. The outcomes are promising, showing an accuracy of 54.07% for Model-B with the Crema-d dataset and 98.92% for Model-A with the TESS dataset.

Keywords. Speech, Architecture, Emotion, Accuracy, Recognition.

Study of the damage of a pipeline under internal pressure

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Abstract. In industrial sectors, pipelines have been used as the most economical and safe means of transporting oil and gas. However, the number of accidents has increased considerably with their increasing use. Due to the workload and pressure used, the tube thickness must be increased and the mechanical characteristics improved. Our work consists of comparing the distribution of stresses over the thickness of a pipeline made of API X65 material, with an internal pressure variation, as well as the thickness variation. A comparative study of analytical and numerical results using two calculation codes, ANSYS and SolidWorks (conclude which is the best software).

Keywords. Steel, Pipeline, Internal Pressure, Thickness, finite element, Numerical Simulation

Mathematical modeling of surface roughness in end milling of treated and untreated AISI 52100 steel

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Abstract. In this study we present the results of the response surface methodology (RSM). A statistical analysis of variance (ANOVA) study was carried out to calculate the contribution of the various factors cutting speed (Vc), feed per tooth (fz), radial depth of cut (a_e) and their

interactions on the technological parameters surface roughness (Ra) before and after heat treatments. The latter enabled us to develop mathematical models, to express the relationship between the elements of the cutting regime and the technological parameters studied, and to present in 3D in the form of a response surface comparing untreated with treated states. These responses were measured during end milling of AISI 52100 steel using taguchi's full factorial experimental design 3^3 (27 tests). The aim of this analysis is to determine the factors and interactions that have a statically significant effect on the parameters studied, define mathematical models of the responses, comparing between experimental and predicted values of surface roughness (Ra) before and after heat treatments.

Keywords: Heat treatment, End milling, Surface roughness, AISI 52100, RSM, ANOVA.

Parameter Optimization for a Novel Dynamic Vibration Absorber with Grounded-Negative Stiffness using Chebyshev's Equioscillation Theorem

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Abstract. In this present paper, a mini-max optimal design of a non-traditional Dynamic Vibration Absorber with grounded negative stiffness (NTNS-DVA) for damped structures is investigated to reduce high amplitudes in the resonant range of vibrations. The differential equation is formulated and the analytical solution of the system is derived. The formulation of optimal design parameters of DVA is a very complicated task when the primary structure is damped. Using the principles of fixed-point theory and under the assumption of a structural damping ratio within the range of light to moderate, the closed-form solution for the optimal tuning coefficient is analytically obtained. Then, the optimal damping ratio and the optimal negative stiffness parameter of the proposed non-traditional DVA with grounded negative stiffness are determined numerically by solving a set of nonlinear equations established using Chebyshev's equi-oscillation theorem. Extended simulations are conducted to examine the effectiveness of the optimally designed NTNS-DVA and the sensitivity of the optimal parameters. Finally, the vibration control performance of the proposed configuration is compared with those of two typical DVAs, which were presented by Liu and Pennestri, respectively. The comparison results demonstrate that the non-traditional DVA with negative stiffness significantly enhances vibration control by reducing the dynamic magnification response of damped structures.

Keywords: Mini-Max optimization, Dynamic vibration absorber, Damped structure, negative stiffness, vibration control performance, dynamic response mitigation.

Smart PDF Query Engine: OpenAI + LangChain

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Abstract. The problem of extracting accurate and relevant data from a large source of unstructured content such as PDFs still persists and acts as a bottleneck towards the efficient process of knowledge mining.

This paper proposes a new PDF querying system deployed with the OpenAI's language model (LLM) and leveraging on LangChain for contextual comprehension to transform how information is extracted from various PDFs. The proposed system is modelled to use the following stages. First, text extraction and embedding generation for PDF documents are performed, in which the embeddings are saved in a vector DB. A business user can then submit natural language queries which will prompt LangChain's Conversational Chain. This component extracts text chunks, context as well as optimized prompts from the vector database using the query and prior conversation. The OpenAI's LLM which is currently the most advanced perceives this input to provide relevant and accurate responses in light of the sought information. The performance of the system has been tested and compared with the other conventional keyword search methods in a number of experiments for different PDF documents proposing enhanced accuracy as well as relevance of a query, exactness of the reply and satisfaction level of the user. Some of them are the symbiosis of OpenAI's language understanding capabilities and LangChain's contextual reasoning to extract structured and accurate information from text documents. The proposed system opens a new path towards deep learning that is useful in different fields including science, legal publications, finances, and other domains, whereby PDF storages contain vast information wealth and natural language interfaces allow users to unlock these resources.

Keywords. PDF querying, natural language processing, language models, contextual AI, LangChain, document understanding, semantic search.

An NLP and Rule-Based Approach to Extract Spatial Entities and Relationships in Arabic Text

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Abstract. Information extraction is a fundamental area of automatic natural language processing (NLP), enabling the transformation of unstructured text into organized data. In geographic information systems (GIS), this extraction is crucial for identifying and precisely structuring spatial entities and relationships. Among current methods, Java Annotation Patterns Engine (JAPE) rules are widely used for their ability to capture specific linguistic patterns, particularly in Arabic, enabling accurate annotation of spatial entities. This work presents an approach based on JAPE rules, optimized for simple geographic information retrieval systems, and distinguished by its flexibility and accuracy. By applying linguistic structures adapted to Arabic, this method demonstrates its effectiveness in classifying and annotating spatial data. The results obtained confirm the relevance of this approach, with a precision of 0.90, a recall of 0.85 and a F-measure 0,87, offering a reliable solution for geospatial information extraction.

Keywords. information extraction, spatial information, NLP Arabic, rules JAPE

Emergence detection using a fuzzy expert system in complex system

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Abstract. Swarms of insects, schools of fish, flocks of birds, and other natural phenomena all exhibit emergent behaviors, which are among the most widely discussed subjects in the world today. When these organisms are on a mission, it is evident that they maintain their consistent direction of travel without colliding with one another. This paper suggests a fuzzy expert system-based approach to emergent behavior analysis. Besides that, the paper describes the first results of a three-step procedure and investigates how interactions can be utilized as a metric to detect emerging behaviors in the Boids model: (1) Representation and acquisition of simulation data,(2) Building a fuzzy expert system,(3)Learning process and emergence detection. Since this is a part of ongoing research, future direction is also discussed.

Keywords. Expert systems, Emergence, Agent-based modelling, Swarm introduction

ANFIS-PID-based PSO algorithm controller for chaos suppression

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Abstract. This work discusses a powerful adaptive neuro-fuzzy inference system (ANFIS)-based optimized PID controller for stabilizing the Lorenz chaotic system. The Particle Swarm Optimization (PSO) approach is used to determine the best PID controller parameters. The ANFIS controllers have been thoroughly educated, examined, and verified with the information set generated from the optimized PID controller-based PSO method. The reliability and accuracy of the ANFIS model are assessed. Finally, the stabilization is accomplished and demonstrated using numerical simulations.

Keywords. Chaotic system, ANFIS controller, PID controller, PSO algorithm, Stabilization.

A Hybrid Consensus Mechanism for Enhancing Security and Efficiency in IoV Networks

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Abstract. The advancement of the Internet of Vehicles (IoV) necessitates secure, scalable, and energy-efficient networking solutions to support seamless, real-time data exchange among connected vehicles. This paper introduces a tailored hybrid consensus mechanism, Delegated and Authorized Proof of Stake (DPA-PoS), which addresses these needs by combining Delegated Proof of Stake (DPoS) with Proof of Authority (PoA). Enhanced with advanced cryptographic techniques such as Zero-Knowledge Proofs (ZKP) and homomorphic encryption, DPA-PoS offers significant improvements in security, privacy, and efficiency. By minimizing latency and lowering energy demands, this approach proves well-suited for critical IoV applications like autonomous vehicle coordination and secure inter-vehicle communication.

Performance tests demonstrate that DPA-PoS surpasses traditional consensus protocols (PoW, PoS) in efficiency metrics, including reduced latency, faster transaction processing, and improved energy savings, highlighting its potential as a foundational solution for next-generation IoV systems.

Keywords: Internet of Vehicles (IoV), Delegated Proof of Stake (DPoS), Proof of Authority (PoA), Zero-Knowledge Proofs (ZKP), Encryption, Data Security.

Blockchain-Based Payment System for Registration Fees in higher education: A Case Study of Algeria

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Abstract. This paper describes the development and deployment of a blockchain-based payment system specifically intended to handle enrolment fees in universities, especially those in Algeria. The main goal is to eliminate the inefficiencies of conventional payment systems, which frequently entail labour-intensive processing by hand, lengthy processing times, and significant administrative costs. This system seeks to reduce reliance on banks and minimize processing errors by offering a safe, transparent, and automated fee payment platform through the use of blockchain technology. The suggested method automates real-time student registration changes, payment verification, and receipt issuance using Ethereum smart contracts. The system also seamlessly functions inside the academic ecosystem by integrating with the current university infrastructure, including the Financial Management System (FMS) and Student Information System (SIS). The system's capacity to shorten transaction times, improve data integrity, and offer scalability by utilizing Layer-2 technologies to handle large transaction volumes during peak times is demonstrated via a prototype implementation at Skikda University. The pilot program's results show notable gains in security and payment efficiency, and automatic auditing features guarantee openness for both administrative personnel and students. The system's scalability, compliance with legal requirements, and possibility across the state implementation across Algerian universities are all included in the study's conclusion. Future research will look into extending the system's capabilities to include more financial operations in the educational field.

Keywords: Blockchain, Smart contract, Registration, Payment.

Sentiment Analysis of Digital Currency Discussions: A Machine Learning and Ontology Approaches

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Abstract. Sentiment analysis on social networks has become an increasingly important research field in recent years, driven by the rapid growth of social media and the vast amount of user-generated data. Understanding online opinions and sentiments is crucial for gaining

insights into public attitudes and trends. In this study, we compare two approaches for sentiment detection: the first relies on ontologies, and the second utilizes machine learning techniques. Ontologies provide a structured framework to represent domain-specific knowledge, thus enhancing the accuracy of sentiment analysis. In the machine learning approach, we employed four algorithms: Support Vector Machines (SVM), K-Nearest Neighbors (K-NN), Decision Tree, and Random Forest. SVM demonstrated superior performance compared to other algorithms such as K-NN. Our approach was applied to sentiment analysis of Facebook discussions about Bitcoin, demonstrating the practical application of both ontology-based and machine learning techniques in the financial domain. The results highlight the effectiveness of both approaches in economic sentiment analysis, offering valuable insights into trends and sentiments that could be extended to other fields such as finance and commerce.

Keywords. Sentiment Analysis, Social Networks, Ontology, Bitcoin, Machine learning

An Internet of Things Based-Revolutionizing Vending Machine System with Solar Panel and Conversational AI Assistance

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Abstract. In vending machine retail settings, there are major challenges it encounters: lack of real-time monitoring capabilities, continuous electricity consumption, and a lack of human interaction. To address this, the researchers developed an IoT-based vending machine with solar panels and conversational AI assistance that allows real-time monitoring of stocks of the vending machine that allows the operator to manage the vending machine online and even gets notified once a certain product is almost out of stock, solar panels and voice recognition command are also implemented. By implementing these, the systems utilize a more sustainable alternative energy source as opposed to traditional energy sources and also provides a way for the customer to interact with the vending machine system. The IoT was evaluated with the ISO/IEC 25010:2023 standards, focusing on Functional Suitability, Performance Efficiency, Interaction Capability, Reliability, and Maintainability. The results show a favorable score of 4.86 in Functional Suitability, 4.86 in Performance Efficiency, 4.95 in Interaction Capability, 4.83 in Reliability, and 4.70 in Maintainability. These results show that the IoT developed for monitoring the vending machine was dependable and highly favorable. By developing an IoT-based vending machine with solar panels and conversational AI assistance, the system provided a significant advancement in automated retail settings.

Keywords. Conversational AI, Internet of Things, Solar Panel, Vending Machines, Voice-activation.

Routing with QoS and Fault Tolerance in WBAN: The HEALTH Protocol

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Abstract. The Internet of Things (IoT) is a technology for connecting physical objects via various digital systems, and is used in many fields, including medical monitoring. In this context, a specific network, the Wireless Body Area Network (WBAN), can be integrated into the IoT infrastructure. The increase in the use of WBANs in the medical field can be explained by their many advantages in terms of patient monitoring, early detection of health risks and the provision of personalized medical care. However, researchers are faced with challenges such as managing energy consumption, guaranteeing quality of service and resilience to outages, while ensuring patient comfort. This study proposes a new routing protocol, HEALTH, for WBANs, aimed at guaranteeing quality of service in terms of temperature and delivery rate. The performance of this protocol was evaluated using the BNS and Castalia frameworks, based on the Omnet++ simulator. The simulation results demonstrate the effectiveness of the protocol while maintaining a good quality of service.

A Knowledge Graph-based Approach for Business Processes Integration in Smart Grids

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Abstract. The widespread adoption of the Smart Grid (SG) technology requires more efficient mechanisms for ensuring Business Processes (BP) integration and cooperation. In fact, in SG ecosystems, different stakeholders, i.e.; producers, consumers, transporters . . ., are involved in a global interaction in order to achieve common objectives. However, as each actor handles its own business logic and resources governed by specific constraints, the integration and cooperation of the deployed BPs in a hole synergy for achieving a particular business goal becomes a challenging issue. This paper tackles the issue of BP integration in SG environments. It explores existing relevant models for representing BPs specifications, and knowledge modeling techniques to handle integration concerns. To this trend, a novel paradigm shift approach based on the utilization of knowledge graphs is suggested for managing BPs integration. In the proposed approach, BPs are represented with BPMN diagrams and their specification is enriched through an hybrid model incorporating knowledge graphs allowing to support context-aware business processes. The enhanced BP model allows a more smarter and coherent process handling, which is essential for an efficient monitoring and management of smart grids systems.

Keywords. Smart grids, Business processes, Business Processes integration, Knowledge graph, Mapping.

Binary Grey Wolf Optimizer for Mapping Real Time Applications on MPSOCs Architecture

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Abstract. With the growing complexity of real-time applications, MultiProcessor Systems-on-Chip (MPSoCs) have become a vital solution for meeting stringent performance, power, and scalability requirements. Efficient task mapping plays a crucial role in optimizing the performance of such systems, particularly for real-time applications that demand strict timing constraints. Traditional mapping techniques, including static and dynamic strategies, struggle with balancing execution time, energy efficiency, and communication overhead in heterogeneous MPSoC architectures. In this paper, we propose a novel approach for optimizing task mapping in MPSoCs, based on the Grey Wolf Optimizer (GWO), a bio-inspired metaheuristic renowned for its effectiveness in solving complex optimization problems. This methodology aims to minimize task execution times and communication delays by intelligently mapping real-time tasks onto heterogeneous processing elements (PEs), while also adhering to realtime constraints and reducing energy consumption.
The results confirm that the improved GWO algorithm is a powerful tool for addressing the challenges of real-time task mapping in MPSoCs, providing a robust and scalable solution for future embedded systems.

Keywords. Multi-Processor Systems-on-Chip · Network-on-Chip · Elephant Herding Optimization · Mapping · Optmization · heterogeneous architectures.

Optimal tuning of Hybrid Photovoltaic-Battery Systems Using Tilted Integral-Derivative Control Strategy

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Abstract. The research introduces an advanced control strategy, namely the Tilted Integral-Derivative (TID) controller, within the context of managing a hybrid energy system that integrates Photovoltaic (PV) technology with Battery Storage. Implemented using Matlab Simulink, this controller aims to optimize the system's performance under varying load demands and meteorological conditions.

The hybrid system architecture employs Boost and Buck-Boost converters to interface the PV array and battery bank with the DC bus, while load supply is facilitated by a three-phase three-level inverter. Lead-acid batteries, chosen for their cost-effectiveness and suitability for large-scale energy systems, are extensively discussed in the study alongside modeling techniques for both the PV system and Lead-acid battery.

The proposed control strategy involves three distinct loops: the Maximum Power Point Tracking (MPPT) loop, battery control loop, and inverter control loop. These loops ensure efficient power extraction from the PV module, bidirectional power flow between the battery and DC bus, and robust voltage regulation in response to sudden load variations. Research findings emphasize the effectiveness of the TID controller in maintaining a stable DC bus with minimal chattering, particularly during rapid changes in irradiation levels and load demands.

Comparative analysis with conventional PID controllers underscores the superior performance and stability of the proposed control strategies, thereby enhancing the operational efficiency and reliability of hybrid energy systems.

Keywords: Hybrid Energy System, Tilted Integral-Derivative, Photovoltaic, Maximum Power Point Tracking, Battery Storage.

Brain Tumor Segmentation Using a Dual-BranchU-Net Model: Analysis and Comparison

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Abstract. This research introduces a dual-branch U-Net model for brain tumor segmentation in MRI images. By combining VGG16 and ResNet50 as encoders, the model enhances segmentation accuracy and robustness, achieving a Dice coefficient of 92% and an Intersection over Union (IoU) of 82% on the BraTS dataset. The detailed methodology and obtained results confirm the potential of this model for advanced clinical applications. Furthermore, we perform a comprehensive analysis of the model's performance compared to existing architectures, discussing the implications for clinical deployment.

Keywords. Brain tumor segmentation, MRI, Dual-Branch U-Net, Deep learning, VGG16, ResNet50.

Overview of Current Trends in Machine Learning Approaches for EEG-Based Brain Computer Interface Applications

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Abstract. The potential of the human brain to communicate and interact with the environment is promoted by advances in neuroscience and computer science, making brain-computer interface (BCI) top interdisciplinary study. Addition-ally, with recent developments in machine learning (ML), electroencephalogram (EEG)-based BCIs for AI are gaining popularity. This review article offers a look at recent research on brain-computer interfaces (BCIs) and how the technology of machine learning (ML) is used in BCIs. It highlights the role that ML has had in the execution of various BCI tasks and examines the various research methodologies used in this area. Additionally, it discusses ML techniques for detecting mental states, classifying mental tasks, classifying emotions, classifying electroencephalogram (EEG) signals, classifying event-related potential (ERP) signals, classifying motor picture data, and classifying limb movements. This paper aids readers in learning about recent advances in BCI and ML as well as upcoming discoveries required to enhance and create better BCI applications.

Keywords. Brain-Computer Interfaces (BCI), Electroencephalography (EEG), Classification, Machine Learning.

A New Subband Set-Membership Fast NLMS (SB-SM-FNLMS) Adaptive Algorithm

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Abstract. This study introduces a novel Subband Set-Membership Fast Normalized Least Mean Square (SB-SM-FNLMS) adaptive filtering algorithm. By integrating the subband adaptive filtering approach into the Set-Membership Fast Normalized Least Mean Square (SM-FNLMS) algorithm, the convergence rate, final mean square error (MSE) and computational complexity (CC) are improved. A performance comparison, based on learning curve (Mean Square Error (MSE) plot), between the proposed SB-SM-FNLMS algorithm and the existing Normalized Least Mean Square (NLMS), Set-Membership Normalized Least Mean Square (NLMS), Fast Normalized Least Mean Square (FNLMS), and Set-Membership Fast Normalized Least Mean Square (SM-FNLMS) algorithms, demonstrates the superior performances of the proposed algorithm.

Keywords. NLMS, FNLMS, SM, SB, SM-FNLMS, SB-SM-FNLMS, SegMSE, CC.

Parallel computing for 3D Delaunay triangulation of non-uniform cloud points

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Abstract. 3D acquisition technologies have favored the development of geometric modelling of 3D objects based on data from their digitization. The aim is to use the Delaunay triangulation approach to generate a digital model of the external surfaces of a physical object from point clouds. The generation of a Delaunay triangulation from a non-uniform point clouds is an arduous and time-consuming task. Moreover, point clouds are very large and computationally intensive, which increases processing time and therefore costs, especially if only one processor is used. The fastest Delaunay triangulation algorithm is based on the divide-and-conquer, which is generally designed to be used for parallelism. This algorithm is carried out in two steps. The first step recursively partitions the points set into sub-regions; each is assigned to a processor. Independently, these regions are further triangulated simultaneously. The second step merges the sub-regions into the final mesh, which is applied in the reverse order of points set partitioning. This work deals with the generation of a 3D triangulation from any point cloud, which is partitioned to several sub-points using cells. Independently, the sub-points are further triangulated simultaneously by parallelizing the calculations on several processors. After that, an allocated area of each cell is determined, as well as the strategy for the fusion. Finally, this solution is tested and validated through many unstructured point clouds.

Keywords: Cloud of points, cells, 3D Delaunay triangulation, merging, parallel computing.

Optimizing Drilling Performance: A Machine Learning Approach to Rate of Penetration Prediction

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Abstract. The prediction of the rate of penetration (ROP) during drilling operations is of the utmost importance for improving efficiency and reducing costs of operations in the petroleum industry. This research investigates the efficacy of advanced machine learning algorithms, specifically Random Forest, Gradient Boosting, and Multi-Layer Perceptron (MLP), in forecasting ROP through analysis of extensive drilling data from the HMD field in Algeria. The study makes use of the strengths of ensemble learning and neural networks in order to address the inherent complexities of drilling data analysis. Prior to the training of the model, rigorous data preprocessing was undertaken, encompassing the normalization and imputation of missing values. The performance of the models was evaluated using key metrics, including the coefficient of determination (R^2), the Mean Absolute Error (MAE), and the Root Mean Squared Error (RMSE). Model robustness was further validated through cross-validation techniques. The results demonstrated the superior performance of the Random Forest and Gradient Boosting algorithms, achieving the highest R^2 values of 0.978 and 0.977, respectively, and the lowest RMSE values of 0.055 and 0.056. Furthermore, the MLP regressor demonstrated robust predictive capacity, attaining an R^2 of 0.926 and an RMSE of 0.101.

This study provides a practical illustration of the deployment of machine learning techniques in a real-world industrial context, making a significant contribution to the broader fields of applied mathematics and computer science. The research promotes collaboration between academia and industry, with implications extending beyond petroleum engineering to other data-intensive domains requiring complex pattern recognition and prediction capabilities.

Keywords. Rate of Penetration (ROP), Machine Learning, Drilling Operations, Ensemble Learning.

Mixed texture descriptors for facial expression recognition

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Abstract. This article proposes a novel approach to recognize facial expression using a combination of three local texture descriptors such us Local Binary Pattern (LBP), Gradient Direction Pattern (GDP) and Local Directional Pattern (LDP). Firstly, we need to perform the pre-process of face image, which includes face detection and face image cropping. Next, we calculate texture descriptors based on LBP, GDP and LDP operators. Histogram sequence concatenation is then applied to these descriptors after dividing the facial image into a number of non-overlapping blocks. Finally, the concatenate histograms represent an input to a Support Vector Machine (SVM), which will be used to classify facial images in one of the six universal expressions. Experimental results using CK+ and JAFFE database show that the proposed approach achieves superior recognition performance compared to the existing studies with classification accuracy of 97, 62% and 93, 84% respectively.

Keywords. Facial expressions, human face, emotional recognition, LBP, GDP, LDP, SVM.

Predictive Modeling of Hydrocarbon Flash Points using QSPRApproch and MLP-ANN technique

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Abstract. This study presents a predictive model for estimating the flash point of hydrocarbons using a Quantitative Structure-Property Relationship (QSPR) approach combined with a Multilayer Perceptron Artificial Neural Network (MLP-ANN). The flash point is a critical safety property in the processing and handling of petroleum-based products, as it indicates the temperature at which a substance can ignite. The model was trained on a dataset of 121 hydrocarbon molecules, divided into training, testing, and validation sets, with molecular descriptors analyzed to determine the most relevant features. The resulting MLP-ANN model structure was optimized for performance, achieving high accuracy in flash point prediction, as indicated by metrics including a high correlation coefficient and low error rates. These results underscore the effectiveness of neural network-based QSPR models in providing reliable predictions for complex hydrocarbon properties, supporting enhanced safety protocols and operational efficiency in the petrochemical industry.

The model offers a valuable alternative to experimental measurements, which are often costly and time-consuming, making it a useful tool for preliminary assessments and risk evaluations in industrial settings.

Keywords: Hydrocarbons, Flash Point, MLP-ANN, QSPR Modeling.

A Review of Bio-Inspired Methods for Intrusion Detection in the Internet of Medical Things

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Abstract. The Internet of Medical Things (IoMT) is transforming healthcare by enabling seamless communication between medical devices, sensors, and networks. However, its reliance on interconnected systems exposes it to a variety of cyber threats, particularly intrusions that can compromise patient data and system functionality. Bio-inspired algorithms, which draw inspiration from natural phenomena such as evolution, swarm behavior, and immunity, have emerged as effective tools for enhancing Intrusion Detection Systems (IDS) in IoMT environments.

This review highlights the role of bio-inspired methods, including Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), and Artificial Immune Systems (AIS), in detecting and mitigating intrusions in IoMT. These methods provide advantages such as adaptability, robustness, and efficiency in handling dynamic and complex attack scenarios. The paper also discusses their integration with machine learning techniques and evaluates their effectiveness in improving intrusion detection performance. This review concludes by identifying opportunities for future research, emphasizing the need for hybrid approaches and interdisciplinary innovations to enhance IoMT security.

Keywords: Bio-Inspired Algorithms, Internet of Medical Things (IoMT)**,** Intrusion Detection Systems (IDS), IoMT Security.

Optimized LFA Algorithm for Multi-Robot Foraging

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Abstract. This paper focuses on improving the efficiency of multi-robot foraging through the optimization of the Lévy Walk and Firefly Algorithm (LFA). The study proposes a hybrid approach that uses Genetic Algorithms to fine-tune the parameters of the Lévy Walk, enhancing global exploration and robot dispersion in the search space. The optimized algorithm (GLFA) was implemented on the Argos mobile robotics platform, and initial results show improvements in foraging efficiency compared to the original LFA, especially in terms of reducing collection time and increasing target detection.

Keywords. Robotic swarms, Evolutionary algorithms, genetic algorithms, LFA · Lévy walk.

Advances in Machine Learning Methods for Automated Pediatric Epilepsy Seizure Detection: An Overview

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Abstract. Epilepsy is one of the most common neurological disorders in children, characterized by recurrent seizures that can significantly affect cognitive and developmental outcomes if not detected and managed early. Automated seizure detection systems have emerged as a promising solution to aid in timely diagnosis and reduce the reliance on manual electroencephalogram (EEG) interpretation. This review provides an overview of recent advancements in automated epilepsy seizure detection tailored to pediatric patients, focusing on the integration of machine learning (ML) techniques. The review highlights the unique challenges of pediatric seizure detection, such as the variability in EEG patterns and the scarcity of pediatric-specific datasets. It also examines the potential of advanced ML models, including deep learning and hybrid approaches, to address these challenges.

Keywords. Pediatric Epilepsy; Seizure Detection; Automated Detection; Machine Learning Models.

Towards an Intelligent Wheat Stock Management System Using Deep Learning,Ontology, and IoT

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Abstract. Wheat stock management is an important aspect of agricultural supply chains, influencing food safety, quality, and economic value. This paper presents a novel integrated system combining Deep Learning, Ontology, and IoT for intelligent wheat grain stock management. The proposed approach involves real-time monitoring using IoT sensors to capture environmental data, including temperature, humidity and CO2, which are essential for maintaining optimal storage conditions. Concurrently, a deep learning model analyzes captured images of wheat grains to automatically classify their quality into categories such as normal, moldy, broken, sprouted or infected by insects. The classification results and data issue from IoT are then fed into an ontology-based decision-making framework, which uses predefined rules to recommend actions, such as adjusting storage parameters or initiating further inspections.

Keywords. Wheat stock management, Deep Learning, Ontology, IoT, Grain Quality, Smart agriculture.

Blockchain-Driven Data Security in Educational Social Networks: A SecureChain Approach

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Abstract. The COVID-19 epidemic has had a dramatic effect on the face-to-face education landscape, leading to a notable change in favor of e-learning options. Since the introduction of online learning, e-learning platforms have proliferated and provided students with never-before-seen access to a wealth of educational possibilities and resources. Ensuring dependability and trust among users and society about training quality and transparency is a major challenge for e-learning systems. This involves confirming, especially for online tests, the legitimacy of a student's identification and performance within the system. This entails safely recognizing real-world people as digital entities, which presents serious security challenges from the perspective of computer science.

Furthermore, problems with data security and integrity arise when traditional on-site training models switch from paper-based academic records to digital formats. Similar to real data, digital data can be manipulated, which makes managing and storing it in e-learning systems extremely difficult. Achieving a balance between privacy and data security and transparency is essential to tackling these issues. In this work, we provide a novel solution that uses Web 3.0 concepts and blockchain technology to improve the security of e-learning systems.

Keywords: Blockchain Technology, Educational Social Networks, Data Security, E-learning