Series: ELECTRONICS, COMPUTERS and ARTIFICIAL INTELLIGENCE – ECAI-2025

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Book of Abstracts

of the 17th International Conference on ELECTRONICS, COMPUTERS and ARTIFICIAL INTELLIGENCE – ECAI-2025

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Preface

Warm greetings from **"Valahia" University of Targoviste** Romania.

This edition of the ECAI 2024 is organized by **National University of Science and Technology POLITEHNICA Bucharest, Pites,ti University Centre** - Faculty of Electronics, Communications and Computers, and **IEEE ROMANIA SECTION**, and hosted by the **"Valahia" University of Targoviste.**

The buildings of the **"Valahia" University of Targoviste** will host the entire conference activities this year, and attendees will be able to tour and experience the program's state-of-the-art facilities. New broadcasting facilities in computer labs and all classrooms were the latest in educational technology that is from now the standard for all buildings on campus.

Conference sessions will cover a wide range of research subjects, including areas of the electronic and electric equipment, communication, automatic control, applied informatics, information technology and computer science. The conference will include plenary and regular sessions, special sessions for young researchers, e – session, workshops, discussions' groups and social events.

The conference will conclude with a special invited panel and in the closing session will be included the comments and observations of the participants about the scientific impact of ECAI 2024 edition, considering that this edition will be IEEEXplore indexed.

This volume contains the papers presented at ECAI-2025: 17th Edition of In- ternational Conference on Electronics, Computers and Artificial Intelligence held on June 26-27, 2024 in Targoviste.

There were 185 submissions. Each submission was reviewed by at least 2, and on the average 4.5, program committee members. The committee decided to accept 133 papers. The program also includes 6 invited talks. The following workshops are organized under ECAI-2025

- **12th International Workshop on Applied Electronics-IWAE'25 ,** Organizers: Mihai Oproescu and Iana Gabriel
- **International Workshop "Emerging Technologis Remodeling the Legal World - Challenges and Question" ETRLW - CQ' 2025,** Organizers: Elise Valcu, Dana Iancu, Andra Dascalu, Constanta Matusescu
- **13th International Workshop on Systems Safety & Security-IWSSS' 25,** http://iwsss.org
- **2025 International Workshop on Virtual Ubiquitous and Intelligent Computing (VUICON),** Organizers: Nicu Bizon, Bhargav Appasan and Bharati Ainapure
- **5th International Workshop on Technology and Materials Engineering - IWTME' 2025,** Organizers: Adriana-Gabriela Șchiopu and Mohammed Sallah
- **The 14th Ro-Fr Workshop on Automotive:**
- **Advanced techniques to increase the autonomy of the plug-in electric vehicles - AT2APEV** with technical sponsorship of the IEEE Romanian section and IAS Ro&Fr

Chapters; Organizer: Nicu Bizon.

- **International Workshop "Trends and Opportunities in Engineering Career" IWTOEC' 2025,** Organizers: Departament of Teacher's training by Adriana-Gabriela Șchiopu, Mihai Oproescu and Ionut Bulgaru
- **2025 International Workshop on Future Energy Market Based on Advanced Computing and Communication Technologies for Smart Grids (TechEnergy Market) ,** Organizers: Nicu Bizon and Florentina Magda Enescu
- **2025 International Workshop on Artificial Intelligence of Things for Efficient Energy Generation and Management (AI-Energy),** Organizers: Nicu Bizon , Bhargav Appasani and Florentina Magda Enescu
- **2025 International Workshop on Advanced Medical Imaging Techniques using Generative Artificial Intelligence (AI-Medical),** Organizers: Nicu Bizon and Bhargav Appasani
- **2025 International Workshop on Emerging Technologies for Future Smart Grids (TechSmartGrid),** Organizers: Nicu Bizon and Bhargav Appasani
- **2025 International Workshop on Modeling, control and optimization methods in engineering-MCOME'25,** Organizers: Mihai Oproescu and Luminita Mirela Constantinescu
- **2025 International Workshop on IoT, Energy Internet, Blockchain Technology and Smart Contracts-IoT'25,** Organizers: Nicu Bizon, Bhargav Appasani and Florentina Magda Enescu
- **2025 International Workshop on Hybrid power systems and migrogrids-HPS&Mg'25,** Organizers: Nicu Bizon and Mihai Oproescu
- **2025 International Workshop on Hydrogen and fuel cell applications-HyFC'25,** Organizers: Nicu Bizon and Mircea Raceanu
- **2025 International Workshop on Electric and hybrid vehicles-EHV'25,** Organizers: Nicu Bizon and Mihai Oproescu
- **2025 International Workshop on Embedded Systems-EmbSy'25,** Organizers: Laurentiu. Ionescu and Alin-Gheorghita Mazare
- **2025 Special Session on Artificial Intelligence and Embedded Systems for Next-Generation Energy Conversion,** Organizers: Mourad Yessef and Hatim Ameziane

E-session information

The e-session sections of the ECAI 2024 Conference take place through the TEAMS platform. The time of the sections is Romanian time: https://www.thetimenow.com/romania

Don’t miss out on what promises to be an engaging and dynamic event. We are looking forward to seeing you in Iasi, at **“Valahia” University of Targoviste**, during the conference days. If you have any questions, please do not hesitate to contact the organizers at office@ecai.ro.

June 06, 2025

Pitesti

Mihai Oproescu
Gabriela Schiopu
Vlad-Ionut Oproescu

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Book of Abstracts
17th International Conference on ELECTRONICS, COMPUTERS and ARTIFICIAL INTELLIGENCE – ECAI-2025

The Role of Technology in Mediating and Moderating the Relationship between Academic Pressure and Mental Health

Irugu Chandana and Thaya Madhavi

Keywords: *Academic Pressure, Mental Health, Technology, Mediation, Moderation*

Abstract: Students' mental health issues are significantly influenced by academic pressure. This study investigates the dual function of technology as a moderator and mediator in the connection between students' mental health and academic stress. This study uses SPSS for both mediation and moderation analysis, based on data from 384 students. The results show a strong positive correlation between mental health problems and academic pressure, with technology acting as a partly mediating factor. Technology does not, however, have a significant moderating influence on this relationship. The study also identifies harmful and protective technical factors that affect this dynamic. The findings imply that although technology can improve coping strategies, excessive usage of it may make psychological stress worse. Based on the results, this study provides educators, legislators, and mental health specialists with practical insights that highlight the benefits and drawbacks of integrating technology in the classroom and direct the development of instructional strategies that promote student academic achievement and mental health.

Smart elections: Can artificial intelligence influence voter behavior?

Andra Nicoleta Puran and Andreea Elena Tabacu

Keywords*: electoral process, AI, right to vote, voters decision, electoral campaign*

Abstract: Traditional electoral systems have been adapted to the rapid evolution of new technologies, trying to find solutions for the various problems that have arisen in the electoral process. From the use of electronic voting to combat political absenteeism to the use of AI in the electoral campaign, recent advances in the field of artificial intelligence have an unprecedented impact on the electoral process, both positively, through multiple benefits, and negatively, through the possibility of being misused and violating fundamental rights. The ability of artificial intelligence systems to launch cyber attacks and produce deepfakes, thus leading to disinformation of the population, can negatively affect democratic electoral processes. So we do not hesitate to ask ourselves, as in any other field, what are the costs of using artificial intelligence in the electoral process? Is the electorate prepared to validly express its right to vote in the current situation of multiple sources of information? Romania, like other countries, recently experienced this negative experience, during the presidential elections of November 24, 2024, when artificial intelligence was used abusively, which led to the manipulation of the electorate and election fraud by violating freedom of expression, the right to vote, but also the principle of equality regarding the right to be elected.

The Evolution of Blockchain Security and Examining Machine Learning's Impact on Ethereum Fraud Detection

Gopichand Bandarupalli

Keywords: *Blockchain, Ethereum, Fraud Detection, Machine Learning*

Abstract: Blockchain innovation, best embodied by Ethereum, has revolutionized online transactions by making them more transparent and secure. However, the demand for more sophisticated fraudulent schemes increases with wider adoption, calling for more sophisticated fraud detection methods. Therefore, this paper contributes to the area of blockchain security by providing insights to regulators and stakeholders in Ethereum through an analysis of the Machine Learning (ML) models. We compare traditional approaches like logistic regression and decision trees with more advanced techniques like neural networks and ensemble methods. The performance of the model is measured using accuracy, precision, recall, and the ROC curve. The best accuracy of 0.98 is achieved by the optimized XGBoost framework.

End-to-End Spoken Language Recognition using Self-Attention Speech Models

H.Hakan Kilinc, Hasan Kilimci and Zeynep Hilal Kilimci

Keywords: *language recognition, transformers, HuBERT, Wav2Vec2, WavLM*

Abstract: Spoken language recognition (SLR) is a pivotal challenge in speech processing, serving a variety of practical applications such as cross-lingual communication platforms, speech-based authentication systems, and real-time transcription that adapts to multiple languages. This study evaluates the effectiveness of self-attention-driven transformer models in automatically identifying spoken languages, with a particular emphasis on five distinct languages: German, Turkish, French, Spanish, and English. To build a diverse and representative dataset, speech samples are systematically gathered from YouTube using API integration. This approach ensures a broad range of speakers, accents, and environmental conditions, enriching the model training process. The collected data undergo essential preprocessing steps, including noise reduction and normalization, to improve audio quality and standardize input. These refined datasets are used to train and assess the performance of several advanced transformer-based models, including HuBERT, Wav2Vec2, and WavLM, along with their specific variants. The experimental results reveal that HuBERT leads with an accuracy of 99.30%, achieving near-perfect results. These outcomes emphasize the efficacy of transformer-based architectures in distinguishing between linguistically diverse languages. Furthermore, the findings point to the substantial potential of these models in real-world multilingual applications, where precise and effective spoken language recognition is essential for seamless interaction with automated systems.

Automated Washroom and Monitoring System: IoT- Driven Hygiene Management for University Facilities

Sukhman Singh, Robin Kumar and Gourav Rana

Keywords*: IoT, Machine learning, Washroom hygiene, Real-time monitoring, Predictive ML model*

Abstract: For university washrooms which have high occupancy and smell surges—especially in post-class hours with peaks ranging from 25 to 35 users hourly and air quality dropping from 300 to 700 ppm—cause serious hygiene issues. The Automated Washroom and Monitoring System provides an IoT-based system combining two ESP8266 microcontrollers with HCSR04 ultrasonic sensors for occupancy tracking, DHT11 for humidity, and MQ-135 for air quality monitoring. A 5V relay manages ventilation and Firebase records real-time data and a Django dashboard offers administrative insights that show the real-time sensor data in the form of current ppm, current occupancy, and average ppm today and Twilio sends SMS warnings to maintenance staff. a bi-daily random forest model with 85% accuracy estimates cleaning requirements. Applied in a four-week pilot at Lovely Professional University, the approach validated by fifty user surveys (p = 0.03) dropped sanitary concerns by thirty%. This scalable system increases user comfort and operational efficiency around ₹1600. By addressing dynamic use patterns, it meets with India's Swachh Bharat aim and thereby sets a benchmark for smart hygienic management in public and educational facilities. Future advancements will include multi-washroom scalability and advanced prediction models integrating deep learning to boost accuracy and adaptability even more.

A Hybrid Technique based on Fusion of Bat Algorithm (BA) - Grey Wolf Optimizer (GWO) - Deep CNN for Classification of Military Ground Vehicles in SAR Aerial Imagery

Liviu Rujan and Victor-Emil Neagoe

Keywords: *Bat Algorithm (BA), Grey Wolf Optimizer (GWO), Deep CNN, Automatic Target Recognition (ATR), Synthetic Aperture Radar (SAR), Moving and Stationary Target Acquisition and Recognition, (MSTAR)*

Abstract: This paper proposes a novel hybrid classification model obtained by fusion of two Swarm Intelligence techniques (Bat Algorithms (BA) and Grey Wolf Optimizer (GWO)) with a Deep Convolutional Neural Network (CNN). The proposed method is applied for Automatic Target Recognition (ATR) to classify military ground vehicles in SAR Aerial Imagery. We have evaluated the performances of the model, using MSTAR (Moving and Stationary Target Acquisition) dataset and choosing a Residual Neural Network (ResNet) as CNN classifier to be combined with BA and GWO. One obtains an accuracy of 91.60% using the proposed fusion of BA-GWO-ResNet by comparison with an accuracy of only 83.4%, obtained when one uses a standalone ResNet. We point out that the presented classification algorithm does not require a processing phase for object detection.

Development of a Methodology for Evaluating the Stress and Strain Fields in the Elastic Domain through Finite Element Modeling of a Non-Standard Mechanical Loading Test

Denisa Toma, Nicu Bizon, Alexandru Nitu, Vasile Radu, Alexandru Toma, Alexandra Jinga, Viorel Ionescu, Larisa Popescu and Sebastian Dragusin

Keywords: *generation IV, LFR, fuel elements, thin-walled tubes, Zircaloy-4, finite element modeling, thermomechanical stress*

Abstract: The thin tubes used for cladding fuel elements in Generation IV liquid lead-cooled reactors (LFRs) are currently in the preliminary research stage; the nature of the material, the thermomechanical stress conditions, and the material parameters are still unknown. However, efforts are being made to predict their behavior under appropriate mechanical stresses, most often using the finite element method. In the concrete lack of Generation IV materials, studies currently consider the materials and structural components of existing reactors, the exercise is useful in establishing a test matrix, test conditions, methodologies for evaluating material properties, and behavior of future tubes for Generation IV molten lead-cooled fuel elements. In this regard, modeling with the ANSYS code of non-standardized mechanical tests performed on thin-walled tubes used in fuel elements is a solution to study the behavior of the material. This modeling of non-standardized mechanical tests is a first in scientific studies in Romania, being necessary in preparing the analyses on the fuel element claddings of generation IV reactors, when they will be available in the Pitești Nuclear Research Institute. In the future, the fuel elements that will be used in the ALFRED demonstrator (Advanced Lead Fast Reactor European Demonstrator) will be considered. In this paper, a presentation is made of the modeling stages with the ANSYS code of the behavior of thin tubes in non-standardized Ring Tensile Test (RTT) type tests, having as material the Zircaloy-4 (Zy-4) alloy used in the CANDU (CANadian Deuterium Uranium) fuel element. Also, the results of the simulations obtained from the finite element modeling of RTT-type samples with the properties of the Zy-4 material regarding the stress and strain field are presented.

Global Path Planning for UAVs Using a Simplified Visibility Graph with Obstacle Merging

Dang Khoa Do and Minh Hieu Tran Van

Keywords*: Unmanned Aerial Vehicles, Global Path Planning, Visibility Graph, Obstacle Avoidance.*

Abstract: Efficient path planning is essential for Unmanned Aerial Vehicles (UAVs) to navigate complex environments while avoiding obstacles. This paper presents a novel global path planning algorithm that integrates a simplified visibility graph (VG) method with the Dijkstra algorithm to enhance computational efficiency and adaptability. Unlike traditional polygon-based approaches, the proposed method models obstacles as rectangles with safety buffer, reducing graph node complexity. The algorithm optimizes the graph by considering only obstacles intersected by the M-Line connecting start and goal points, minimizing unnecessary computations. A smart obstacle merging strategy ensures path existence by addressing narrow gaps between adjacent obstacles and accounting for UAV size and sensor noise-induced position errors. Simulation results show that the proposed method outperforms the traditional VG approaches as well as another popular global path planning algorithm, the Rapidly exploring Random Tree Connect (RRT-Connect), achieving shorter paths and faster computation time. These advantages make the proposed algorithm well-suited for real-time UAV navigation in obstacle-rich environments.

Multi-Version YOLO-Based Inventory Detection for Automated Facility Management

Elif Seray Bilgin and Zeynep Hilal Kilimci

Keywords: *Deep learning, Object detection, Inventory management, Facility management, YOLO*

Abstract: Effective inventory tracking plays a crucial role in facility management by optimizing resource allocation, reducing operational costs, and minimizing manual effort. This study conducts a comparative analysis of multiple YOLO-based deep learning models—YOLOv8, YOLOv9, YOLOv11, and YOLOv12—for office inventory detection and quantification. The primary objective is to assess the performance of these models in accurately identifying and counting office supplies from image data. Since standard YOLO architectures do not include predefined categories for office inventory, a custom dataset is developed. A total of 10,000 images of common office inventory items are gathered through web crawling, and 2,000 images are manually annotated using Roboflow to facilitate model training. The dataset comprises 14 distinct office inventory classes, ensuring a broad representation of essential items. Each YOLO version is evaluated based on detection accuracy, processing speed, and computational efficiency. Comparative experimental results reveal the strengths and limitations of each model, highlighting the trade-offs between precision and inference time. The findings provide valuable insights into the most suitable YOLO architecture for real-world facility management applications, contributing to the advancement of automated inventory tracking systems.

XIMR-Net: A Robust Deep Learning Model for Automated Lemon Leaf Disease Classification

Isha Das, Amit Saha, Md. Abdulla-Hil-Kafi, Md. Minhajul Hayat Mim, Chinmoy Bhowmik Utsha, Chonchal Khan and Md. Alif Sheakh

Keywords: *Lemon leaf disease, classification, Ensemble learning, Transfer learning, Preprocessing*

Abstract: Lemon leaf diseases threaten global citrus production, causing significant economic and agricultural losses. While deep learning offers solutions, existing models often lack robustness under real-world conditions like variable lighting and disease severity. This study introduces XIMR-Net, an ensemble deep learning framework that synergizes transfer learning and multi-model fusion to achieve unprecedented accuracy in lemon leaf disease classification. Our methodology begins with rigorous preprocessing: resizing images, normalization, and Contrast Limited Adaptive Histogram Equalization, which improves image quality, as validated by the Peak Signal-to-Noise Ratio. We evaluated ten state-of-the-art CNN architectures known as the transfer learning model. The four main models (InceptionV3, Xception, ResNet101V2, MobileNetV2), each exceeding the accuracy 94%, were integrated using weighted averages in XIMR-Net. Hyperparameter optimization, including focal loss and advanced data augmentation, enhanced precision and recall by over 75% for individual models. XIMR-Net achieved 99.28% accuracy, 98.99% precision, 99.07% recall, and 98.99% F1 score outperforming both standalone models and existing ensemble approaches. Five fold cross-validation confirmed robustness, while confusion matrices revealed near-perfect classification across nine disease categories. By addressing critical gaps in scalability and field adaptability, XIMR-Net provides a deployable tool for precision agriculture, compatible with mobile-based monitoring systems. This work advances AI-driven disease management, offering farmers a reliable, early detection solution to mitigate crop losses and promote sustainable practices.

Hydrogen-Oriented Cost-Aware Dispatch Modeling Of RES-Coupling Systems Under Stepped Carbon Trading Constraints

Hossein Shayeghi, Babak Mohamadi, Peman Zare and Nicu Bizon

Keywords: *Stepped Carbon Trading Constraints, Carbon Emission Reduction, Dispatch Optimization, Real-Time Pricing, Wind-Hydrogen Joint System*

Abstract: Harnessing wind power for hydrogen production enables a carbon-free energy conversion pathway, offering a key solution for advancing China's low-carbon energy transition. This study presents an optimal dispatch strategy for a wind-hydrogen joint system (WHJS) under a stepped carbon trading constraints. Initially, the WHJS model is constructed, incorporating real-time electricity price fluctuations derived from load and price forecasting. A stepped carbon trading framework is then introduced to guide emission limitations within the market-based regulatory environment. Based on this model, an optimization strategy is developed to minimize total system operating costs. The proposed strategy is constructed as a linear programming and solved in Python using CBC. Simulation results demonstrate that, in comparison to the conventional carbon penalty mechanism, the proposed approach reduces system-wide carbon emissions by 1456.98 kg-equivalent to a 27.5% decreasing- highlighting its effectiveness in promoting both economic and environmental performance.

Designing a Smart Device for Personal Assistance based on Artificial Intelligence

Constantin-Valentin Dănescu, Florentina Magda Enescu, Nicu Bizon, Ștefania-Alexandra Sebe and Mihai Selea

Keywords*: smart device, health monitoring, personal safety, artificial intelligence, facial recognition, voice assistance, machine learning, security and privacy, environmental analysis*

Abstract: This project proposes a smart watch that combines health monitoring and personal safety using artificial intelligence. The device features facial recognition, voice assistance, and two cameras that analyze the environment to detect dangers, such as suspicious individuals or emergencies, automatically calling emergency services and sending the user's location. Sensors track heart rate, blood oxygen levels, and stress, while advanced algorithms can anticipate medical issues and better recognize risk situations. Data is protected through encryption and local storage, providing a complete solution for safety and health.

Intersection of pre-trained deep model and Vision Transformer for face spoof detection

Bharti Thakur, Arvind Selwal and Ambreen Sabha

Keywords*: Face recognition, Spoof attacks, Anti-spoofing techniques, Deep Convolutional Neural Network, Vision Transformer*

Abstract: The face recognition systems are the most widely deployed biometric infrastructure for secured human authentication. However, these systems are vulnerable to a variety of spoof attacks, where assaulters utilize artificially created fake replicas of the human face. To mitigate these attacks, a variety of face anti-spoofing mechanisms are used, where generalization and accuracy of these algorithms are crucial performance protocols. In this research work, we expound an efficient and accurate face anti-spoofing model (i.e. HyFaNet) that integrates feature maps of a pre-trained model with Vision Transformer (ViT). The proposed face anti-spoofing model exploits the potency of the pre-trained model to generate face feature maps and global-level singularities are explored via ViT to yield a robust model. The HyFaNet is trained and evaluated on a benchmark face anti-spoofing dataset and it demonstrates a remarkable performance under unseen scenario with an EER of 0.83%. Moreover, the model exhibits a comparable performance with state-of-the-art (SOTA) face liveness detection methods.

Smart over-temperature protection connector for DC electrical circuits

Emanuel-Valentin Buică, Andrei Militaru, Horia Leonard Andrei, Isabela Elena Bănescu, Liviu Olteanu and Mihăiță Nicolae Ardeleanu

Keywords*: smart connector, microcontroller, NTC sensor, I2C communication, UART communication, MOSFET*

Abstract: The operating temperature of the DC circuits is a very important parameter in terms of their reliability. Temperature increases due to the ambient environment, imperfect connections or imperfect functioning of some DC circuit elements can cause serious destruction and damage. This paper presents an advanced smart device designed for over-temperature protection in DC electrical circuits. Equipped with a microcontroller and Negative Temperature Coefficient sensors, the device monitors temperature, using Inter-Integrated Circuit or Universal Asynchronous Receiver / Transmitter Communication during the experimental phase. Once a specific temperature threshold is reached, using MOSFET transistors the device controls the load by switching it on-off. The experiments involve exposure to high currents over extended periods of time and rapid current variation, highlighting the sensor's precision and the efficacy of the protection mechanism.

Novel Integral Continuous Sliding Mode Control Design for Robust Speed Regulation of PMS Motors

El-Houssine Bekkour, Zakariae Sakhri, Badre Bossoufi, Youness El Mourabit and Safae Merzouk

Keywords: *PMSM, Integral Sliding Mode Control, exponential reaching law, saturation function, disturbance rejection, robust control*

Abstract: This paper presents a novel integral continuous sliding mode control (ICSMC) strategy designed to enhance the dynamic performance of speed servo systems in permanent magnet synchronous motors (PMSM) while effectively mitigating external disturbances. The proposed controller incorporates an integral sliding surface structure that successfully eliminates steady-state error and maintains robust system stability under varying operating conditions. To address the fundamental trade-off between rapid convergence and chattering suppression inherent in conventional sliding mode controllers, we develop an innovative reaching law featuring a high-slope saturation function that seamlessly replaces the traditional discontinuous sign function. Rigorous stability analysis based on Lyapunov theory demonstrates that the closed-loop system maintains global stability, while mathematical proof confirms finite-time convergence of tracking error to zero. The superiority of the proposed ICSMC methodology over conventional control techniques is validated through comprehensive numerical simulations implemented in MATLAB environment, demonstrating significant improvements in terms of response time, steady-state error elimination, and robustness against external disturbances.

A STUDY ON EFFECTIVENESS OF TECHNOLOGICAL ADVANCEMENTS ON HUMAN RESOURSE PRACTICES IN SELECTED IT FIRMS

Gollapalli Vasundhara and Thaya Madhavi

Keywords*: Technological Advancements, Human Resource Management, Training and Development, HRM Challenges, IT Firms, Digital Transformation in HR*

Abstract: Technological advancements have significantly transformed Human Resource Management (HRM) practices, particularly in IT firms, by enhancing efficiency and streamlining operations. This study focuses on analyzing the impact of technology on HR functions such as training and development and recruitment, assessing how digital tools improve HR processes and decision-making. With the increasing adoption of artificial intelligence, automation, and HR analytics, organizations can optimize talent acquisition and employee development strategies. The research also examines employee perceptions of technology adoption in HRM and its impact on job satisfaction and productivity. Understanding these perceptions is crucial for organizations to ensure a smooth transition to digital HRM and enhance employee engagement. While technology offers numerous benefits, resistance to change and lack of digital literacy can affect its effectiveness. Furthermore, the study identifies key challenges faced by HR professionals in integrating advanced technologies into HR practices, such as data privacy concerns, implementation costs, and adaptability issues. By analyzing primary data from selected IT firms, this research provides valuable insights and strategic recommendations to improve the effectiveness of technology-driven HRM, ensuring a balance between innovation and human-centric HR practices

Innovations in Energy Sustainability: An Ecological Approach to Refrigeration

Adriana-Andrada Ciorobea, Florentina Magda Enescu, Nicu Bizon, Sebastian-Alexandru Dragusin, Diana-Ioana Popa, Iulia-Mariana Manuca, George-Razvan Manuca, Arthur Negosanu and Andrei-Alexandru Besliu-Gherghescu

Keywords*: sustainability, energy efficiency, recyclable materials, magnetic refrigeration technologies, smart solutions*

Abstract: This paper addresses the pressing ecological and technological challenges associated with conventional refrigeration systems by proposing an integrated, sustainable approach centered on magnetic refrigeration. The study identifies key issues such as high energy consumption, the use of harmful refrigerants, and inefficient end-of-life practices. The research aims to develop an innovative solution that combines eco-design principles, recyclable materials, and circular economy strategies to enhance sustainability across the product life cycle. The originality of this work lies in the experimental implementation and comparative evaluation of a magnetic refrigeration system versus a traditional compression-based refrigerator. Results demonstrate significant improvements in energy efficiency (up to 40%), noise reduction, and material recyclability. The study concludes that magnetic refrigeration represents a viable and environmentally responsible alternative for future cooling technologies, with broad applicability in residential and commercial appliances.

Internal Model Control for Efficient Power and Current Management in Grid-Tied VSIs

Ersan Kabalcı and Volker Staudt

Keywords: *Internal Model-Based Control (IMC), grid-tied inverter, power quality, current control, total harmonic distortion (THD).*

Abstract: Grid-connected inverters are evaluated under operational challenges such as grid disturbances, nonlinearities, and parameter variations. This paper investigates the Internal Model Control (IMC) principle for inverter control in renewable energy integration, microgrids, and smart grids. A literature review that is followed by a detailed analysis on mathematical base of IMC examines existing control strategies and their limitations. The study highlights the robustness of IMC in managing system uncertainties and disturbances by highlighting its advantages over conventional control methods. Mitigation strategies including advanced filtering and adaptive control are discussed. To validate the proposed IMC-based control strategy, simulations assess its performance under different grid conditions. Results confirm the ability of IMC to enhance stability, reduce harmonic distortion, and improve dynamic response. The study also explores future advancements, focusing on weak grid environments and optimized filter topologies to improve power quality. Outcomes contribute to developing more resilient and adaptive inverter control strategies for modern energy systems that reinforce the role of IMC in ensuring stable and efficient grid integration.

Smart City and the Transports

Amelia-Veronica Gheoculescu

Keywords: *Transport, smart city, sustainable development, digitalization*

Abstract: Transport deeply influences the quality of life. In an increasingly urbanized and connected world, modernizing transport is essential for a sustainable and equitable future. Smart cities integrate technology into urban life, and transport becomes a connected, digitalized and automated system. This transformation raises new legal issues, which require modern regulations to ensure the safety of citizens, respect for fundamental rights, and the correct and legal functioning of technologies used in transport. Smart transport plays an essential role in the development of smart cities, contributing to the efficiency, sustainability and accessibility of urban mobility. By using digital technologies, sensors, artificial intelligence and real-time data, transport systems optimize traffic, reduce congestion and minimize pollution. Electric vehicles, autonomous transport and shared mobility solutions improve the experience of citizens, offering fast and environmentally friendly alternatives. The integration of digitalized public transport facilitates access and travel planning. These solutions contribute to the quality of life, a healthier environment and increased urban efficiency. A smart city cannot function without a modern and connected transportation system, adapted to the needs of society.

Secure Embedding of Sensitive Identity Data in Surveillance Videos using Steganography

Miruna-Mihaela Modiga, Stefania Loredana Nita and Stefan-Ciprian Arseni

Keywords: *Video steganography, video metadata protection, DCT-based embedding*

Abstract: As more and more surveillance systems integrate biometric recognition and real-time tracking, the secure handling of sensitive identity metadata has become essential for ensuring privacy, regulatory compliance, and data integrity. Conventional approaches rely on external logs or visible overlays to associate metadata with video, but these methods come with significant challenges, such as tampering, loss of synchronization, and privacy violations. Advances in steganography have enabled robust techniques for concealing information within multimedia, particularly in video, which offers high capacity, temporal redundancy, and resilience to detection. Transform-domain methods like Discrete Cosine Transform (DCT) embedding are suitable for video streams due to their compatibility with compression standards and resistance to distortion. In this paper, we propose a real-time system for securely embedding facial identity metadata directly into surveillance video frames using a DCT-based steganographic method. The architecture integrates face detection and tracking with parallelized embedding and lossless encoding, enabling invisible and codec-resilient metadata insertion. This approach ensures that sensitive information remains tightly bound to the video stream while maintaining imperceptibility and playback compatibility.

Study on the Development of an Application for Ultrasonic Microscanning of Metal Samples in Demineralized Water

Popescu Larisa, Bizon Nicu, Radu Vasile, Nitu Alexandru Ionut, Toma Denisa, Ionescu Viorel and Jinga Alexandra

***Keywords**: microscanning, ultrasound, Olympus flaw detector, automation, CANDU reactor*

Abstract: The management of the operating time of a nuclear power plant, the estimation and prediction of the operating period of structural components, between two periodic inspections, occupies a central place, both in the exploitation activity and in the research and development activity that provides technical support to this field. For nuclear power reactors, the operating conditions specific to the active zone assume high temperatures and mechanical stress states, but also a corrosive environment and a strong radiation field. In this field, nuclear components must operate under conditions of maximum safety and nuclear security. Thus, for CANDU reactors in the Romanian nuclear power industry, maintaining the structural integrity of the pressure tubes, throughout the entire designed lifetime, represents one of the main factors in ensuring efficient exploitation under conditions of maximum security. One of the experimental means that can be used for the non-destructive investigation of materials is ultrasound and ultrasonic examination of materials is one of the most preferred non-destructive techniques. The technique being volumetric, through ultrasonic examination, inhomogeneities and discontinuities in the volume of the material can be highlighted and evaluated. This paper studies the possibility of creating an experimental laboratory system intended for the non-destructive examination of structural materials of nuclear interest (zirconium alloys) by ultrasonic beam microscanning in automatic mode.

Digital versus Traditional Instruments in the Practice of Legal Professions: An Overview of the Lawyer and Public Notary Professions

Lavinia-Mihaela Vlădilă, Ilioara Genoiu, Manuela-Luminița Niță and Olivian Mastacan

Keywords: *digital and artificial instruments, legal professions, lawyer, electronic register used in advocacy, public notary, notary activity, notary registers*

Abstract: This article aims to highlight the latest developments in legal professions regarding the integration of digital and artificial instruments, in contrast with traditional, analogue instruments. Among the multitude of legal professions, the roles of lawyer and notary are particularly significant. Despite their deep-rooted connection with the people, defending their rights and aiding them through complex situations, these "liberal" professions are fundamentally interrelated with public aspects of social and economic life. Both professions fulfil essential public functions that underpin the current structure of society. Their liberal nature does not stem solely from progressivism but from the autonomy they offer practitioners and the intelligent application of legal frameworks within a solidly regulated context. These are professions that are simultaneously innovative and traditional, as they are unified by law, legal norms, and regulation, which constitute the foundation of the manifested universe. Thus, what is the future? Can these professions fully embrace technological advancements? And if so, to what extent ? Assuming that both professions are inherently tied to human, social, relational, political, and economic needs, we express the hope that the integration of new technologies will occur without dehumanizing the legal act, whether notary and lawyers or in nature.

Toward Efficient Energy Management in Electric and Hybrid Vehicles: Progress, Prospects and Emerging Trends of Hybrid Storage Systems

Jouhayna Bouanani, Mourad Yessef and Ahmed Lagrioui

Keywords: *Microgrid (MG), Hybrid Energy Storage Systems (HESSs), Battery Lithium-ion (LiB), Supercapacitor (SC), HESS Topologies, PV*

Abstract: Transition to sustainable mobility could include advanced and reliable solutions for storing energy to cover the fundamental issues related to electric and hybrid vehicles. The problem in such vehicles remains limited energy issues of capacity, power delivery, and battery degradation. Battery energy storage systems (BESS) remain the specific but expensive component in such vehicles. Also, extreme temperatures and high dynamic loads may disturb the battery's chemistry, resulting in irreparable damage, shorter life-cycle, and high overall cost. This paper introduces dual-level HESS with Lithium batteries, supercapacitors, and photovoltaic sources. Fully active design is considered to improve energy management and overall performance. These early gains in efficiency, through to the present, have shown the positive benefits of this source with smoother power delivery, extended battery life, and better efficiency. The integration of microgrid (MG) technologies further enables coordinated control of distributed energy and storage units, ensuring real-time power balancing and scalability. Further analysis is conducted on multi-source HESS setups within new technologies, like fuel cells and flywheels, to see how they measure up and lock in even more gains.

Development of an electronic simulator for relay interlocking (ESRI)

Florin Badau, Valentin Iordache, Angel Ciprian Cormos and Valentin Alexandru Stan

Keywords*: railway, interlocking, relay interlocking, simulator, LabVIEW*

Abstract: Railway interlockings represent the systems on which the safety of all people using the railways depends on. Legacy systems, especially relay based interlockings, persist on the railway network and are foreseen to remain in operation in the long term. This paper presents the development of an electronic simulator of relay interlocking designed to be used for the training of future engineers. The system reproduces the functions of a typical Romanian relay interlocking. The simulation software was developed in LabVIEW, while hardware development involved the design of special interfaces with a traditional mosaic control panel and a scale railway model.

Reference-Based Detection and Classification of Printed Circuit Boards Defects Using Deep Learning and Image Processing Techniques

Andreea-Daniela Savu, Nicu Bizon and Sebastian-Alexandru Dragusin

Keywords: *printed circuit boards, defect detection, reference image comparison, deep learning, convolutional neural networks, automated optical inspection, computer vision, image preprocessing, predictive modeling*

Abstract: Printed Circuit Boards (PCBs) are essential components in modern electronic assemblies, where even minor defects can lead to significant performance degradation or total system failure. This paper presents a novel, automated framework for defect detection and classification in PCBs, based on a reference comparison approach integrated with deep learning techniques. The methodology involves aligning each test PCB image with a defect-free reference, performing image pre-processing to highlight discrepancies, and applying a YOLO-based convolutional neural network for defect localization and categorization. The model is trained to identify various defect types, such as missing holes, spurs, open circuits, and short circuits, by learning from annotated visual patterns. Preprocessing steps include grayscale transformation, morphological operations, image differencing, and bounding box annotation for supervised training. Experimental results demonstrate the system's high detection accuracy and robustness across multiple defect classes, confirming its potential for real-time application in industrial quality control processes.

Implementation of artificial intelligence in a PC-based application for controlling a solar system

Georgi Mihalev

Keywords: *PC based control systems, Artificial intelligence, RAD application, GPT, PV solar system, intelligent control, autonomous optimization*

Abstract: The paper presents a PC-based system for control and monitoring of a PV solar system. An architecture based on the AI principle in the control loop is proposed. The developed AI system is designed to improve the use of control efficiency by adapting the parameters, as well as providing new optimization opportunities. These functionalities are included in the developed software, and a detailed description is provided. The system is tested by implementing communication between a RAD application and a simulation model in a MATLAB/Simulink environment. The simulation model includes an expanded set of subsystems in order to study the dependencies and influence of each of them. The simulation results show that the combination of a GPT model for dynamic determination of the controller parameters leads to better stabilization of the PV power and the overall system performance under dynamic changes in solar radiation, achieving an efficiency of 98.12%. The development and research confirm the potential of reproducible AI for intelligent management of renewable energy sources, offering guidelines for future improvements in industrial automation and energy systems, by upgrading to self-aware intelligent control systems.

Contributions regarding the use of unmanned ground robots for radiation measurements

Carmen Silvia Oprina, Ciprian Racuciu and Lucian Stefanita Grigore

Keywords: *robot, radiation, kinematics, dynamics, simulation*

Abstract: In this paper we describe the development of a terrestrial robotic system that uses specialized sensors to create a map of the radiation intensity in the environment, predominantly in buildings or underground - salt mines. The data collected by the sensors are used to calculate the radiation intensity. A control system involves moving the robot along the contours of constant intensity. The purpose of this paper is to highlight the kinematic and dynamic characteristics of the terrestrial robot on wheels. Potential beneficiaries of the research are Research groups, in particular those in radiation physics, high energies, seismology, with needs to secure the information transmitted from the governmental, industrial and commercial areas.

Model Predictive Direct Power Control with Selected Switching State Table for 3L-NPC Rectifier

Nguyen Hoang Viet, Pham Duc Dai and Hoang Khac Nhiem

Keywords: *active rectifier, 3L-NPC rectifier, model predictive direct power control, selected switching state table, weighting factor*

Abstract: The classical model predictive direct power control (MPDPC) structure for 3L-NPC rectifier requires selecting the weighting factor of the cost function weights for the capacitor voltage balance problem. This selection usually only ensures the system operates well at some specific operating points. However, when the operating point changes, the performance of the MPDPC structure is no longer good and may even lead to system instability. The paper proposes a control structure, model predictive direct power with selected switching state table (MPDPCST) for the 3L-NPC rectifier. The selected switching state table is built based on the operating principle of the 3L-NPC rectifier. The switching states used in the predictive model will be pre-selected through this selection table. Besides eliminating the weighting factor selection, the proposed control structure also reduces the computational burden of the predictive control algorithm. Simulation results show that the MPDPCST structure is capable of maintaining good performance even when the operating points change significantly.

Brain Tumor Prediction using Hybrid Deep Learning Features

Istabraq Jassim, Zakariya Oraibi and Alaa Alsafar

Keywords: *Brain Tumors, Deep Features, EfficientNet, MobileNet*

Abstract: The effective treatment of brain tumors can be accelerated by the early detection of the disease. Machine learning techniques can be used to provide an accurate diagnoses with minimal prediction error. Instead of using traditional techniques like hand-crafted features, in recent years, deep learning models proved to be successful in generating reliable classification results offering automated solutions thereby revolutionizing medical image analysis. In this paper, we propose a framework of combining multiple deep features extracted from two efficient Convolutional Neural Networks (CNNs): EfficientNet and MobileNet and combined to form a robust neural network. This network achieved high classification accuracy by utilizing the efficient features extracted from the two networks. To evaluate the new network, we applied the framework on a brain tumor dataset with two classes. Augmentation techniques were used to increase the number of images per class during training. The accuracy of the new model for detecting brain tumor cases is 98.04\%. This accuracy is better than using features extracted from a single network.

Dynamic Battery Storage Sizing for Solar Smart Grids: A Machine Learning Framework for Seasonal Demand Adaptation

Md Nafeez Rahman, Md Maidul Islam, Viacheslav Vavilov, Md. Siddikur Rahman, Jai Govind Singh and Roman Rinatovich Akhtyamov

Keywords: *Machine learning, Battery energy storage system, State of charge prediction, Random forest, Smart grid, Solar energy optimization*

Abstract: The integration of renewable energy into smart grids requires intelligent battery storage systems that can adapt to fluctuating loads and intermittent generation. This paper presents a machine learning-based approach for predicting battery's state-of-charge (SoC) and optimizing storage capacity in solar-powered smart grids. A random forest regressor (RFR) is trained on time-series data, including energy load, time, and previous load features, to forecast SoC with higher accuracy. The model achieved a mean absolute error (MAE) of 8.31% and a mean squared error (MSE) of 106.40, demonstrating its effectiveness in SoC estimation. These predictions are used to determine optimal battery capacities for different seasonal demands using a storage capacity of 233 kWh is sufficient for summer, while 200 kWh meets requirements. This dynamic sizing approach helps avoid battery oversizing and under utilization, improving reliability and suggests potential cost-efficiency under idealized conditions. The proposed system supports real-time adaptability and outperforms traditional rule-based energy management strategies. Overall, this study highlights the potential of integrating machine learning with smart grid infrastructure to enhance operational efficiency and enable more sustainable and intelligent energy storage solutions.

A Hybrid Framework for Domain-Specific Knowledge Integration in Large Language Models: A Comprehensive Survey

Jerrick Godwin and Banuka Athuraliya

Keywords: *Large Language Models, Retrieval Augmented Generation, Fine-tuning*

Abstract: In recent years, Large Language Models (LLMs) have excelled in different domains to an expert's level by training them on downstream tasks. However, re-training them on tasks where the information is constantly being updated can be computationally expensive and incurs additional costs and time. To address this problem, end-task knowledge is added through common techniques, such as Retrieval Augmented Generation (RAG) and Fine-tuning with Parameter Efficient Fine Tuning (PEFT). This paper critically examines the existing solutions and methodologies to address such limitations. In particular, challenges including hallucination, computational overhead, and underperformance on critical tasks can lead to unreliable results, affecting both user experience and trust in AI-driven applications. As solution, we propose a two staged framework, utilizing Facebook AI Similarity Search (FAISS) and Hierarchical Navigable Small World (HNSW) to optimize RAG system and fine-tuning with LoRA Hyperparameter Tuning under limited computational setting. An evaluation was conducted on four different GPU units, demonstrating outstanding performance across various evaluations, including accuracy, memory usage, and output diversity.

Partial Encryption With Data Hiding Performed On-the-fly On Compressed Sensed Measurements

Cristina Elena Popa, Constantin-Cristian Damian and Daniela Colțuc

Keywords: *compressive sensing, reversible data hiding, data protection, single pixel camera, partial encryption*

Abstract: Single Pixel Cameras (SPC) deploy the Compressive Sensing (CS) theory to sequentially acquire data directly in a compressed format (measurements). This paper proposes a method to perform reversible data hiding (RDH) with partial encryption in CS measurements by encrypting part of them using a secret key and then inserting the resulting values on-the-fly in the following eligible measurements. The insertion results in visible distortion, the images reconstructed based on the marked measurements still having discernible content. Without performing a decryption an unauthorized user can only obtain a low quality version of the original image. The simulation results show that the capacity and distortion are directly linked, while the number of insertion levels also determines the image distortion. The proposed modifications to the prediction error expansion algorithm adapt it for usage in a SPC scenario while limiting the data expansion.

Elaboration of ZnO nanoparticles using egg white and zinc sulphate

Andreea Elena Onache Vijan, Adriana-Gabriela Schiopu and Georgiana Cirstea

Keywords: *biogenic synthesis, zinc oxide, ovalbumin, zinc sulfate*

Abstract: The biogenic synthesis of zinc oxide refers to the process by which living organisms are used in its preparation. Zinc oxide is one of the most researched oxides, because it is used in a wide range of fields such as skin treatment, ceramic industry, food industry or antibacterial. In this research, zinc oxide was developed with the help of the biological precursor: ovalbumin from free-range chicken eggs. Zinc sulfate of different molar concentrations was also used, making a comparison between the obtained powders. The samples were subjected to compositional characterization through ATR-FTIR analysis and molecular absorption characterization using UV-VIS.

Fuzzy control of skeletal muscles

Mihai Popescu, Cristian Ravariu and Avireni Srinivasulu

Keywords: *motoneuronal, pool, working, like, car, fuzzy, gearbox*

Abstract: There are three types of striated muscles fibers. All of them are controlled by dedicated motoneurons types with which are making closely bounded structures named motor units. This motor units are working together like three subsystems of a large system named neuronal pool. This neuronal pool resembles with a gearbox with the motoneuronal subsystems being like three sprockets. You can say that every of these sprockets are dedicated to a certain speed domain, so there are three domains. All this domains are not strictly separated, on the contrary they interfere at the border behaving like a fuzzy system. The upper control and the tiredness complicate furthermore the functioning. The purpose to make light in this problem is a challenge which must be assumed.

Design and Implementation of Reconfigurable Approximate Adder in Real Time for Image Watermarking

Alidena Bhargavi, Darla Sahithya, I. Venu Madhav, Anchakanti Naveen Kumar, Prof. Avireni Srinivasulu, Musala Sarada, Bhargav Appasani and Prof. Cristian Ravariu

Keywords: *Full Adder, Reconfigurable Approximate Adder, Image Watermarking, LSB Substitution, VLSI*

Abstract: Using VLSI, a larger number of transistors can be embedded on a single chip. As the space between transistors or circuits decreases, the system or chip becomes more susceptible to faults. To avoid inaccurate results, fault-tolerant systems are required. An adder is the fundamental computational circuit in digital Very Large Scale Integration (VLSI) design. To improve the design metrics of an adder, Reconfigurable Approximate Adders (RAAs) have been proposed. Approximate adders are widely used in error-resilient applications such as multimedia, machine learning, and signal processing, where absolute precision is not critical. In this project, we propose the design of a new or modified approximate adder that can address both permanent and transient faults. This design presents an efficient architecture for self-tolerant approximate adders, integrating fault tolerance mechanisms to handle both hardware-induced errors and approximation-related inaccuracies. The proposed architecture incorporates error detection and correction mechanisms at the circuit level, offering a versatile solution for low-power, high-efficiency computing systems. The thus designed adder's design metrics will be calculated and image watermarking will be performed using MATLAB and Cadence Virtuoso Software.

String Current Variability in 3D-NAND Flash Memory: A TCAD Simulation Study

Mrinmoy Mahapatra and Akshay K.

Keywords*: 3D NAND flash memory, process variation, string current, electrical parameters, fixed charge, interface trap charge, electron mobility*

Abstract: In this study, we employ TCAD (Technology Computer-Aided Design) simulations to comprehensively investigate the influence of process-induced variations on the electrical parameters of 3D NAND flash memory string. While prior research has extensively addressed dimensional variability, this work uniquely emphasizes the impact of material and transport level fluctuations, particularly focusing on oxide fixed charge (Qf), interface trap charge (Qtrap) and electron mobility (µn). Our simulations are designed to assess the variability in key electrical parameters, on-current (Ion), threshold voltage (Vth), maximum transconductance (Gm) and subthreshold swing (SS). Results indicate that Vth is significantly influenced by variations in Qf and Qtrap leading to a 36% change, while µn has a substantial impact on Ion and Gm with changes of 21% and 19%, respectively. These findings underscore the critical importance of process stability and variability-aware circuit design methodologies, particularly in the context of aggressively scaled, high-density vertical NAND architectures. As device integration continues to expand into the hundreds of layers, understanding and mitigating the impact of non-idealities such as charge fluctuation and mobility degradation becomes essential for maintaining reliability, yield, and overall system performance. Our results offer valuable insights for device engineers and memory architects aiming to enhance the robustness of next-generation 3D NAND technologies.

Stacking Ensemble Approach for Diabetes Patient Readmission Prediction

Mohaiminul Islam, Abdelaziz Qassi and Nasrin Chowdhury

Keywords*: Machine Learning, Stacking, Prediction, Ensemble Learning, Diabetes, Readmission, Healthcare*

Abstract: This paper investigates the use of a stacking en semble model for predicting hospital readmissions in diabetic patients, focusing on the urgent issue of hospital readmission rates, which are an important indicator of healthcare quality and cost control. We analyze the effectiveness of different machine learning algorithms and their integration using a dataset from the UCI Irvine Machine Learning Repository. The dataset includes information from 130 US hospitals between 1999 and 2008. The evaluated machine learning models consist of Decision Tree, Random Forest, Gradient Boosting, XGBoost, LightGBM, Logistic Regression, and MLP Classifier(Neural net work). Every model passed through hyperparameter tuning using GridSearchCV for optimal performance, specifically targeting metrics such as accuracy, precision, recall, and F1 score across training, validation, and testing datasets. The stacking ensemble technique, which combines predictions from multiple models, has been modified using Gradient Boosting as the meta-learner to improve predictions even more. The results of our study highlight the small improvements in performance that achieved through hyperparameter tuning and ensemble learning. The stacked ensemble model achieved an accuracy of 89%, higher than other models such as the decision tree with an accuracy of 86% and the neural network with an accuracy of 84%. . These f indings offer important perspectives into how these techniques might be strategically used in healthcare settings. The findings contribute to the continuing discourse on using powerful machine learning methods to improve diagnostic accuracy and the delivery of healthcare for chronic diseases such as diabetes.

The influence of precursors in the development of zinc oxide nanopowder using ovalbumin from chicken eggs raised in poultry farms

Andreea Elena Onache Vijan, Adriana-Gabriela Schiopu, Denis Aurelian Negrea, Sorin Georgian Moga and Ecaterina Magdalena Modan

Keywords: *green synthesis, ovalbumin, zinc oxide, zinc nitrate, zinc sulfate*

Abstract: Zinc oxide nanopowders can be obtained by different synthesis methods, such as chemical, physical or mechanical synthesis. This research develops the production of zinc oxide by green synthesis. Green synthesis brings as a novelty the use of natural precursors in the production of oxides. Thus, the research consists in the biogenic elaboration of zinc oxide by using ovalbumin from chicken eggs raised in poultry farms as a precursor. The zinc oxide powders are characterized structurally and morphologically with the help of SEM-EDS and XRD.

Inverse Kinematic of Differential Drive Robot Using Neural Networks and Vrep Simulation

Hamid Bezzout, Bilal Aghoutane, Mohammed El Ghzaoui and Hanan El Faylali

Keywords: *Kinematic Modeling, Inverse Kinematic model, Artificial Neural Network, Robot Control*

Abstract: This study focuses on the Inverse kinematic modeling of a differential drive robot. A common design in mobile robotics with (CoppeliaSim) is used for modeling the robot's physical structure. The model controls MATLAB Simulink to run simulations. To tackle the challenges of establishing inverse kinematics, a neural network-based method is provided. The neural network model is created and tested with simulated data to forecast wheel velocities for various robot trajectories. Its performance is then compared to that of the theoretical inverse kinematic model in terms of accuracy, robustness, and computing time. The findings indicate that the neural network achieves equivalent accuracy while being more responsive to variations in robot parameters and ambient variables. Our paper deals essentially with the need to combine certain approaches centered on artificial intelligence with classical tools.

The Study of Using Wind Energy to Reduce Energy Consumption in a Residential Building

Florentina Magda Enescu, Ioan Cristian Hoarcă, Nicu Bizon, Florin Lungu, Valeriu Manuel Ionescu and Luminița Mirela Constantinescu

Keywords: *hybrid power sources, wind turbine, Diesel generator, net present cost*

Abstract: The scope of this paper is to present a hybrid power system primarily based on renewable energy sources, and to study the sizing of the system using the iHOGA software. The hybrid system is composed of: wind turbines, a Diesel generator (D.G.), a converter, a battery, and an electric load. Two case study on the design of a systems were performed using IHOGA: first case for the city Rm. Valcea (County Valcea) and second case for the city Mioveni (County Arges), for the same load. The results from the simulation are presented both in tabulated and graphical forms in order to provide a better way to visualize any differences present between them. To further help an investor in choosing the most convenient design, the pros and cons of each city were presented in a comparative analysis. The analysis is made in the southern part of Romania, the locations chosen are the city Rm. Valcea situated at Latitude: 45.1 and Longitude: 24.36 and the city Mioveni situated at Latitude: 45.9 and Longitude: 24.95. Simulation results show that the share of renewable energies for the city Mioveni is higher, sitting at a value of 16.36%, in comparison to the city Rm. Valcea which is currently proving a renewable energy share of 7.06%. The operating costs are higher for the city Rm. Valcea with 24.37% compared to the city Mioveni (1189 Euro/ year - Rm. Valcea, 899,6 Euro/ year - Mioveni). The cost of energy supplied by the city Rm. Valcea is 6% more expensive than the same cost for the city Mioveni. Regarding the pollutant emissions as expected, they are with 9.83% higher for city Rm. Valcea, the city Mioveni produces 432 kg/year less carbon dioxide than Rm. Valcea.

Experiments for Control Plane Optimization in SDN Networks Using OMNeT++

Maria Daniela Ungureanu, Ovidiu Pascutoiu and Iulian Teodor Ciolacu

Keywords: *SDN architecture, dynamic control adaptation, network optimization, scalability, redundancy, control plane.*

Abstract: This article studies the problem of SDN controller placement in the network, as well as the deployment of multiple controllers in large-scale networks. Given the SDN technology's principle of centralized organization, this issue is highly relevant, which justifies the importance of this study. On the other hand, optimizing the placement of SDN controllers within the network is a complex multi-criteria problem; therefore, numerous studies and/or experiments are focused on this research subdomain, which remains open—especially under dynamic conditions. We propose an SDN architecture that provides the functional support required for optimizations within the SDN control plane. In particular, the goal is to achieve optimal placement of the SDN controller(s) in the network (Controller Placement Problem – CPP) as well as dynamic adaptation of control in response to traffic and/or topology changes. The functional blocks of the system implementing the architecture are defined and configured, followed by the development of optimization experiments in the control plane.

Using Instruction-Following LLM Hidden States as Conditioning for Video Diffusion Model

R Hema Bhushan, Amritha G K, Sathvik S Malgikar, Pranav Ambiga and Badri Prasad V R

Keywords: *VIDEO GENERATION, GENERATIVE AI, ARTIFICIAL INTELLIGENCE, LARGE LANGUAGE MODEL, MULTIMODAL, PROMPT ENGINEERING, DIFFUSION, VARIATIONAL AUTOENCODER, HIDDEN STATES, FVD, CLIP SCORE, UNET, LATENT*

Abstract: Video generation has applications in several fields. With the advent of Generative AI, we see extensive research being conducted on video generation using AI. Through this project, we experiment the usage of LLM Hidden states as conditioning to train a Video Latent Diffusion Model to study their ability of passing richer semantic information about the video samples. We did a comparative study of context retention abilities of LLMs in case of embeddings and hidden states separately. We create a pipeline with 3 major components - the LLM, a custom Bridge Network and the Diffusion UNet. We conduct our study using two different datasets - the simpler Captioned Moving MMNIST and a subset of the Sakuga-42M dataset. We conclude by evaluating our model variants on standard benchmarks and metrics, and state our findings, which could serve as ground for future work.

THE IMPACT OF USING EMERGING TECHNOLOGIES IN BANKING

Adriana Panțoiu, Daniela Iancu and Elise Nicoleta Valcu

Keywords: *Emerging technologies, IA, hyper-personalization, DORA*

Abstract: Emerging technologies are being successfully used in banking and are enjoying real success. But their use is not without challenges, both technological and legal. Emerging technologies, on the other hand, come with a number of benefits, but they also create a great deal of vulnerability for individuals and businesses. The law is challenged to face up to these challenges, to ensure adequate protection for all subjects of law and to keep pace with the rapid evolution of these technologies. The legislator plays an extremely important role in this period, both at international and national level. They must issue rules that are applicable in the long term, which requires them to have a good knowledge of, and anticipate, future developments in the field of emerging technologies, so that they are not surprised by the new realities but must somehow steer them towards healthy development.

Commitment Schemes for Multi-Party Computation

Ioan Ionescu and Ruxandra F. Olimid

Keywords*: Multi-Party Computation (MPC), Commitment Schemes (CS), Security*

Abstract: The paper presents an analysis of Commitment Schemes (CS) used in Multi-Party Computation (MPC) protocols, with an emphasis on (security) properties and their impact on the upper layer MPC. We analyze a selection of distinct MPC protocols used in various real-life applications (e.g., electronic voting, auctions) that rely on different types of CS. We investigate how various properties of CSs impact the functionality of MPC, aiming for more robust and privacy-preserving cryptographic applications.

SwiftCommit: Integration of Commit Summary Generator Into Version Control Workflow

Mohammad Sali Jauhari, Gene Alprince Braga, Antonette Manolis and Jaydee Ballaho

Keywords: *commit messages, generator, software development, version control, visual studio code plugin*

Abstract: Commit messages are crucial in software development, documenting code changes and ensuring project clarity. However, writing clear and concise messages can be tedious, leading to inconsistencies that affect collaboration and maintainability. This study presents SwiftCommit, an Artificial Intelligence (AI)-powered commit summary generator designed to automate and improve commit message writing within version control workflows. Transformer-based models BART and CodeT5 were trained on the CommitBench dataset, and their performance was evaluated using Bilingual Evaluation (BLEU), Recall-Oriented Understudy for Gisting Evaluation (ROUGE), and CodeBERT scores, ultimately selecting CodeT5 for its superior accuracy in generating meaningful summaries. SwiftCommit was then integrated into a Visual Studio Code plugin, enabling seamless automatic commit message generation. A total of 10 professional developers from the Information Technology (IT) industry assessed the effectiveness of the SwiftCommit. Participants rated the generated commit messages on adequacy, conciseness, and expressiveness. Results indicated a moderate level of agreement among respondents, confirming that SwiftCommit produces reliable commit summaries that align with human-written messages. This study demonstrates the potential of AI-driven tools in improving software documentation and developer efficiency by reducing the manual effort required for commit writing. Future enhancements may include support for additional programming languages, broader integration with development platforms, and further refinement to improve message quality.

Classification on Three Phases of Vermicomposting using VGG-16 Implemented in Impulse Radar

Vrian Jay Ylaya, Arrianne Mae Angob and Glanestly Abarca

Keywords: *Vermicomposting phase classification, Impulse radar technology, VGG-16 convolutional neural network, Non-invasive compost monitoring, Precision agriculture applications, Sustainable organic waste management*

Abstract: Traditional vermicomposting assessment methods rely on labor-intensive manual sampling and subjective visual inspections, which introduce delays in process optimization, compromise compost quality, and hinder scalability in agricultural waste management. Current techniques lack non-invasive tools for real-time monitoring of subsurface parameters such as moisture content and pH levels, leading to inefficient resource utilization and suboptimal nutrient retention. To address these limitations, this study introduces a novel integration of impulse radar technology and the VGG-16 convolutional neural network (CNN) for the automated classification of three vermicomposting phases, Pre-decomposition, Curing, and Maturation. The methodology employs impulse radar (1.3–4.4 GHz) to generate wide bandwidth signals and convert the reflected signals into high-resolution grayscale radargrams, which are analyzed via a pre-trained VGG-16 model. Experimental results show that CNN with pre-trained model VGG-16 demonstrates 90.16% overall classification accuracy, with phase-specific accuracies of 85.34% (pre-decomposition), 89.10% (Curing), and 96.28% (Maturation), outperforming ResNet50 (78.02%) and in actual testing's 8/10 or 80% were correctly predicted by the system. By eliminating physical sampling, the non-invasive design preserves compost bed integrity. It supports real-time decision-making while enhancing humus consistency and nutrient retention. Combining impulse radar with deep learning establishes a new benchmark for precision in organic waste management, demonstrating significant potential to advance sustainable agriculture and circular economy initiatives.

Study on the Ultrasonic Characterization Method of Liquid Heavy Metals

Denisa Toma, Nicu Bizon, Viorel Ionescu, Alexandru Nitu, Alexandra Jinga, Larisa Popescu, Sebastian Dragusin, Robert Bostinaru and Alexandru Toma

Keywords: *LFR, lead, signals, liquid heavy metals, ultrasonic transducer, ultrasonic measurements, ultrasonic technology*

Abstract: Due to their specific thermo-physical and chemical properties, heavy metals such as lead (Pb) and its alloy, the Pb-Bi eutectic (lead-bismuth), have been chosen as the main coolants for generation IV nuclear reactors, the LFR (Lead Cooled Fast Reactor) series. For operational safety reasons, it is necessary to monitor the capacity of structural materials to withstand the intended operating conditions, the configuration of the fuel core, but also the flow of liquid metal in the reactor circuit throughout the entire operating period. Given the opacity of the liquid metal environment at high temperatures, ultrasonic waves are the only viable physical method for obtaining internal information during reactor operation. The practical implementation of ultrasound technology under such extreme conditions is not yet fully validated and requires extensive experimental investigations. For this purpose, dedicated test facilities, specialized equipment and measurement methods adapted to the liquid metal environment are required. In this regard, within the Institute for Nuclear Research (ICN) Pitesti, activities are being carried out to develop the experimental infrastructure for ultrasonic measurements regarding the determination of the acoustic parameters of liquid lead. The paper presents general aspects regarding ultrasonic technology, the equipment used, signal processing means and preliminary results for the verification of the test system for ultrasonic measurements in the molten lead environment.

The method of Cybersecurity Audit in Public Administration and Business

Zdzislaw Polkowski and Nikolas Papenfus

Keywords: *ICT, ICNT, Network Penetration, Cybersecurity, Cybersecurity Audits, Public Administration, Business*

Abstract: The current geopolitical situation in the world, the development of information and communication technologies (ICT) have caused significant changes in the functioning of public administration and business in the European Union. Currently, the digital economy is driven by modern information technologies, which offer new tools for effective operation. ICT technologies also affect the everyday life of citizens. The KRI introduced in 2012, General Data Protection Regulation (GDPR) and NIS2 in 2023 takes into account the development of technology and globalization, sensibly regulating aspects related to information and IT (Information Technology) security. Unfortunately, the geopolitical situation in the world and in particular the situation in Europe, cause new cyber threats to appear. In this situation, existing regulations as well as existing tools and methods in the area of IT security do not always keep up with these dynamic changes. The aim of this study is to present an original method of conducting a cybersecurity audit in selected public administration institutions and business. The first part of the article presents the current situation regarding IT security and legal regulations in Poland. The next part presents an analysis of the literature on this topic. The last part of the work focuses on presenting the cybersecurity audit method and analyzing selected case studies. The study includes recommendations that are the result of the activities carried out. The conducted research, analysis and tests have shown that the best results are obtained when using advanced tools for penetration testing and vulnerability testing. Further research can be aimed at verifying the developed method in other conditions, especially in the area of the technical tools used

Advanced Energy Management in Microgrids: Leveraging Machine Learning and IoT for Optimization and Sustainability

Hanane Tasmant, Badre Bossoufi and Aziz Derouich

Keywords: *Microgrid, Energy Management Systems (EMS), Renewable Energy, Machine Learning (ML), Internet of Things (IoT)*

Abstract: As the global energy corrective shifts towards sustainability, microgrids have surfaced as a viable solution to integrate renewable energy sources with increased energy resilience. Efficient energy management within microgrids assists with appropriate power distribution, cost minimization, and grid stabilization. This paper discusses the role of machine learning and the Internet of Things, through real-time monitoring, predictive analytics, and intelligent decision-making, in enhancing the energy management of microgrids. Machine learning algorithms help in demand forecasting, fault detection, and adaptive control strategies; IoT enables seamless collection and transmission of data across the microgrid ecosystem. The paper discusses several advantages of integrating machine learning and IoT with energy management, such as greatly increased efficiency, reliability, and sustainability. We discuss the scope of extension from small microgrid solutions to larger energy networks and provide indications for future work, notably refining machine learning models for increased accuracy along with operational issues ensuring security in IoT-based solutions. The results demonstrate how machine learning and IoT technology will transform the future of intelligent, autonomous, and sustainable energy management systems.

Droop Control and Active Power Filter Coordination in Low-Voltage Microgrids with EV Charging Stations

Doğan Çelik

Keywords: *droop control, active power filter, electric vehicle charging, harmonic mitigation, low-voltage microgrids*

Abstract: The increasing deployment of nonlinear loads (NLLs) such as electric vehicle (EV) chargers and renewable energy inverters has raised serious power quality concerns in low-voltage microgrids (MGs), particularly due to harmonic distortions. To address these challenges, this paper proposes a coordinated control strategy that integrates droop-controlled inverters with a decentralized active power filter (APF). The inverters employ a virtual voltage reference generation technique in the αβ-frame, avoiding the need for direct voltage measurements and enabling autonomous operation. The APF is responsible for compensating harmonic currents and reactive power, improving the power quality at the point of common coupling (PCC). A comprehensive stability analysis of the droop control scheme is presented, and damping conditions are derived to ensure robust operation. The proposed system is evaluated under various conditions including islanded and grid-connected modes, using PSCAD/EMTDC simulations. Results demonstrate that the integrated control approach ensures seamless transition between modes, reduces total harmonic distortion (THD), and maintains voltage and frequency stability even under highly nonlinear EV charging conditions.

Advanced Control of Grid-Tied LCL Inverters with Fixed Switching Frequency Direct MPC

Ersan Kabalcı and Volker Staudt

Keywords: *Model predictive control, fixed switching frequency MPC, grid-tied inverter, power quality, current control, total harmonic distortion*

Abstract: This paper proposes a Fixed Switching Frequency Direct Model Predictive Control (FSF-MPC) strategy for a two-level grid-tied inverter with an LCL filter. The control method is tested with 100 kVA grid-tied inverter that is implemented to manage active and reactive power rates individually to ensure precise power regulation. The proposed FSF-MPC method maintains a fixed switching frequency that enables the inverter to generate a discrete grid current harmonic spectrum for effectively reducing total harmonic distortion (THD) and improving the power quality. Various simulation studies have been conducted under different grid conditions to assess the performance of the proposed control strategy. The results demonstrate the robustness and efficiency of the FSF-MPC approach in handling dynamic grid disturbances including frequency and phase shifts, voltage sags, swells, and sudden load variations. The ability of controller to maintain stable operation, fast transient response, and low harmonic distortion highlights its suitability for medium-power grid-tied applications by ensuring compliance with grid codes and enhancing overall system efficiency.

Multi-Beam Antenna Array Synthesis Using the Fourier Method for Reliable 5G Applications

Adel Kouki, Ramzi Kheder, Wided Amara, Ridha Ghayoula, Lassaad Latrach, Leila Ben Ayed and Jaouhar Fattahi

Keywords: *Multi-beam antenna arrays, Fourier method, Beamforming, 5G, Side lobe suppression, MIMO*

Abstract: High-capacity wireless communication needs driven by the emergence of 5G technology have triggered advancements in sophisticated antenna array designs. Multi-beam antenna arrays function as core components in these systems due to their capabilities of precise beam steering and their contributions to enhanced spectral efficiency and better spatial coverage. This study introduces a new Fourier-based approach for designing multi-beam antenna arrays. Unlike traditional methods, our technique gives precise control over beam shaping while significantly lowering unwanted side lobes. A more optimized radiation pattern that boosts performance for 5G and beyond. Through theoretical framework development and numerical simulations supported by experimental validation we demonstrate the method's potential to enhance antenna array optimization. The experimental and numerical findings validate that the introduced method based on Fourier synthesis considerably boosts beamforming performance through enhanced directivity and side lobe suppression. The demonstrated results reveal the method's potential to enhance multi-beam antenna arrays in 5G networks by enabling efficient spectrum utilization and interference control.

Integration of SystemC with PSpice Simulations Models

Ionut Alexandru Dragomir, Laurentiu-Costin Gogu, Dwivedi Shikhar and Laura-Alexandra Gheorghe

Keywords: *Co-simulation, OrCAD, PSpice, SystemC, Automotive application*

Abstract: This paper focuses on the integration of SystemC with PSpice, by allowing the simultaneous simulation of the digital and analog behavior of an electronic system, providing a complete and accurate overview of its performance. The presentation will cover topics like configuring and connecting components, creating a co-simulation model, as well as interpreting the results obtained. As electronic systems become increasingly complex, it is important to accurately simulate their behavior. This requires a combination of analog, digital, and mixed-signal simulations, which can be challenging to perform using traditional analog simulation methods. Co-simulation with PSpice and SystemC could provide a powerful solution supporting complex simulations systems using both analog and digital models. By integrating these two simulation environments, users can leverage the strengths of each tool and accurately model the behavior of complex mixed-signal systems. The new Infineon Automotive Smart Power Switches are providing protection functions and enhanced diagnostic capabilities. The device offers an adjustable current limitation to offer higher reliability for protecting the system. In case of a short circuit to ground the PCB traces, connectors, as well as loads, can be protected. Furthermore, the device has a capacitive load switching mode implemented to charge capacitors. Having all of this in mind we developed a analog behavior model using PSpice and SystemC. In our example, creating a model containing a complex finite state machine to handle all the function of the device could be a challenge using circuit level implementation or Spice and analog behavioral modeling methods. While PSpice is a powerful simulation tool, it is primarily focused on analog circuits. In contrast, SystemC is specifically designed for modeling digital systems and provides a more intuitive and efficient way to create FSMs. Using SystemC modules we can avoid convergence issues generated by the digital hazards, also the simulation time improves significantly. The seamless integration of different modeling techniques into a single environment and simulator has been a significant advantage in overcoming the challenges of simulating complex mixed-signal systems. This has been demonstrated through the integration of SystemC with PSpice, which allows for the simulation of the behavior of such systems in a more efficient and accurate manner. As digitalization becomes an essential part of the automotive application design-in process, simulation models provide a valuable solution. The research will be helpful for engineers who need to develop and validate complex electronic systems by using co-simulation of SystemC with PSpice.

Fuzzy Logic based Collision Avoidance for Autonomous Surface Vehicle

Joaquin Roldan Regidor, Mariano Ovelar Lopez, Yu-Chen Liu and Min-Fan Ricky Lee

***Keywords**: Artificial Intelligence, Autonomous Surface Vehicle, Fuzzy Logic, Soft Computing*

Abstract: Traditional control methods often struggle handling uncertainty, particularly for Autonomous Surface Vehicles (ASV) operating in dynamic environments. To address this problem, our Fuzzy Control System dynamically adjusts both steering and speed in response to real-time measurements of obstacle distance and relative bearing angle, thereby significantly enhancing the system's adaptability and responsiveness to changing environmental conditions. A Case- Based Reasoning (CBR) fuzzy inference system is implemented to receive sonar-based range and relative angle data of obstacles, enabling robust obstacle identification and distance assessment. Experimental results demonstrate that the proposed fuzzy control system effectively manages uncertainty, proving suitable for complex scenarios such as autonomous navigation and industrial automation. The system ensures stable ASV operation and reliable obstacle avoidance. Furthermore, the fuzzy controller demonstrates advanced navigational intelligence and improved equipment protection, validating its applicability in maritime and fluvial operations including environmental monitoring and offshore inspection, where reliable collision avoidance is essential.

Advanced Audio Signal Processing Methods for Automatic Classification of "fire" and "fireless" Sounds

Robert-Nicolae Boştinaru, Nicu Bizon, Sebastian-Alexandru Dragusin, Gabriel-Vasile Iana and Denisa Toma

Keywords: *audio signal processing, automatic classification, fire detection, MFCC, acoustic characteristics, machine learning, CNN, trait extraction, background noise, spectral analysis*

Abstract: The automatic classification of "fire" and "fireless" sounds plays a crucial role in the development of intelligent fire warning and detection systems. This paper explores advanced methods of audio signal processing, with a focus on extracting relevant acoustic characteristics (Mel-Frequency Cepstral Coefficients (MFCC), Spectral Centroid, Zero Crossing Rate (ZCR)), used to train automatic classification models. Challenges such as ambient noise, spectral variability and feature redundancy are analyzed. The study demonstrates the potential of acoustic processing technologies in improving early fire detection systems in real-world environments.

Performability Analysis for Fault-Tolerant Flexible Manufacturing Systems Downtime Minimization

Ramez Daoud, Hassanein Amer, Yves Sallez, Hani Ragai and Gehad Alkady

Keywords: *flexible manufacturing system, degraded performance, fault tolerance, failure, performability*

Abstract: This paper studies the introduction of fault tolerance into Flexible Manufacturing System (FMS) design. The focus is on workcell controller failures. The proposed solution does not require any additional hardware. Riverbed simulations are used to prove that the proposed solution satisfies the required timing constraints. To keep the packet delay within acceptable limits, it is necessary to operate some workcells at a reduced speed. To quantify the effect of speed reduction (in case of a controller failure) on the production rate, a performability model is developed which takes into account controller lifetime and the speed of operation of the different workcells in the FMS over time.

Human-Machine Proximity and Warning System for Industrial Safety

Tarik Ege Bilsel, Melike Çolak, Nergis Pervan Akman and Ali Berkol

Keywords: *Human-Machine Proximity, Industrial Safety, Object Detection, Distance Measurement, Human-Object Interaction*

Abstract: In the early 21st century, the adoption and use of robots and machines in the industrial field has increased significantly due to rapidly developing technology. Therefore, critical safety issues have arisen, especially in areas where people and machines work nearby. This research aims to develop an artificial intelligence model that detects people and estimates their distances to machines using computer vision as a solution to the problem mentioned above. The system, obtained by combining the YOLOv8 deep learning model used for object detection with distance calculation algorithms, ensures safety by continuously examining human-machine interactions. This artificial intelligence-supported detection system can be used in industrial environments such as factories and warehouses to prevent accidents and ensure safety. The system receives a video captured by monocular cameras integrated into the environment where people and machines are located as input. Later, processes each frame for human and machine detection, and places the detected people and machines in a bounding box. Then, the distance between the machines and humans is estimated by using the bounding box coordinates. The system provides feedback based on the estimate obtained, allowing immediate intervention in case a person gets too close to the machine. During the development process of the approach, different object detection models and distance measurement methods were tried. For the object detection component, different versions of YOLO from YOLOv8 to YOLO12 were trained with two different datasets, and YOLOv8l produced the best results with the mAP50 (Mean Average Precision) value of 0.948. The measuring distance using depth image, a top-down view, and meter/pixel ratio were tried for the distance measurement, and meter-pixel ratio method generated the best results. Therefore, used in the system along with the YOLOv8l.

Artificial Intelligence as an Ethical Tool in IT Risk Management

Claudiu Iuonas, Aurel Mihail Titu and Danut Iuonas

Keywords: *Artificial Intelligence, IT Risk, Ethics, ISO 31000, Risk Management, Trustworthy AI, Cybersecurity*

Abstract: This paper explores the ethical integration of Artificial Intelligence (AI) into IT risk management processes. With a focus on transparency, fairness, and accountability, the work investigates how modern AI technologies can be deployed in various dimensions of risk identification, analysis, prevention, and control. Referencing ISO 31000 and NIST AI RMF, the paper presents key domains where AI intersects with IT risk management and proposes a structured ethical model supported by real-world examples.

Whisper Based Speech Recognition for Emergency Services

Daniel Eduard Minulescu and Stefan-Adrian Toma

Keywords: *speech transcription, Whisper, emergency services*

Abstract: Artificial intelligence is increasingly integral to emergency response systems, offering capabilities such as real-time call transcription, keyword detection, and prioritization of life-threatening situations. It also facilitates rapid access to protocols, location data, and caller history, supporting more efficient and informed decision-making by emergency operators. This paper presents an enhancement to the speech transcription module of the ODIN112 system by replacing the Kaldi-based module with one built on Whisper. The Whisper-based solution has the potential for improved transcription accuracy using a smaller dataset. Moreover, Whisper's superior multilingual support is an essential feature in future developments of the ODIN112 system, for accommodating the languages of ethnic minorities and supporting non-native speakers (e.g., tourists).

Optimizing the Travel Planning Process based on Personalization and Efficiency using Artificial Intelligence and Political Sciences

Ion Bostan, Mădalin Ciprian Enescu and Cristina Claudia Bizon

Keywords: *Artificial Intelligence, political sciences, TensorFlow.js, Node.js, React, tourism, API, Google Maps, Machine Learning*

Abstract: Travel planning is a complex process that requires consideration of many factors such as cost, comfort level, user preferences, geopolitical situation and available locations. Artificial Intelligence (AI) and political sciences offers significant opportunities to transform this process, reducing the time required for planning and improving the user experience through personalized and efficient recommendations. This paper explores the use of an AI-based model for optimizing the selection process of hotels, activities and restaurants, taking into account user preferences and user constraints as well as the interdisciplinary combination with political sciences, which will essentially contribute beneficially to the planning process. The proposed solution uses modern technologies, such as TensorFlow.js, Node.js and React, to develop a scalable and user-friendly application. The model trained on real data analyzes and ranks the available options, providing users with the most appropriate recommendations. The results highlight the satisfactory performance of the model, with high accuracy in identifying the optimal locations, even on complex datasets. This study highlights the potential of AI in collaboration with the geopolitical situation in the area to revolutionize the tourism industry, contributing to a simpler and more efficient planning experience for users.

Configuring KNN-based Receiver for Machine Learning-assisted Secure Random Communication System under Gaussian Environment

Areeb Ahmed and Zoran Bosnic

Keywords: *Machine learning, random communication, KNN, alpha-stable noise, covert transmission*

Abstract: Physical Layer Security (PLS) is considered as the boundary wall of modern communication systems. In this study, we investigated the possibility of ensuring PLS through unconventional random communication systems by incorporating a supervised machine learning algorithm. The proposed machine learning-assisted secure random communication system (ML-RCS) exploits skewed alpha-stable (α-stable) noise signals as random carriers for secure transmission of binary digits. At the authorized reception side, we utilize a KNN-based receiver, who has been pretrained on a private α-stable noise dataset (Private-αSND) which consists of privately chosen combinations of parameters required to encrypt and decrypt the transmitted α-stable noise signals. Along with the secure key-based dataset, a static key (the pulse length) is also needed for exact decryption of hidden binary digits. We evaluated the approach using bit error rate (BERs) plots with all possible parameter's combinations present in Private-αSND by performing Monte Carlo simulations. With this approach, we practically evaluated the behavior of ML-RCS under additive white gaussian noise (AWGN) channel. The results show that the ML-RCS is resistant to eavesdropping under all AWGN channel environments, which makes it a prospective candidate to establish secure communication by unconventional means.

Modeling Key Parameters in Wastewater Treatment Plants

Gheorghe Popescu and Nicu Bizon

Keywords: *wastewater treatment, modeling, dissolved oxygen, nitrate, nitrogen compounds, process optimization, predictive modeling, activated sludge, nitrification, denitrification*

Abstract: Wastewater treatment is a critical process for protecting water resources and ensuring environmental sustainability. The modeling of key parameters such as dissolved oxygen (DO), nitrogen (in various forms like ammonia, nitrite, and nitrate), plays a fundamental role in understanding and optimizing the performance of wastewater treatment plants (WWTPs). This paper presents a detailed overview of modeling strategies for oxygen and nitrogen compounds, with a focus on predictive accuracy and process control. A comprehensive literature review highlights current advancements, while recent research findings are analyzed to identify gaps and limitations in existing models. Based on these insights, a novel modeling approach is proposed to improve accuracy and adaptability. Simulation results are compared with previous studies through tables and graphical representations. The paper concludes with recommendations for future model refinement and implementation in real-time monitoring systems.

Digital Solutions for Smart Logistics: A Synthesis of AI- and IoT-Based Architectural Paradigms

Gheorghe Radulescu, Vasile-Gabriel Iana, Bogdan-Adrian Enache, Emil Pricop, Mihai Oproescu, Ioan Lita, Ovidiu Constantin Novac Novac and Mihaela Cornelia Novac

Keywords: *Logistics optimization, embedded systems, Internet of Things, Artificial Intelligence, edge computing, Industry 4.0, intelligent orchestration*

Abstract: This paper proposes an integrated architecture designed to enhance the performance of logistics systems through the convergence of embedded systems, the Internet of Things (IoT), and Artificial Intelligence (AI) applications. A layered structure is introduced, combining real-time data acquisition from embedded devices and sensors, intelligent orchestration through edge computing, and advanced analytics powered by machine learning algorithms. The novelty of the architecture lies in its intelligent middleware layer, semantic data modeling, distributed learning capabilities, and context-aware adaptive behavior in dynamic logistic environments. A simulated environment will be developed, , in a future research paper, to validate the architecture, including embedded IoT devices, edge gateways, and a cognitive layer implementing predictive models such as Random Forest and LSTM. Key performance indicators such as delivery time, prediction accuracy, anomaly detection rate, and system responsiveness will be monitored. The expected results suggest significant improvements in operational efficiency, decision accuracy, and resilience compared to conventional systems. This contribution supports the development of scalable, intelligent logistics infrastructures aligned with Industry 4.0 paradigms. Future work will address deployment in real-world scenarios and integration with ERP and WMS systems.

Applying NLP for emotional tone detection in medical abstracts using Bio_ClinicalBERT

Mironela Pirnau, Iustin Priescu, Aurel Mihai Țițu, Claudiu Pirnau and Catalina Mihaela Priescu

Keywords: *NLP, tone classification, Bio_ClinicalBERT, PubMed, fine-tuning, medical abstracts*

Abstract: In the digital age, analysing the discursive tone in medical articles has become essential for evaluating scientific objectivity and credibility. This paper explores an automated method for tone classification in medical abstracts, using a BERT-based model adapted as "Bio_ClinicalBERT" and modern natural language processing techniques. Data were automatically extracted from PubMed, and a labelled subset was used for fine-tuning. The labels were generated heuristically and used to train the model in a Databricks environment. The paper evaluates the model's performance and highlights the method's limitations, offering recommendations for extending the research through manual labelling and GPU (Graphics Processing Unit) usage. The results demonstrate the potential of tone classification in supporting critical analysis of medical literature.

A Brief Review on Fuel Cell/Battery Based Hybrid Zero-Emission Power System for Transport: Critical Analysis, Current Challenges and Trends

Elena Carcadea, Mihail Culcer, Mariana Iliescu, Mircea Raceanu, Adrian Enache, Alin Nicolae Corbu, Ana Nasture, Nicu Bizon and Mihai Oproescu

Keywords: *Fuel Cell, Battery, Hybrid Power System, Zero-Emission, Transport Vehicles*

Abstract: In the last three years, many research papers have been published in the field of Hybrid Energy Systems based on Fuel Cells/Batteries, which highlight that the Zero Emissions objective for transport can be achieved soon, according to the requirements of transport regulations that have been recently revised relative to the proposed objectives for pollutant emissions, carbon footprint, etc. The main objectives of this paper are to analyze the new Hybrid Energy Systems proposed for vehicles, the new Management Systems proposed for these systems, highlighting their advantages and disadvantages compared to previously proposed solutions, emission reduction, etc. compared to previously proposed solutions. The contribution and novelty of the analysis refers to the critical analysis of the new proposed solutions and the presentation of current solutions and challenges for this field.

Experimental Assessment of Two Wind Turbine Control Techniques: Real-Time Implementation on dSPACE 1104 Board

Mourad Yessef, Yassine Seghrouchni, Ahmed Lagrioui and Badre Bossoufi

Keywords: *WECS, DFIG, Fuzzy logic controller, Backstepping, PIL test, dSPACE 1101*

Abstract: The development of variable-speed wind energynnconversion systems is essential for the next power system generation. This new resarch article presents and compares two control techniques for a wind turbine: Backstepping (BS) control and Fuzzy Logic Control (FLC), an artificial intelligence-based method. The goal is to maximize power extraction under variable wind conditions. The system is based on a Doubly Fed Induction Generator (DFIG). Both control strategies are first designed and tested in simulation using MATLAB/Simulink, and then implemented in real time using a Processor-in-the-Loop (PIL) test on the dSPACE 1104 board. Tests are carried out under a real wind speed profile. The results show that the BS controller offers a response time of approximately 0.023 seconds, while the FLC stabilizes faster at around 0.012 seconds, confirming a 48% improvement in dynamic behavior. Additionally, the Tip Speed Ratio (TSR) is better maintained around its optimal value of 8.17 ± 0.01 with FLC, compared to 8.14 ± 0.02 for BS, resulting in more efficient aerodynamic performance. Both controllers demonstrate good performance in tracking the angular speed of the wind turbine. Furthermore, their real-time implementation on the dSPACE 1104 platform confirms the practical feasibility of integrating both control strategies into real wind energy conversion system prototypes.

Communication Protocols in Embedded Systems for Automotive Applications: Comparative Analysis and Implementation through Virtual Instruments

Sebastian-Alexandru Drăgușin, Nicu Bizon, Rodica-Mihaela Teodorescu, Denisa Toma, Robert-Nicolae Boștinaru and Gheorghe Anghel

Keywords: *communication protocols, embedded systems, automotive applications, virtual instrumentation, real-time data acquisition, sensor interfaces*

Abstract: This paper presents a comparative analysis of key communication protocols used in embedded systems within the automotive industry, with a focus on both wired and wireless technologies. The study explores the architecture, data rate, reliability, and application domains of protocols such as CAN (Controller Area Network), LIN (Local Interconnect Network), FlexRay, MOST (Media Oriented Systems Transport), Modbus (TCP/IP (Transmission Control Protocol/Internet Protocol)), Ethernet, I2C (Inter-Integrated Circuit), UART (Universal Asynchronous Receiver-Transmitter), Bluetooth, and Wi-Fi. These protocols are evaluated based on their suitability for various vehicle subsystems including powertrain, infotainment, diagnostics, and sensor networks. In addition to the theoretical review, the paper includes two practical implementations developed using virtual instrumentation tools: a Modbus TCP/IP-based monitoring system in LabVIEW and an I2C/UART-based sensor interface in MATLAB. These demonstrators illustrate real-time data acquisition and visualization techniques relevant to embedded automotive communication. The integration of both classic and modern protocols provides insight into the current and emerging trends in vehicle networking.

Social Media Sentiments Analysis on the July Revolution in Bangladesh: A Hybrid Transformer Based Machine Learning Approach

Md Sabbir Hossen, Md Saiduzzaman and Pabon Shaha

Keywords: *Machine Learning, Deep Learning, Sentiment Analysis, Natural Language Processing, Transformer Model*

Abstract: The July Revolution in Bangladesh marked a significant student-led mass uprising, uniting people across the nation to demand justice, accountability, and systemic reform. Social media platforms played a pivotal role in amplifying public sentiment and shaping discourse during this historic mass uprising. In this study, we present a hybrid transformer-based sentiment analysis framework to decode public opinion expressed in social media comments during and after the revolution. We used a brand new dataset of 4,200 Bangla comments collected from social media. The framework employs advanced transformer-based feature extraction techniques, including BanglaBERT, mBERT, XLM-RoBERTa, and the proposed hybrid XMB-BERT, to capture nuanced patterns in textual data. Principle Component Analysis (PCA) were utilized for dimensionality reduction to enhance computational efficiency. We explored eleven traditional and advanced machine learning classifiers for identifying sentiments. The proposed hybrid XMB-BERT with the voting classifier achieved an exceptional accuracy of 83.7% and outperform other model classifier combinations. This study underscores the potential of machine learning techniques to analyze social sentiment in low-resource languages like Bangla.

NiO nanostructures synthesis and characterization for functional antibacterial applications

Daniela Istrate, Ecaterina Magdalena Modan, Denis Aurelian Negrea and Adriana-Gabriela Schiopu

Keywords: *nickel oxide, nanoparticle elaboration, antibacterial properties*

Abstract: Nickel oxide (NiO) nanostructures exhibit remarkable physicochemical and antimicrobial properties, making them highly relevant for biomedical and environmental applications. This study presents a comparative analysis of various synthesis methods for NiO nanoparticles, including chemical reduction, sol-gel, hydrothermal, and solvothermal techniques. Two types of NiO nanoparticles, synthesized via hydrolytic routes with and without urea, were characterized by Attenuated Total Reflectance Fourier transform infrared spectroscopy (ATR-FTIR), Scanning Electron Mycroscopu and energy-dispersive X-ray spectroscopy (EDS). The NiO nanostructures were further tested for their antibacterial performance against Escherichia coli and Enterococcus faecalis reference strains. Results revealed a significant reduction in bacterial colonies, particularly after 3 hours of contact, confirming the antimicrobial potential of the NiO nanostructures.

Blockchain-based Efficiency of Energy Consumption in a Homeowners Association

Florentina Magda Enescu, Nicu Bizon, Ioan Cristian Hoarcă and Adela Gabriela Husu

Keywords: *blockchain, renewable energy, ownership association, energy trading, energy efficiency*

Abstract: Today, there is a strong focus on improving the efficiency of both energy consumption and its sources. To this end, renewable energy generated by photovoltaic panels presents an effective solution. On the one hand, it can be used for both individual and shared consumption, while any surplus can be stored in batteries or injected into the grid, leading to a significant long-term reduction in consumers' energy bills. On the other hand, efficient and transparent energy management can be achieved through advanced technologies such as blockchain. This research validates, through the implemented application, the feasibility of using blockchain technology to optimize electricity consumption within a homeowners' association. Based on an analysis of the operating principles of blockchain and an analysis of specialized studies proposing its use in the energy sector, the study introduces mechanisms for trading electricity through blockchain in a small community, with the aim of optimizing consumption. A suite of software tools is implemented to facilitate the trading of renewable electricity and provide statistical insights into energy consumption, both at the organizational and individual levels. The use of photovoltaic panels and blockchain in a small homeowners' association brings multiple benefits, including cost reduction, increased trust among members due to the transparency provided by blockchain, and increased sustainability through reduced energy consumption and greater energy independence. This integration transforms a homeowners' association into a smart, efficient, and sustainable community. In addition, based on the rewards offered within the application, it encourages responsible consumption of electricity.

Technical Review of Class TD Audio Power Amplifiers

Andrei Militaru, Emanuel Valentin Buica and Horia Leonard Andrei

Keywords: *Class TD amplifiers, Power amplifier efficiency, Total Harmonic Distortion, Frequency response, Signal to noise ratio*

Abstract: This paper presents an extensive evaluation of power amplifier classes by analyzing Class TD amplifiers alongside standard classes A, B, AB, D and G/H. Class TD amplifiers serve high-power applications because they deliver efficient and high-performance audio amplification. The design of these amplifiers supports high power output together with excellent fidelity characteristics which makes them appropriate for professional sound reinforcement, large-scale public address systems and high-power studio monitoring applications. Class TD amplifiers combine AB class audio quality with class D power efficiency through their design to deliver strong performance without major heat dissipation. The initial section presents a basic outline of audio power amplifier configurations. A thorough explanation follows about Class TD amplifier operation principles together with their distinctions from other amplifier classes. The research evaluates essential performance metrics through a comparative study of efficiency, total harmonic distortion, linearity, complexity, cost, output power, energy consumption, signal-to-noise ratio and frequency response. The evaluation assesses both benefits and drawbacks of Class TD amplifiers when used in high-power applications. The paper finishes by discussing general findings about Class TD audio power amplifiers for high-power applications and their potential future development.

Advancing Reliability and Monitoring Strategies for Microgrids: Building on Previous Findings Towards Future Perspectives

Mohammed Amine Hoummadi, Badre Bossoufi and Mohamed Karim

Keywords: *microgrid, resilience, fiability, energy, EMS*

Abstract: There is an increasing recognition of microgrids as fundamental to the modern configuration of energy infrastructures because of their localized generation, which increases the resilience of energy distribution and seamlessly integrates renewable energy sources. The article reviews new approaches toward increased microgrid reliability and resilience and takes a close look at the transformative contribution of Energy Management Systems in that regard. Thus, EMS intelligently copes with energy distribution, storage, and backup systems toward great reductions of blackout duration and minimization of energy imbalances, hence a notable improvement in the performance of microgrids. Taking a case study from a Hypothetical Microgrid of 100 Homes, the implementation of robust EMS increased the resilience score by almost 15% from 5.5/10 to 7/10. It also covers the use of comprehensive monitoring, predictive maintenance, and data analytics in those upgrades. The future of microgrid reliability looks even more promising with the integration of newer technologies, such as artificial intelligence a new era for energy independence and sustainability.

Leveraging Top-Model Selection in Ensemble Neural Networks for Improved Credit Risk Prediction

Vincent Dey, Felix Hamza-Lup and Ionut Iacob

Keywords: *Ensemble Neural Networks, credit prediction, majority decision*

Abstract: Credit risk prediction is both a difficult and of great interest problem, due to inherently unbalanced nature of such data and continuous interest in performing the prediction with high precision. We improve previous results on credit risk prediction and present an ensemble of decision Artificial Neural Networks architecture for credit risk classification. The extensive experimental results we present show improvements of previous work on metrics including accuracy, precision, sensitivity and specificity. Unlike previous methods, our method is completely automated, eliminating the need of manual processing and selection of data features, which improves generalization and scalability. While the main focus of this work is on credit risk prediction, our analysis shows that the model we propose can be used successfully for dimensionality reduction and classification of unbalanced data, in general.

Deployable Cylindrical Parabolic Antenna Design for InSAR Applications

Eda Taşci and Mesut Kartal

Keywords*: InSAR, SAR, CubeSat, reflector, lineer array, deployable antenna, mesh surface, remote sensing, microstrip array*

Abstract: In this paper, a cylindrical parabolic antenna with a broadside microstrip array feed antenna with dual linear polarization is designed for CubeSat InSAR systems operating in Ka band. The antenna structure is designed and optimized to provide minimum reflective loss and gain in the desired frequency range. As a result of these simulations performed with HFSS software, it has minimum reflective loss and high gain in the desired frequency range. The proposed antenna design provides a solution to both InSAR applications and CubeSat's size and gain limitations.

Emerging Trends in Regulating the Use of Digital Technologies for Sustainable Forest Management

Dan Alexandru Guna, Constanta Matusescu and Mocanu Livia

Keywords: *forest monitoring, digital technologies, integrated information system, EU law, Romanian law*

Abstract: Abstract: Law and the legal world are often perceived as archaic, unsuitable, or even behind the times in relation to the evolution of society. However, in the context of unprecedented technological developments in recent decades, it was natural for legislation to take them into account and use them for the benefit of achieving major social objectives, especially related to environmental protection. The sustainable development objectives assumed at a global level and the Regional-European initiatives to achieve the targets thus established represent an opportunity to raise awareness of the need for technology and law to work together for the benefit of people and societies. Even if the introduction of technical notions into legal language is not without complications, and digital technologies are, in fact, transforming the rules and practice of law, requiring a constant effort of adaptation on the part of legal professionals, who must stay abreast of technological developments, the use of modern technologies makes a considerable contribution to the application of law, in terms of effectiveness and accessibility of the data necessary to allow decision-makers to take appropriate measures. This study aims to illustrate the convergence between law and new technologies for sustainable forest management, providing an overview of the most recent initiatives of the European Union and Romania, based on a content analysis of policy documents and legal acts, as well as the literature on the subject.

Temperature estimation using infrared thermal imaging camera and temperature sensor probe in the Electromagnetic Diaphragm Pump

Grazia Lo Sciuto, Szymon Skupien, Pawel Kowol, Giacomo Capizzi and Salvatore Coco

Keywords: *Electromagnetic Diaphragm Pump, Electromagnets, Infrared Thermal imaging*

Abstract: The electromagnetic diaphragm pump system, which contains electromagnets, permanent magnet, membrane, valves, chamber, has electromagnetic forces that act to change the position of the permanent magnet located on membrane driven by the polarization of magnets and has the pressure to pump the liquid under the control of digital cabinet. This study proposes a novel approach that uses the temperature sensor probe and an infrared thermal imaging camera to measure the temperatures of an electromagnetic diaphragm pump. The results show good agreement between the infrared and temperature sensor techniques confirming that the proposed technique could accurately estimate the temperature. The temperature varies as a function of liquid pumped in the electromagnetic pump system, and an equation model is proposed to express the formulation dependence between temperature, the switching speed of the permanent magnet and the pumped liquid.

AI and IoT Integration in Pediatric Phototherapy: Revolutionizing Approach for Neonatal Care

Akash Katode and Saurabh Gupta

Keywords: *IoMT, AI, Machine Learning, Phototherapy, Edge Impulse, Embedded System, IOT, Biomedical Device*

Abstract: Neonatal jaundice is a common condition in newborns, treated through phototherapy to degrade excess bilirubin. However, high costs and limited access to advanced incubators remain barriers, especially in regions like Asia and Africa. This paper introduces an affordable IoT-based phototherapy device powered by Extensa LX6 and LX7 processors, featuring programmable temperature and humidity control, along with sensors to monitor skin temperature and cradle moisture. The system includes a 360-degree rotational light source for effective phototherapy. Using Edge Impulse, a machine learning model is deployed on the hardware to monitor the baby's position through live video streams for real-time remote monitoring. IoT connectivity enables remote control of the light source and exhaust fans, ensuring a safe environment. The device also includes fire protection, auto-sterilization, and a hand disinfectant system, ensuring hygiene and safety. This system combines AI, IoT, and automation to improve neonatal care in underserved regions.

Effectiveness of YOLO11-Based Lightweight Model for Drone Detection in Noisy Environments

Bhanu Prakash Meena and M. Sabarimalai Manikandan

Keywords: *Drone, detection, YOLO11s, salt-and-pepper, noise, Gaussian, filter, median, deep, learning, aerial, surveillance, computer, vision*

Abstract: The proliferation of drones, particularly in unauthorized or hostile deployments, has necessitated the development of automated anti-drone systems capable of accurate real-time detection. However, the effectiveness of vision-based drone detection remains hindered by challenges such as cluttered backgrounds, varying environmental conditions, and the visual similarity between drones and benign aerial objects like birds or aircraft. Existing datasets are often insufficiently diverse, limiting model generalization. This study addresses these challenges by constructing a high-resolution, square, rectangular and polygon-shaped annotation drone detection dataset comprising 3359 images that capture diverse real-world aerial scenes. A lightweight, you only look once version 11 small model (YOLO11s) detection framework was trained and evaluated under both ideal and noisy conditions. On noise-free test images, the model achieved a strong recall of 95.76% and mAP of 83.53%, though the moderate precision of 71.31% suggested over-detection. Under high Gaussian noise ($\sigma = 50.0$), recall dropped to 57.80% while precision increased to 81.97%, with mAP falling to 69.89%. Salt-and-pepper noise ($p = 0.5$) caused complete failure across all metrics. Gaussian and median filtering techniques were applied as pre-processing steps to enhance robustness. Median filtering demonstrated superior resilience under impulsive noise, preserving a F1-score of 27.02% at $p = 0.5$, compared to 10.56% using Gaussian filtering. Overall, the proposed pipeline combining noise-resilient filtering and YOLO11s detection offers a reliable framework for drone identification in both ideal and degraded visual environments.

KS-LSTM: Improved Obesity Weight Prediction Accuracy based on Kalman Smoothing LSTM

Andri Pranolo, Fairuz Khairunnisa Anasyua, Agung Bella Putra Utama, Irfan Taufik, Refangga Akhmad Rizki and Navandra Rafa Ariseno

Keywords: *Kalman smoothing, LSTM, Weight prediction, health monitoring system*

Abstract: Weight prediction is one of the important aspects in health risk modeling and the development of artificial intelligence-based health monitoring systems. Long Short-Term Memory (LSTM) models are known to be effective in processing sequential data but are often susceptible to high data fluctuations and noise. This study proposes a Kalman Smoothed LSTM (KS-LSTM) approach by applying Kalman Smoothing to the input data before training the LSTM model to reduce irrelevant variability and improve prediction accuracy. Experiments were conducted on a body weight dataset with evaluation based on RMSE, MAPE, and R^2 metrics. Results show that KS-LSTM performs better on the MAPE metric (0.9430 vs. 1.3576), indicating an edge in proportional accuracy. Although the LSTM showed a slight edge on RMSE and R^2, the overall results support the use of Kalman Smoothing as a preprocessing step to improve the stability and reliability of the weight prediction model.

Economic and regulatory aspects of sustainable shipping with hydrogen fuel cells and battery energy storage

Mihai Oproescu, Nicu Bizon, Alin Gheorghita Mazare, Maria Simona Raboaca and Claudiu Ioan Abrudan

Keywords: *sustainability, shipping, fuel cell, battery storage*

Abstract: Maritime transport is the backbone of global trade, accounting for about 80% of the volume of international trade. However, the sector generates a significant proportion of greenhouse gas (GHG) emissions and contributes to marine pollution. In this context, the development of a regulatory framework that encourages the transition to renewables and clean technologies is essential. This paper analyzes the main international, regional and national regulations, with a special focus on the integration of renewable energy sources in maritime transport, highlighting the associated challenges and opportunities. At the same time, a case study is presented on the sustainability, from an energy point of view, of hybrid fuel cell-battery energy systems, taking into account the conditions of use of these systems on maritime transport vessels.

An Approach to Lung Cancer Detection and Classification from Chest CT-Scan Images Using Deep CNN and Decision Fusion as a Diagnostic Tool

Elena-Daniela Macașoi and Victor-Emil Neagoe

Keywords: *lung cancer, chest CT-scan imaging, deep learning, CNN, GoogLeNet, decision fusion, Dempster-Shafer theory*

Abstract: Lung cancer is the deadliest disease in the world and its diagnosis as early as possible is necessary. First part of this paper is dedicated to the identification of lung cancer in chest CT-scan imaging using deep learning CNN for subject classification in four categories: normal, adenocarcinoma, large cell carcinoma, and squamous cell carcinoma. The GoogLeNet architecture is chosen, and the classification performances are evaluated for various training conditions. The second part of the paper has as aim lung cancer detection in chest CT-imaging, namely, to diagnose if a patient has lung cancer (any of the above mentioned three categories of lung cancer) or he is normal. For the lung cancer detection task, we propose an ensemble of two GoogLeNet modules performing a decision fusion according to Dempster Shafer theory. The two GoogLeNet modules of the ensemble have identical architecture but they use an asymmetric training technique controlled by a parameter denoted as a. The influence of asymmetry parameter a on the performances of the CNN ensemble decision is shown. We have also pointed out the advantage of the proposed decision fusion model over a standalone classifier with the same architecture. We have obtained an Overall Accuracy of 96.37% for decision fusion with optimization of asymmetry parameter a, versus 92.45% for a standalone classifier with balanced training.

Evaluation of Machine Learning Algorithms for Predicting Cybersecurity Incidents

Aniruddha Chatterjee

Keywords*: machine learning, cybersecurity, GUIDE dataset, proactive security, incident prevention*

Abstract: This research examines the utilization of machine learning to proactively forecast cybersecurity problems, hence reducing the likelihood of substantial system interruptions. Utilizing the public GUIDE dataset, we intend to create a machine learning model that can analyze historical event data and discern trends that signal emerging hazards. The model will be developed to enhance current security measures by delivering early alerts of possible problems, facilitating prompt intervention and averting system failures. This research's conclusions aim to improve cybersecurity measures and mitigate the financial and operational consequences of intrusions.

Fuzzy decision system for the management of nitrification processes in wastewater treatment plants

Maria-Elena Stanciu, Mihai Oproescu and Silviu Ionita

Keywords: *Fuzzy Logic, Water Purification, Nitrification Control, Energy Optimization*

Abstract: This paper proposes a control system based on fuzzy logic for optimizing the operation of blowers in a wastewater treatment plant. The system uses ammonium (NH_4^+) and nitrate (NO_3^-) concentrations as input variables to decide whether to turn the blowers on or off in order to maintain efficient nitrification and reduce energy consumption. The implementation was carried out in MATLAB/Simulink, using a modular architecture and fuzzy Mamdani rules. The proposed method was tested in two scenarios: one with synthetic data and one with real data from the Pitesti Wastewater Treatment Plant. The results indicate a good correlation between the decisions of the fuzzy system and those of the existing SCADA system, confirming the practical applicability of the solution. The approach is flexible and can be extended to integrate additional parameters such as dissolved oxygen or temperature, thus providing intelligent support for the control of biological purification processes.

Waste Heat Recovery for a PEM Electrolyzer

Florin-Alexandru Lungu, Laurentiu Patularu, Ana Nasture, Elena Carcadea, Ioan Cristian Hoarca and Mihai Serbanescu

Keywords*: electrolysis, green hydrogen, waste heat recovery*

Abstract: With hydrogen becoming an attractive energy carrier, the generation of green hydrogen through electrolysis to decarbonize sectors with high greenhouse gas (GHG) emissions such as the energy generation and transportation sectors has started to gain more traction as an important research focus. Electrolysis, as a process that is not fully efficient, results in the generation of waste heat. The scope of this paper is in increasing the overall efficiency of an electrolyzer system by utilizing the waste heat generated.

Design and Implementation of Energy-Efficient Approximate Adder Supporting Image Processing Applications

Harsha Vardhan Kudumula, Girish Kumar Reddy Kapu, Manideep Kakaravada, Divya Vani Kothapalle, Papisetty Sai Prasad, Musala Sarada, Prof. Avireni Srinivasulu, Cristian Ravariu and Bhargav Appasani

Keywords: *Approximate computing, approximate adders, arithmetic circuits, image blending, CMOS, FPGA, energy-efficiency*

Abstract: Approximate computing is a fast and energy-efficient way to handle tasks that can tolerate some errors. This study investigates the application of approximate computing to digital image blending, a method commonly used in visual effects and image processing. We designed an approximate adder that is suitable for both FPGA- and ASIC-based implementations and utilized it to blend two images and compared the results with those of accurate adder. The quality of blended images produced by approximate adder is comparable to that of accurate adder, as demonstrated by our results. Using the structural similarity index and peak signal-to-noise ratio, the image quality was assessed. The thus built approximate adder was proven to be superior for image blending, taking into account the blended image's quality and design metrics. We considered the 90nm CMOS Cadence design tool to perform ASIC implementation of the accurate adder and the designed approximate adder. The blended image was generated in MATLAB using the designed approximate adder function to alter the process. The findings indicate that the suggested approximate adder is suitable for image blending, producing blended images of equivalent quality to conventional full adders.

Stochastic Gradient-Based LMS Algorithm for Reliable and Adaptive 5G Systems

Adel Kouki, Ridha Ghayoula, Lassaad Latrach, Leila Ben Ayed, Jaouhar Fattahi and Mohamed Mejri

Keywords*: LMS algorithm, Stochastic gradient descent, 5G communications, Adaptive filtering, Beamforming, Low-complexity algorithms, Real-time systems*

Abstract: This paper explores use of the Least Mean Squares (LMS) algorithm, based on stochastic gradient descent, for implementation in adaptive beamforming systems in 5G millimeter-wave (mmWave) multiple-input multiple-output (MIMO) systems. An 8-element array designed for use at 28\,GHz is integrated with the LMS algorithm to give the radiation beam dynamic steering capability in multiple directions during operation. The mathematics of the LMS algorithm is demonstrated before applying this to lead to optimization and full-wave electromagnetic validation of the LMS applied to a patch antenna array prototype built with a RO4003C substrate. Simulated results show its success to achieve solid beam steering capability with increased directivity and sidelobe suppression over four different steering angles of 0°, ±30°, and ±60°. The results presented in this paper demonstrate the algorithm's potential for near-real-time spatial filtering and spectral efficiency enhancement for massive MIMO implementations and exhibit robust performance, fulfilling the requirements for next generation communication systems in a dynamic and high-performance way.

New Method for Sensitivity Analysis of Reactive and Apparent Power in Non-sinusoidal State

Paul Cristian Andrei, Sorin Deleanu, Emil Diaconu, Andrei Cosmin Gheorghe, Marilena Stanculescu, Emil Cazacu and Horia Andrei

Keywords: *nonsinusoidal regime, sensitivity analysis, reactive power, apparent power*

Abstract: Nowadays, the quantitative and quality characteristics analysis subjecting a nonsinusoidal regime has become one of the most significant preoccupations for researchers involved in power systems and is triggering considerable interest. The drawbacks determined by the nonsinusoidal regime negatively affect the electrical power systems and their components. The time variation of the quantities that define the nonsinusoidal regime directly influences electrical energy quality. Following this reality, this paper proposes a new method for assessing the dependency between the relative weightings of the voltage, respectively current harmonics and the reactive and apparent power recorded in the nonsinusoidal regime. Such a method relies on using sensitivity as a tool for analysis. The present material includes the mathematical formulation of the problem through new calculation relationships, including the reactive, apparent power expressed with respect to the harmonics' weightings, voltage and current, respectively sensitivities. The implementation of the logical flow diagram utilized the MATLAB/Simulink software package to run a case study. Following the reactive and apparent power determination using voltage and current harmonics' weightings formulas versus their evaluation based on sensitivities, one can figure out extremely low differences between the values obtained with both methods. Considering the first method based on weightings as the reference, one can observe minimal errors, whereas using the second one utilizes sensitivities, rightfully claiming the correctness of the second method as well.

Deep Learning Network-Based Fruit Name Recognition for Interactive Fruit Shopping Interface and Fruit Sugar Recommendation App

Manohar K and M Sabarimalai Manikandan

Keywords: *Fruit recognition, Discrete Wavelet Transform(DWT), Daubechies, Convolutional Neural Networks (CNNs), Image processing, Noise robustness, Real-time deployment, Android app*

Abstract: This paper presents an deep learning approach for fruit recognition to enhance accuracy and computational efficiency for real-world applications. Fruit recognition is challenging due to variations in background, illumination and color, high processing latency, large model sizes, and the need for effective classification across multiple categories. To address these issues, the method integrates discrete cosine transform (DCT), discrete wavelet transform (DWT), and compressed imaging techniques with convolutional neural networks (CNNs) to improve feature extraction, reduce dimensionality, and enhance model robustness. The models were evaluated using the fruits 360 dataset, consisting of 141 fruit categories, and benchmarked using accuracy, precision, recall, and f1-score. Results show that the wavelet transform-based model achieved an accuracy of 97.53%, while the baseline CNN reached an accuracy of 98.05%(existing model), but with higher computational complexity. The approach improves noise resilience and reduces computational demands without significant accuracy loss. Additionally, the models were deployed in an Android application for real-time fruit recognition, demonstrating their efficiency in resource-constrained environments. This study highlights the effectiveness of integrating image processing techniques with deep learning for efficient and scalable fruit recognition, enabling applications in automated retail, precision agriculture, and dietary management.

Comparative Study of Deep Learning Models for Traffic Forecasting in V2V Communication in VANETs

Meryem Hanine, Zytoune Ouadoudi and Mohammed Oumsis

Keywords: *V2V communication, deep learning, traffic prediction, RNNs, LSTM, GRU*

Abstract: Vehicular Ad Hoc Networks (VANETs) are one of the most significant enablers of intelligent transportation systems by facilitating vehicle-to-vehicle communication, also known as Vehicle-to-Vehicle (V2V) communication. VANETs play a vital role in road safety improvement, traffic optimization, and overall transportation efficiency. In this paper, we compare various deep learning algorithms applied for V2V communication to predict traffic in an exhaustive manner. We focus on evaluating the performance, precision, and computational complexity of such algorithms for different traffic scenarios, e.g., urban congestion, highway drive-through, and mixed driving patterns. Specifically, we investigate deep learning-based models such as Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM)networks, and Gated Recurrent Units (GRUs) that perform significantly well in discovering temporal patterns and dependencies within traffic data. The study identifies the strengths and weaknesses of every model with regards to their applicability in real-time traffic forecasting assignments. Through presenting findings about the usability of such algorithms, the paper aims at contributing towards building more reliable and effective traffic control systems for VANETs.

Innovative Practices For Managing End-of-Life Aircraft: A Review of Circular Strategies And Digital Solutions

Zaki El Hani, Jaouad Karroum, Aniss Moumen, Youssef Rochdi and Abdelmajid Elouadi

Keywords: *End-of-life aircraft management, Aircraft dismantling, Circular economy in aviation, Composite material recycling, Lean disassembly methods, Digital traceability, RFID and blockchain, Predictive maintenance modeling, Sustainable aerospace innovation*

Abstract: As the global aircraft fleet continues to age, the aviation industry is increasingly confronted with the environmental, economic, and logistical challenges of managing end-of-life (EOL) aircraft. This paper presents a comprehensive review of recent innovations and strategies aimed at improving the dismantling, recycling, and valorization of retired aircraft. Emphasis is placed on circular economy principles, Lean methodologies, and emerging digital technologies that enhance traceability and operational efficiency. Tools such as blockchain, RFID systems, and predictive maintenance models are explored for their capacity to streamline EOL processes and support sustainable resource recovery. Particular attention is given to the growing presence of composite materials and the technical constraints they pose for recycling. By adopting a systematic literature review approach, this study identifies current best practices, persistent barriers, and potential avenues for integrating eco-design, automation, and collaborative frameworks into a unified model for sustainable aircraft decommissioning.

MBISort Algorithm: A Novel Hybrid Sorting Approach for Efficient Data Processing

Mohammed Alaa Ala'Anzy, Alan Zhumalin, Daulet Temirtay and Alsadg Abdalhafid

Keywords: *Hybrid sorting algorithm, Block sort, Adaptive Merge sort, In-place sorting, Threshold Optimization*

Abstract: A novel and efficient hybrid sorting algorithm, termed the Merge-Block-Insertion sort (MBISort) algorithm, is proposed. MBISort combines the principles of insertion sort, block sort, and merge sort into an in-place procedure that exhibits markedly improved average-case performance compared to standalone block sort and adaptive merge sort. Comparative analyses on structured datasets, such as sorted and partially sorted arrays, demonstrate that MBISort achieves faster execution times over a broad range of input sizes (from 100 to 1,000,000 elements). On average, performance improvements of 20% over adaptive merge sort and 41% over block sort are observed, highlighting its robust efficiency across diverse data types and distributions. The algorithm also performs exceptionally well for large datasets with high degrees of order, a result of the dynamic integration of insertion sort with an adaptive merging strategy. Additionally, a tunable threshold parameter allows MBISort to adapt to varying data distributions and optimize performance.

A Systems Engineering Approach to Modeling Reliability and Vulnerability in Automated Airport Baggage Networks

Cătălin Coman, Laura Dobrescu, Florin Ruscă and Florin Badau

Keywords: *Reliability, Vulnerability Modelling, Airport Baggage Systems and networks, Cascading Failures, Resilience, Agent-Based Simulation*

Abstract: Automated baggage handling networks are critical to airport operations, yet their reliability and interdependencies make them vulnerable to disruptions ranging from electrical power outbreaks to mechanical failures or to cyber-attacks. This study proposes a systems engineering framework to model and quantify vulnerabilities in automated airport baggage handling systems ("BHS"), integrating classical models, failure mode analysis, and simulation techniques. By mapping BHS components (e.g., conveyor systems, electrical motors, sorting mechanism, IoT sensors and data) and their interactions, the framework identifies cascading failure risks and vulnerable points which threaten operational continuity. Using a combination of SysML (Systems Modelling Language) diagrams and agent-based simulations, the research evaluates scenarios such as ransomware attacks on control systems, sensor malfunctions, and peak-load congestion. Metrics like node criticality, recovery time, and redundancy efficiency are developed to prioritize mitigation strategies. The study analyses how adaptive redundancy, predictive maintenance solutions, and decentralized control architectures can reduce system-wide vulnerability exposure by up to 30%. By bridging systems engineering principles with real-world baggage logistics, this approach provides actionable insights for designing reliable and resilient, self-healing networks. The findings advocate holistic vulnerability assessments in aviation infrastructure, ensuring compliance with evolving safety standards like ICAO's cybersecurity guidelines. This methodology is scalable to other automated transport systems, fostering safer, more reliable air travel ecosystems.

Toward green port operations: modelling and reducing emissions in container terminals

Andreea Maria Moldoveanu and Aurel Mihail Titu

Keywords: *carbon footprint, container terminal operations, sustainability, operational efficiency*

Abstract: The increasing pressure to reduce carbon footprint in the logistics sector has driven significant interest in sustainable practices within container terminal operations. This paper focuses on modelling and optimizing the carbon footprint of a container terminal operator by analyzing key operational processes. Existing literature extensively covers carbon footprint reduction strategies in logistics; however, specific optimization models tailored to container terminal operations remain limited. This study employs a quantitative approach, integrating existing simulation and optimization models to assess the impact of different operational strategies on carbon emissions. Key research questions refer to the primary sources of carbon emissions in container terminal operations and how can operational adjustments and technological interventions optimize carbon footprint reduction. Findings suggest that electrification of handling equipment, process automation, and energy-efficient scheduling significantly reduce emissions. The study provides a structured framework for terminal operators to assess and enhance sustainability efforts, contributing to the broader discourse on green port operations.

Real-Time Pick-and-Place Optimization Using Q-Learning in a Digital Twin

Marius Constantin Marica, Nicu Bizon and Ionel Bostan

Keywords: *Digital Twin, Q-Learning, Pick-and-Place, Real-Time Simulation, Reinforcement Learning, Industry 4.0*

Abstract: Digital Twin technology offers new opportunities for optimizing industrial operations. In the context of Pick-and-Place operations, a real-time framework is proposed that integrates a Unity-based digital twin, synchronized with a Siemens S7-1200 PLC, and a Q-Learning algorithm to reduce cycle time without compromising positional accuracy. The Digital Twin continuously collects kinematic and state data (positions, velocities, accelerations, vacuum states) via a PLC web server. The Q-Learning algorithm is trained offline in the simulated environment to learn an optimal X- and Y-axis movement policy, Z-axis control, and vacuum management. The learned policy is then transferred to the live system, avoiding wear and tear on the physical equipment. Experimental results indicate an approximately 10% reduction in total cycle time and maintain positional deviations below 2%, compared to conventional control. This solution demonstrates the feasibility of real-time optimization through reinforcement learning in industrial environments and opens up prospects for adaptive, data-driven control strategies within Industry 4.0.

A Systematic Review of Machine Learning and Deep Learning Techniques for Exoplanet Detection

Pooja Illangarathne, Janani Harischandra and Kanishka Hewageegana

Keywords: *Exoplanet Detection, Machine Learning, Deep Learning, Hybrid Models*

Abstract: The search for exoplanets has rapidly advanced with the surge of astronomical data from missions such as Kepler, Transiting Exoplanet Survey Satellite (TESS), and James Webb Space Telescope (JWST). In this context, Artificial Intelligence (AI) techniques particularly Machine Learning (ML) and Deep Learning (DL) have become essential tools for detecting planetary candidates in vast and noisy datasets. This systematic review examines studies across four major databases (IEEE, Springer, Web of Science, and Semantic Scholar), focusing on the evolution, application, and comparative performance of ML and DL approaches in exoplanet detection. The review reveals that DL methods, outperform ML in accuracy and scalability, while ML techniques remain valuable for interpretability and real-time applications. Emerging hybrid models combine strengths from both paradigms to improve robustness, adaptability, and scientific utility. This paper presents a detailed taxonomy of AI techniques, comparative evaluations, and outlines challenges such as interpretability, data quality, and computational efficiency. The paper critiques current limitations in exoplanet detection and suggests future research directions, recommending the integration of machine learning and deep learning models.

Dimensionality Reduction with Principal Component Analysis for Fire And Non-Fire Audio Classification: A New Approach

Robert-Nicolae Boştinaru, Nicu Bizon, Sebastian-Alexandru Dragusin, Gabriel-Vasile Iana and Denisa Toma

Keywords: *PCA, Audio Classification, Fire Detection, Dimension Reduction, Machine Learning (ML), Mel-Frequency Cepstral Coefficients (MFCCs), Chroma, Spectral Centroid, Zero-Crossing Rate (ZCR), Environmental Sound Recognition, Feature Extraction*

Abstract: In recent years, the automatic detection of fire events using acoustic analysis has gained momentum as a viable alternative or complement to traditional sensor-based systems. This paper proposes a modern approach for the classification of fire and non-fire audio smears using principal component analysis (PCA) for dimensionality reduction and supervised machine learning classifiers. Feature vectors are extracted from real-world audio datasets using Mel-frequency cepstral coefficients (MFCCs), Chroma, Spectral Centroid, and Zero-crossing rate (ZCR), they are then compressed via PCA to preserve the most relevant features. These findings highlight the potential of PCA-enhanced audio classification models in real-time sensing systems, including Internet of Things (IoT) and smart city infrastructures. The study concludes with recommendations for the integration of autoencoders, Uniform Manifold Approximation and Projection (UMAP) and audio-visual learning architectures in future research.

Optimal control of a robot manipulator during a load-unload operating cycle

Huynh Nguyen Dinh, Phong Phan Dang, Khoa Do Dang and Sanh Do

Keywords*: Optimal control, Pontryagin's Principle, manipulator, palletizing robot*

Abstract: This paper introduces an optimal control approach for a palletizing manipulator operating within a load-unload cycle. By employing the matrix representation of the Lagrange dynamics, the motion equations of the manipulator are systematically derived. An energy-based objective function, together with terminal state constraints, is incorporated into the Hamilton formulation. By applying Pontryagin's Principle to this formulation, a set of optimality conditions is obtained in the form of a two-point boundary value problem. This problem is then addressed through numerical simulation using computer software, thereby validating the effectiveness and applicability of the proposed control strategy.

Development of an AI-Enhanced Arduino-Based Photovoltaic Tracking System for Optimized Energy Efficiency

Cornelia-Mihaela Novac, Marius Codrean, Mihaela Codrean, Ovidiu-Constantin Novac, Cornelia Emilia Gordan and Radu Sebesan

Keywords*: photovoltaic systems, automatic orientation, Arduino, energy efficiency*

Abstract: This article aims to develop an automatically oriented photovoltaic system using the Arduino platform to maximize solar energy capture efficiency. The study investigates the effect of panel orientation angles on energy output by utilizing a solar tracking system that adjusts the position of the photovoltaic panels in response to light intensity. The primary objective is to optimize input parameters to ensure higher energy efficiency. Precise control of panel orientation and improved energy efficiency are the primary benefits of this approach.

Handling imbalanced data: the SMOTE technique

Calin Sandu and Racuciu Ciprian

Keywords: *machine learning, SMOTE, imbalanced data, healthcare, class distribution*

Abstract: In machine learning projects the quality and structure of data play a critical role in determining model performance. One common challenge in real-world datasets is class imbalance, where one class significantly outnumbers others. This imbalance can lead to biased models that perform well on the majority class but poorly on the minority class, resulting in misleading accuracy and limited generalization. A widely adopted solution to this problem is SMOTE (Synthetic Minority Over-sampling Technique), which generates synthetic samples for the minority class to help balance the dataset. This paper explores how SMOTE works, its advantages over traditional oversampling methods and its impact on improving model performance in imbalanced classification tasks. A practical, step-by-step implementation is also presented to illustrate how SMOTE can be applied to a real-world imbalanced dataset, making this paper a useful guide for practitioners and researchers seeking to understand and use the technique effectively.

SPI Digital Twin in MATLAB/Simulink

Laura-Alexandra Gheorghe, Elena-Adriana Sorega and Lidia Dobrescu

Keywords: *MATLAB/Simulink, SPI, System simulation, Modeling*

Abstract: System simulation is already state-of-the-art in the era of digitalization. In order to keep up with the latest megatrends, this work aims to present a Simulink model of the Serial Peripheral Interface used in a wide spread of automotive applications, supporting fast design-in. The main benefit consists in a fully customizable solution that combines all modeling components: µC (Microcontroller) ↔ SPI ↔ PROFET™ (PROtected FET) into a single Simulink project. Once the set-up is implemented for the pilot project, it can be reused for many other products, being a cost-effective method. This customer's demand appeared because Spice based simulators are analog oriented and the digital part cannot be integrated. The SPI Simulink model is completely configurable in terms of: register's bit length, MSB/LSB first, clock phase/polarity, being compatible and easy to integrate in use cases for different types of applications.

Optimization of predictive maintenance processes for mechatronic systems using artificial intelligence

Aurel Mihail Titu, Emanuel Balc, Mihai Dragomir, Daniel Balc and Claudiu Covaci

Keywords: *predictive maintenance, mechatronic systems, artificial intelligence, machine learning, Industry 4.0.*

Abstract: In the fast-evolving landscape of industrial automation, maintaining the performance and reliability of mechatronic systems has become increasingly critical. Traditional maintenance strategies, such as reactive and time-based preventive approaches, often lead to inefficiencies, unplanned downtime, and excessive operational costs. This research explores the application of artificial intelligence (AI) in optimizing predictive maintenance (PdM) processes for mechatronic systems, with a focus on improving system uptime, extending asset life, and reducing maintenance overheakd. The study adopts a mixed-methods approach, combining a detailed literature review with case study analysis and model development. By examining real-world implementations from industries such as manufacturing and rail transport, the research identifies key enablers and obstacles in the transition to AI-driven PdM. A structured framework is proposed, guiding organizations through the steps of data acquisition, model selection, integration, and continuous improvement Findings suggest that AI, particularly machine learning and deep learning techniques, significantly enhances the accuracy and timeliness of failure predictions when supported by high-quality sensor data. However, challenges such as data scarcity, system integration, model transparency, and ethical concerns remain barriers to widespread adoption. This work contributes a practical, scalable roadmap for organizations aiming to move beyond traditional maintenance paradigms. It emphasizes the value of aligning technological innovation with human expertise to create more resilient, efficient, and intelligent maintenance ecosystems in the era of Industry 4.0.

Multi-Stream Head Pose Estimation Algorithm Based on Enhanced Feature Extraction

Zihan Liu, Bin Zou, Guohao Liu and Song Jiang

Keywords: *head pose estimation, feature extraction, convolutional attention, asymmetric convolute, bottleneck residuals*

Abstract: Aiming at the existing head pose estimation algorithms with poor real-time performance and low detection accuracy in complex scenes, a Multiple Stream head pose estimation algorithm based on enhanced feature extraction is proposed（FEEM-Net）. First, a three-branch parallel structure is designed with different activation functions and pooling methods to enhance the diversity of feature expression at the same level through multi-channel feature extraction. Second, the CBAM convolutional attention module is introduced after the pooling layer to focus the head region features by using the channel and spatial attention mechanism to effectively suppress the background interference. Finally, a bottleneck residual module based on asymmetric convolution is proposed to enhance the modeling ability of multi-scale and multi-directional information, and improve the information flow transfer efficiency by residual connection. Experimental results show that the proposed algorithm reduces the MAE to 4.63 and 4.06 on the AFLW2000 and BIWI datasets respectively.

Testing Framework for Nuclear Fuel Handling Machines: Design Requirements, Standardization, Specific Technical Issues, and Engineering Challenges

Constantin Darie Predescu, Ionuț Dobrin and Magdalena Maria Vilău

Keywords: *Nuclear fuel handling, CANDU, Out-of-Pile Testing, Advanced Automation*

Abstract: In the context of Romania's expanding nuclear energy program and global initiatives focused on Generation IV advanced reactors, the testing of nuclear fuel handling machines has become essential for ensuring safe and efficient reactor operation. This paper analyzes the applicable design requirements, international standards (IAEA SSG-63, REGDOC-2.4.5), and testing procedures for fuel handling equipment, with emphasis on validated technical solutions used in CANDU, PWR, BWR, SFR, and LFR reactors. The specific characteristics of CANDU systems - enabling online refueling under high-pressure and high-temperature conditions - are highlighted, along with the advantages of Out-of-Pile testing using dedicated facilities. Romania's extensive experience gained through the complete testing of Fuel Handling Machines (F/M) for Unit 2 at CNE Cernavodă provides a strong foundation. This expertise will inform the upcoming test campaigns for Units 3 and 4, to be conducted at the F/M Testing Rig developed at ICN Pitești, which also includes a custom full-scope simulator. The paper discusses specific testing challenges, from replicating thermal-hydraulic conditions to addressing the absence of radiological effects, and outlines the key lessons learned for future generations of equipment. Finally, emerging research directions are explored, including AI integration, advanced automation, and digitally assisted testing. These developments aim to enhance equipment reliability, reduce maintenance time, and enable realistic validation of fuel handling technologies tailored for the next generation of nuclear systems.

Implementing artificial intelligence in a RAD application in the field of industrial automation

Georgi Mihalev

Keywords: *Artificial intelligence, RAD application, GPT, Industrial Automation, PC-based Control Systems*

Abstract: In this article, approaches for implementing Artificial Intelligence (AI) functionalities into Rapid Application Development (RAD) environments are explored. The study emphasizes the advantages of building PC-based control systems through RAD applications, considering both speed of development and flexibility. Various strategies for integrating Generative Pretrained Transformers (GPT) models into PC-based industrial control systems are reviewed and proposed. Specific programming implementations in high-performance computing (HPC) languages such as C++ and Python are presented, illustrating practical methods for enabling AI-driven functionalities within industrial environments. A comparative analysis is conducted based on key criteria, including implementation complexity and the execution time for sending and receiving responses from GPT models. Validation is performed through tasks related to technological process control, focusing on PID controller tuning and system identification using example processes. The paper discusses the challenges and benefits of different integration methods and highlights practical guidelines for choosing the most effective approach in real-world applications.

Deep Learning-Based Road Activity Image Classification for Intelligent Traffic Management

Sivaranjini Perikamana Narayanan, Ajit Jha, Linga Reddy Cenkeramaddi and M.Sabarimalai Manikandan

Keywords: *Urban Scene, Convolutional Neural Network, Road Image Classification, Intelligent Transportation Systems*

Abstract: Automatic vehicle classification is a crucial aspect of intelligent transportation systems for monitoring traffic flow, security enforcement, automated parking, driver assistance, and autonomous vehicle control. These systems face challenges such as limited computational resources, limited sensor range, and communication channels, which demand fast and lightweight algorithms for accurate and reliable performance. This paper presents an accurate, fast, and lightweight convolutional neural network-based vehicle image classification model for intelligent traffic management applications using the urban scene database. The dataset includes multiple scenes captured during morning, evening, and night, presenting diverse lighting and environmental conditions. The performance of the proposed model is evaluated in terms of class-wise accuracy, overall accuracy, and computational resources. The proposed CNN model achieves an overall accuracy of 99.33% with an inference speed of 188fps and a model size of 16.6MB, and outperforms most of the benchmark pretrained models. The classification accuracy highlights the model's reliability and adaptability to real-world challenges such as variable lighting conditions.

Enhancing LLM-Based Text Compression with Context-Aware Frequency Adaptation

Rishika Kinger, Rajith Murali, Pranav Krishna, Meghana Goru and Sujatha R Upadhyaya

Keywords: *Data compression, Large Language Models, Frequency tables, Neural compression, Adaptive encoding*

Abstract: This paper introduces a novel approach to text compression that integrates a large language model with a context-aware frequency adaptation mechanism. Traditional large language model-based compression methods rely solely on model predictions to encode text efficiently. The approach extends this method by constructing context-specific frequency tables for each processing window, which are then used to bias the model's logit distribution before encoding token ranks via arithmetic coding. The method is evaluated on standard compression benchmarks, enwik8 and enwik9 from the Hutter Prize, and on a custom dataset compiled from Project Gutenberg. Using the Llama-3.2-1B model as the base model, alongside the zlib compression library for final encoding, the frequency-scaled approach consistently outperforms both baseline large language model-based compression techniques and traditional compressors. The method achieves compression ratios of 6.4385 compared to 5.8271 for the unscaled large language model approach and 4.0217 for the Lempel–Ziv–Markov chain algorithm on enwik8, 6.7866 versus 6.0632 and 4.6867 on enwik9, and 5.1762 versus 4.8124 and 3.7802 on the Gutenberg dataset. These findings underscore the potential of augmenting large language models with local statistical adaptations to enhance lossless text compression

URL-Based Phishing Detection and Comparison of Encoding Approaches

Muhammed Mutlu Yapici

Keywords*: phishing detection, deep learning, encoding approaches, URL classification*

Abstract: Today, the internet is extensively utilized across numerous domains. With indispensable applications ranging from education to healthcare, and from banking systems to e-commerce, it also attracts the attention of malicious actors. In the first quarter of 2024 alone, approximately 10 million attacks were recorded. Therefore, the detection and prevention of internet-based attacks is an increasingly critical issue that demands resolution. In this study, we propose three deep learning-based models for the detection of URL-based phishing attacks. Additionally, we examine the impact of Word Encoding (WE) and Character Encoding (CE) approaches on the performance of these models. The results demonstrate that the WE approach yields superior performance on large-scale datasets. Conversely, the CE approach achieves better results on smaller datasets that are insufficient for effective model training. In all experiments, the CNN model emerged as the most successful, achieving an accuracy of 0.99732 on the first dataset and 0.83447 on the second dataset.

Blockchain-Enabled Smart Contracts for IoT: Enhancing the Reliability of Electronic Evidence

Kanika Pandit and Dr. Renu Mahajan

Keywords: *Blockchain, Smart Contracts, Internet of Things (IoT), Electronic Evidence*

Abstract: The fast spread of Internet of Things (IoT) devices has created major difficulties to uphold data security and maintain its reliability and integrity for interconnected systems. Traditional centralized systems cannot protect electronic evidence sufficiently in zero-trust environments because they lead to evidence that becomes vulnerable to unauthorized tampering. Blockchain technology solves these issues effectively through decentralized data processing and unalterable databases that remain easily viewable to all users. The research investigates blockchain smart contracts as a solution to improve IoT electronic evidence reliability by implementing automated access verification and data integrity assessment and event activation. Automated smart contract technology establishes transparent data security through policy enforcement which happens without third-party organizations. The research demonstrates how blockchain technology and smart contracts assist different industries like healthcare facilities and supply chains and industrial Internet devices and smart cities to operate. This research describes the principal obstacles within the field like scalability problems together with resource constraints and legal complications while offering recommendations about possible future investigations. Through blockchain technology alongside smart contracts this research develops a framework which enhances the reliability and security of IoT electronic evidence while benefiting IoT ecosystem reliability and safety.

Human-Machine Interface for the Fuel Handling System in CANDU-600 Nuclear Reactors. Design Requirements and Standards, Proposed Solutions and Encountered Issues, Objectives and Challenges

Ionut Dobrin, Constantin Darie Predescu and Magdalena Maria Vilau

Keywords: *CANDU, Fuel Handling System, Human Machine Interface, Standards*

Abstract: The Control Room plays a central role in the operation and supervision of the Fuel Handling System in CANDU-600 nuclear reactor, being responsible for critical decision-making during system exploitation. The current state of the workforce and the limited number of highly trained personnel in this field highlight the need to optimize and simplify operator workload by developing systems capable of taking over parts of their tasks. Romania must develop new electricity generation capacities to support the transition toward a low-carbon economy while ensuring stability, security, and availability within the National Energy System, as well as generating socio-economic benefits. The completion of Units 3 and 4 Project at the Cernavodă Nuclear Power Plant is positioned to deliver these outcomes. This paper aims to explore new solutions for improving the Human-Machine Interaction in Fuel Handling Systems by investigating the implementation of modern display, data acquisition, and control systems suitable for use in the Fuelling Machine Testing Rig located in the Institute for Nuclear Research Pitești. This work addresses the selection of relevant design requirements and standards for nuclear Human-Machine Interfaces, the identification of operational issues encountered in the Control Room, the proposal of improvement solutions, as well as the definition of objectives, while considering the necessity of preparing and optimizing the testing facility for the acceptance and pre-acceptance tests of the Fuelling Machines for Units 3 and 4.

Cultural Fashion Synthesis: Generating Indian Ethnic Wear from Textual Prompts Using GALIP

Hitesh Yadav M, Jayanth K, Gowtham S and Darshan V

Keywords*: Indian ethnic wear, GAN, GALIP, CLIP, text-to-image generation, traditional fashion, cultural fashion synthesis, FID, image synthesis*

Abstract: This paper presents a novel application of Gener ative Adversarial Networks in the culturally significant domain of Indian ethnic wear fashion. Leveraging the Generative Adver sarial Contrastive Language–Image Pretraining approach, Our Proposed system is capable of synthesizing high-quality Indian Men's traditional attire such as kurtas, sherwanis, Indo-Western outfits, and Nehru jackets , based on text descriptions.The model is trained on a comprehensive dataset of ethnic wear, encompassing diverse categories and intricate details such as fabric type, color,embroidery work, and recommended occa sions.The proposed system allows users to visualize personalized traditional outfits from descriptive text. A robust image similarity retrieval system is utilized that connects generated images with actual images of products. Evaluation results using the Fr´ echet Inception Distance and Cosine similarity metrics of contrastive models demonstrate that the system produces coherent and visually consistent images.This work highlights the potential of Generative Artificial Intelligence solutions in such specific fashion settings, giving designers and consumers an enriched, interactive experience of ethnically inspired outfits.

Metallic Oxide Pigments Analysis Applied in Painting Techniques

Alina Maria Iancu and Adriana-Gabriela Schiopu

Keywords: *metallic oxide pigments, painting, pigment dispersion, painting techniques*

Abstract: This study explores the application of metallic oxide pigments in watercolor painting, focusing on the dispersion behavior and aesthetic performance of pigments such as nickel oxide (NiO), zinc oxide (ZnO), and cobalt oxide (Co_2O_3). Ten different pigment formulations were prepared using varying ratios of demineralized water, surfactant (Tween 80), and binder (Arabic gum), and were applied on watercolor paper to evaluate their visual and technical characteristics. The results highlight the critical role of gum arabic in achieving uniform, well-adhered layers and the importance of maintaining a balanced ratio between pigment, liquid, and dispersing agents. Samples containing both surfactant and binder exhibited improved homogeneity, color intensity, and stability. In contrast, samples lacking binder showed weak dispersion and poor fixation. The study identifies optimal formulations and offers practical recommendations for future research and artistic applications involving metal oxide-based watercolors.

Optimization of Object Detection Capabilities in a FPGA SoC Using the Yolo-Tiny Model

Hieu-Truong Ngo, Minh-Phat Le Tang, Xuan-Dung Nguyen, Thai-Thach Dang and Huu-Nghia Huynh Luu

Keywords: *OpenCL, FPGA, YOLO3-Tiny, Object Detection, HPS-FPGA*

Abstract: This research aims to optimize object detection capabilities on the FPGA Arria 10 SoC platform using the YOLO-tiny model. The system integrates hardware and software to optimize data flow with OpenCL. The study uses half-precision floating-point data to balance performance and hardware resource savings, significantly reducing resource requirements without compromising accuracy. Additionally, the system incorporates a data flow pipeline approach. Experiments on a standard dataset demonstrate that the system achieves an average processing speed of 220ms per frame with performance improvements ranging from 15% to 20% when we implemented on-board FPGA Arria 10. These results validate the system's efficiency and highlight its potential applications in AI systems designed for edge devices, which demand high performance while conserving energy and meeting the requirements of real-time applications.

Toward Sustainable Aviation: A Systematic Analysis of Strategies to Reduce Environmental Impact

Zaki El Hani, Abdelmajid Elouadi, Youssef Rochdi and Jaouad Karroum

Keywords: *Sustainable aviation, CO_2 emissions reduction, alternative fuels, biofuels, synthetic fuels, liquid hydrogen, composite materials, carbon fiber composites, electric aviation, lifecycle assessment, artificial intelligence in aviation, operational optimizat*

Abstract: Over the past few years, the aviation sector has come under growing pressure to adopt environmentally responsible practices, particularly by cutting down on CO_2 emissions that harm ecosystems. This review synthesizes existing literature on innovative strategies and technological developments aiming to support this transition. Particular attention is given to alternative fuels such as liquid hydrogen, biofuels, and synthetic alternatives which offer substantial potential to reduce carbon emissions, despite persistent barriers related to cost, availability, and infrastructure readiness. The integration of lightweight composite materials has shown benefits in terms of fuel consumption, yet also presents concerns regarding their end-of-life management and recyclability. Electric propulsion systems are gaining momentum for regional and short-haul applications, although their scalability remains limited by energy storage capabilities and insufficient charging infrastructure. Meanwhile, artificial intelligence is emerging as a strategic asset, supporting more efficient operations, resource optimization, and waste reduction. The review methodology is grounded in the PRISMA protocol for article selection, supported by qualitative coding via NVivo and bibliometric analysis using VOSviewer. Overall, the findings underline that achieving meaningful progress in sustainable aviation extends beyond technological solutions, requiring a concerted effort that brings together regulatory frameworks, industrial innovation, and academic research. The insights provided serve as a foundation for guiding future initiatives toward environmentally responsible aviation.

Deep Fourier Magnitude Spectrum Based Signal Quality Assessment for Reducing False Alarms Under Noisy Recordings

Yalagala Sivanjaneyulu, M.Sabarimalai Manikandan and Srinivas Boppu

Keywords: *Fourier magnitude Spectrum, Hamming Window, Fast Fourier Transform, PPG-FMS Quality Assessment, Convolutional Neural Network*

Abstract: In this study, we propose an automatic photoplethysmogram (PPG) Fourier magnitude spectrum (FMS) quality assessment (PPG-FMS-QA) using deep convolutional neural network (CNN/ConvNet) architectures to reduce false alarm rates. Acceptable and unacceptable quality raw PPG segments are multiplied with a Hamming window (HW) and further computed the FMS using a fast Fourier transform (FFT) to avoid the leakage problem. The noise-free (NF) or acceptable PPG segments are collected from different standard databases. The noisy or unacceptable PPG segments are collected using three sets of noise sources such as wrist-cup database (N-WDB01), random noise corrupted PPG segments (N-RDB02), and acceleration noise corrupted PPG segments (N-ADB03). The proposed method includes a total of six 1D-ConveNet architectures, such as 2 and 4-convolutional layers (CLs) with 16, 32, and 64 kernels, and rectified linear unit (ReLU) activation function (AF). From the evaluation results, the proposed 4-layer with 16 filters and ReLU outperformed other models in terms of benchmark metrics. For the known dataset, the optimal model achieved an accuracy of 70.10% for NF versus N-WDB01, 99.16% for NF versus N-RDB02, and 91.62% for NF versus N-ADB03. Further, the method was tested using unseen databases and achieved an accuracy of 91.36\% for vitalDB, 51.53% for PulseDB.

Image-Based Artificial Intelligence for Early Diagnosis of Ocular Diseases

Adriana-Andrada Ciorobea, Nicu Bizon, Sebastian-Alexandru Dragusin, Cosmin-George Nicolaescu, Robert-Nicolae Bostinaru and Andrei-Alexandru Besliu-Gherghescu

Keywords: *ocular disease detection, artificial intelligence, deep learning, convolutional neural networks, medical image analysis, ophthalmology, early diagnosis, computer-aided diagnosis*

Abstract: Early diagnosis of ocular diseases is crucial for preventing vision loss and ensuring timely medical intervention. This study proposes an advanced artificial intelligence (AI)-based approach for the automated classification of ocular diseases using medical imaging. The proposed model employs convolutional neural networks (CNNs) to analyze retinal images and categorize patients into eight diagnostic classes: Normal, Diabetes, Glaucoma, Cataract, Age-related Macular Degeneration (AMD), Hypertension, Myopia, and other diseases/abnormalities. The dataset used in this research consists of annotated ophthalmic images labeled by expert clinicians. A comprehensive preprocessing pipeline, including noise reduction, contrast enhancement, and augmentation techniques, was applied to improve model performance. The classification model was trained using state-of-the-art deep learning architectures, and its performance was evaluated using accuracy, precision, recall, and F1-score metrics. Experimental results demonstrated that the proposed model achieves high classification accuracy and outperforms existing approaches in detecting early-stage ocular diseases. The study highlights the potential of AI-driven diagnostic tools to support ophthalmologists in clinical decision-making and improve the accessibility of eye disease screening.

Feasibility of Impulse Radar-Based Through-Wall Imaging for Human Detection in Search and Rescue: A Study on Accuracy, Material Penetration, and Deep Learning Integration

Vrian Jay Ylaya, Sharralouze Sinugbuhan and Jovin Jecharr Becena

Keywords*: Impulse Radar Technology, Through-Wall Imaging, Urban Search and Rescue (SAR), Deep Learning Algorithms, Building Materials Penetration, Detection Accuracy Optimization*

Abstract: This study investigates the feasibility of a portable impulse radar-based through-wall imaging system integrated with deep learning algorithms to enhance urban search and rescue (SAR) operations. The system addresses critical limitations in traditional detection methods during disaster scenarios by employing ultra-wideband impulse radar technology coupled with specialized antennas and PicoR 5.0 software. This combination enables the penetration of diverse building materials, including concrete (10 cm), wood, and fiber cement. Through controlled experimental trials and field tests, researchers evaluated detection accuracy and response time across varying wall thicknesses and material compositions, utilizing Convolutional Neural Networks (CNN) for advanced signal processing and target identification. The system demonstrated an overall detection accuracy of 89%, with material-specific performance variations: concrete walls showed reduced precision (70%) but maintained high recall (93%). In comparison, wood and open spaces achieved exceptional precision exceeding 97%. Deep learning integration proved crucial, improving system robustness against environmental interference and enabling the identification of stationary subjects through micro-movements associated with breathing. Field validation using a portable cart-mounted unit confirmed operational viability across multiple scenarios, successfully detecting moving adults/children and static individuals through 10 cm concrete barriers. Key findings from 320 test cases revealed an average F1 score of 89% across materials, with confusion matrix analysis showing 285 correct classifications. The technology's effectiveness correlated strongly with material permittivity and signal-to-noise ratio optimization. These results position impulse radar combined with machine learning as a transformative tool for emergency response, providing real-time situational awareness in collapsed structures.

Intelligent Synthesis of Antenna Array Radiation Patterns using Woodward-Lawson Algorithm

Ramzi Kheder, Wided Amara, Ridha Ghayoula, Jaouhar Fattahi and Lassaad Latrach

Keywords: *Woodward-Lawson algorithm, Antenna array, Radiation pattern*

Abstract: The Woodward-Lawson method combines theoretical frequency sampling with practical parameter adjustments to synthesize antenna arrays that generate customized radiation patterns. In this paper, we provide a synthesis and analysis of radiation patterns for linear antenna arrays using this method, detailing the mathematical framework involved. We validated our approach through simulations of two antenna arrays—one with 10 elements and the other with 20 elements—comparing the results to theoretical predictions. Our evaluation focused on key performance metrics such as directivity, sidelobe levels, and overall efficiency. The findings in this paper demonstrate that the Woodward-Lawson method effectively models and assesses antenna performance, confirming its utility in achieving desired radiation characteristics and providing a valuable reference for future antenna array research.

Two Stage Single Phase PV System Using Sepic Converter

Nguyen Duc, Nguyen Viet, Pham Dai and Bui Dai

Keywords: *P&O algorithm, MPPT, MPC, Double Stage*

Abstract: The design and modeling of a two-stage, single-phase grid-connected photovoltaic (PV) system with a DC-DC converter and a DC-AC inverter are presented in this work. The system is built to provide effective power transfer to the grid while optimizing energy extraction from PV panels. In the DC-DC stage, a SEPIC converter regulates the PV array's output voltage and integrates a maximum power point tracking (MPPT) algorithm to optimize energy harvesting. The Perturb and Observe (P&O) method continuously adjusts the PV operating voltage, ensuring operation at the maximum power point (MPP) under varying conditions. The regulated voltage is then supplied to the DC-AC stage, where a single-phase inverter converts DC power into AC and synchronizes it with the grid. To enhance current control, reduce harmonics, and improve dynamic response, Model Predictive Control (MPC) is applied to the inverter. An L-filter at the inverter output minimizes switching noise and ensures compliance with grid standards. A key component of the system is the phase-locked loop (PLL), which synchronizes the injected current with the grid voltage, ensuring power delivery at the correct frequency and phase. This study analyzes and improves the PLL structure to enhance phase detection accuracy and response speed. MATLAB/Simulink is used to simulate the system in order to evaluate its performance under various operating scenarios. Simulation results confirm effective MPPT operation, stable DC voltage regulation, and high-quality grid-injected current that meets grid standards. By integrating advanced control strategies, this work proposes a robust and efficient solution for grid-connected PV systems, contributing to the reliable integration of renewable energy into the power grid.

A novel approach on Cloudlets based applications using Meta-heuristic technique

Zdzislaw Polkowski, Jyoti Prakash Mishra, Sambit Kumar Mishra and Anwesha Mishra

Keywords: *Cloudlet, Meta-heuristic, Distributed database, Resource allocation, Load balancing*

Abstract: In general, the computing resources linked with distinct distributed locations can be termed as cloudlets. Particularly, these are more provisioned within the latency sensitive and edge computing environments. These decentralized clouds can be deployed within the boundary of the network, closely associated with the system. In such situation, adequate computation adopting low-latency may seek real-time processing. The primary intention in this case is to accumulate the computing resources nearer to the application accessed through central cloud data centers. It is understood that in the cloudlet based environment, the essentiality is observed while allocating the resources on variety of tasks and optimizing the performance minimizing the delay response. Many times several cloudlets can be able to process variety of applications after receiving the requests from other computing resources linked to task execution. In such situation, after verification of the type of applications, the appropriate cloudlet may be retrieved among multiple cloudlets. So adopting specific strategies, the latency linked with applications during execution can be minimized. Accordingly, to optimize the resources within the cloudlets and to prioritize specific aspect like scheduling of tasks, allocation of resources and managing the loads on the processing elements, meta-heuristic technique, specifically particle swarm optimization can be applied to obtain the optimal solution by simulating a swarm of particles.

Determination of the dietary needs of a type 2 diabetic patient: A neural network approach

Sidi Mwakalu, Vincent Omwenga and Patrick Ogao

Keywords: *Diet, Macronutrients, Neural network, Plasma glucose concentration, Type 2 diabetes*

Abstract: Diabetes mellitus is a major global health concern, with an estimated 537 million individuals affected in 2021. More than 90% of these cases are classified as type 2 diabetes. Among the key lifestyle management strategies for diabetic patients, dietary modification plays a crucial role in regulating plasma glucose levels. However, the optimal macronutrient composition for effective glycemic control in type 2 diabetes remains unclear. Existing dietary recommendations for diabetes management are often generalized, lacking specificity in both quality and quantity of dietary intake. To address this challenge, this study developed a neural network-based classifier to determine the dietary suitability of various foods for type 2 diabetic patients with different comorbidities. The classifier categorizes foods for four distinct patient groups: (i) type 2 diabetes with chronic hyperglycemia, (ii) type 2 diabetes with hypertension, (iii) type 2 diabetes with obesity, and (iv) type 2 diabetes with all three conditions. The model was trained using data from the Kenya Food Composition Tables, which contain detailed information on macronutrient and micronutrient content, as well as food processing techniques. The neural network architecture comprised five layers, including three hidden layers with ten neurons each. Key hyperparameters included the tanh and sigmoid activation functions, gradient descent for optimization, cross-entropy as the loss function, and a learning rate of 0.1. During training, the model was optimized with 40 hidden neurons per layer, 60,000 epochs, and a learning rate of 0.2. Model performance was evaluated using five key metrics: Accuracy (91.4%), Precision (86.8%), Recall (88%), F1-Score (86.9%), and Matthews Correlation Coefficient (MCC: 0.808). The high MCC score indicates a strong correlation between the classifier's predictions and the labeled classes, demonstrating its effectiveness in dietary classification for type 2 diabetic patients with comorbid conditions.

Digitalization of the Judicial System in Romania. Important Strategic Objective and Guarantee for a Modern, Fast and Effective Justice System

Steluta Ionescu, Cristian Mares and Alin Petrea

Keywords: *justice, judicial system, digitization and digitalization, Smart justice, Cyberjustice*

Abstract: Today, digitalization is a notorious topic. The problem is no longer circumscribed to computer science, as an important field of science. Through the effects it produces, digitalization has become a phenomenon that transforms social life, under all its aspects. And, like any transformation, digitalization brings change, a change that it imposes quickly and requires an appropriate reaction. To the point, the adaptation of the public service of justice new challenges is a real need and a process always in progress. From this perspective, for over two decades, in Romania, the justice reform has been aiming for a modern, fast, efficient judicial procedure, attributes achievable only by integrating them into the current information society, based on computer science and similar solutions. Thus, at strategic level, between the fundamental premises of the reform of the judicial system, digitalization would occupy an important place. Equally, important changes would also be made in a concrete dimension, through the proper endowment of the courts and prosecutors' offices, as well as thorough the training of the personnel for their use. The study starts with a necessary exercise in defining the terms, synthetically captures the evolution of reform projects of the last decades, the stage of achievements in the field and treats the problem from the perspective of practical utility, that is, of the benefits of a coherent digitalization process, which implements and develops IT solutions for optimization of work. We insist on understanding by benefits of digitalization: direct assistance of the judge, prosecutor and clerk; court management; communication between courts and litigants; securely managing the information system, with the protection of personal data. As for new technological products, seductively qualified as Smart justice or Cyberjustice, as projections of implementing artificial intelligence in the judicial system, we invite to caution, evoking the need for major social responsibility that the judicial system has and emphasizing the fact that the act of justice must remain an approach by man for man. Justice - even digitized - is essentially the justice made by man, with his virtues and weaknesses, helped or assisted by tools to take over his tasks - repetitive, routine, time-consuming - so that justice, expected by the litigant, comes harmoniously, with the use of wisdom, of balance, all essentially human attributes.

Evaluation of Service Assurance in MPLS Networks for Medical Image Transfer

Cristian Stanescu, Gabriel Predusca, Liana Denisa Circiumarescu, Nicoleta Angelescu, Dan Constantin Puchianu and Cezar-Gabriel Dumitrache

Keywords: *medical images, MPLS, OpenSimMPLS, QoS*

Abstract: This paper presents an updated performance analysis of MPLS (Multiprotocol Label Switching) networks used for the transmission of medical images. A new configuration for the MPLS model is proposed and evaluated using the OpenSimMPLS simulation platform, with results compared against a previous model. The focus is on guaranteeing a level of service (GoS) through improved packet transmission rates, reduced delay and jitter, and optimized network behaviour under medical imaging traffic. The results demonstrate that the new configuration offers higher performance and reliability in handling medical image traffic.

A New Approach to Diagnose Driver Drowsiness using an Ensemble of Deep CNN Classifiers with Decision Fusion

Gabriela-Loredana Ghenea and Victor-Emil Neagoe

Keywords: *driver drowsiness, Deep CNNs, decision fusion, Dempster-Shafer theory, YOLOv5*

Abstract: This paper presents a novel approach to diagnose driver drowsiness using an ensemble of Deep CNN classifiers based on Dempster-Shafer decision fusion. The proposed method firstly uses YOLOv5 vs DLIB C++ Library for face localization. The detected faces are then classified into one of three drowsiness states – low, vigilant and alert – using an ensemble of M Deep CNN classifier modules. The decision fusion based on Dempster-Shafer theory is applied to combine the outputs of the M independent CNN modules, where we have considered the cases M=2, 3…,7. We have chosen VGG16 as CNN architecture. Using the proposed decision fusion technique, we have obtained an improved overall accuracy (OA) up to 97.66% for an ensemble of M = 3 CNN classifiers, by comparison with the best accuracy of a standalone classifier of only 78.66%.

An Overview of Pseudorandom Number Generators With Bit Rotations

Veronica Cornaciu and Ciprian Racuciu

Keywords: *PRNGs, bit rotation, cryptography*

Abstract: This article provides a detailed analysis of pseudorandom number generators (PRNGs) that employ bit rotation operations. It examines various generators such as RANROT, PCG, Xoroshiro128+, and RomuTrio, highlighting their principles, operational specifics, and performance characteristics. The advantages of bit rotations, including enhanced computational efficiency and superior statistical distribution, are discussed alongside potential implementation drawbacks. The comparative insights offered underline the significance of bit rotations in the advancement of efficient and statistically robust PRNGs suitable for simulation and cryptographic applications.

Hybrid Ant Colony and Q-Learning Algorithm for Swarm Robots: Path Planning and Collision Avoidance in Unknown Environments

Andrei Dutceac, Iulian-Constantin Vizitiu and Cristian Molder

Keywords: *Swarm robotics, Ant Colony Optimization, Q-learning, path planning, unknown environments*

Abstract: This paper presents a hybrid approach combining Ant Colony Optimization (ACO) and Q-learning for swarm robot path planning and collision avoidance in unknown environments. Traditional ACO-based path planning methods face challenges such as local minima and suboptimal solutions when navigating into complex environments. By integrating Q-learning, the proposed method enhances adaptive decision-making, enabling robots to dynamically explore and optimize their routes. The epsilon-greedy strategy balances exploration and exploitation, preventing robots from getting stuck in dead zones and allowing for the discovery of more efficient paths. Simulations conducted in MATLAB demonstrate that the ACO-Q-learning algorithm generates multiple alternative paths, improves overall path efficiency, and enhances swarm coordination compared to standard ACO and Artificial Potential Field (APF) methods. The results highlight the algorithm's potential for real-world swarm robotics applications, where decentralized robots must autonomously navigate and adapt to changing environments

Optimized Current-Source based on Brokaw Architecture for Constant Input Transistors Transconductance

Cristian Stancu, Anca Andreea Mitu, Andrei Neacsu, Lidia Dobrescu and Dragos Dobrescu

Keywords: *operational amplifier, current-source, temperature, transconductance, input-stage, CMOS technology*

Abstract: The demand for CMOS precision operational amplifiers in critical applications has steadily risen over time, driven by increasing requirements for enhanced accuracy and sensitivity. The input differential pair transconductance impacts important parameters such as the unity gain bandwidth and offset voltage drift. This paper focuses on designing and implementing an innovative current source that optimizes the bias slope to minimize the differential input transconductance fluctuation with temperature, alongside achieving lower cost and decreased die area. A total change in transconductance of only 7 µS over the entire studied temperature range is accomplished with this innovative approach. A comparison between the design provided in this paper and other works from literature is also carried out, with the first one showing superior performance. Corner simulations are also conducted for the proposed architecture to assess the circuit performance under process variations. The circuit layout is also provided.

Basal Ganglia Selection of the Cerebral Cortex Main Conscious Process

Mihai Popescu and Cristian Ravariu

Keywords: *basal-ganglia, main, process, selection, simulation*

Abstract: The somatic system - the system of human body interaction with the environment needs a rigorous control. This effort begins at the spinal level with the spinal reflexes, continues with the feedforward control at the level of cerebellum for the unconscious control of the posture and equilibrium, set at the basal ganglia which is the main process consciously executed in relation with the environment and ends at the cortex as the final level of integration by executing it. At the cerebellum level the hub of communication is the brain stem, whereas at the level of basal ganglia the hub of communication is thalamus. The purpose of this workpaper is the discussion and modeling of the direct and indirect paths motor program selection inside basal ganglia. Because there is a lack of inexpensive ways of investigation at the level of diencephalon, basal ganglia, brain stem and cerebellum it is convenient to work on cybernetic models and make simulations. To validate the models the results obtained can then be compared with the results from the reference. The modeling effort in this paper continues the work of some of our previous publications mentioned after all during the workpaper.

New Method for Sensitivity Analysis of Active Power and Total Harmonic Distortion in Non-sinusoidal State

Andrei Gheorghe, Sorin Deleanu, Paul Andrei, Emil Cazacu, Marilena Stanculescu and Horia Andrei

Keywords: *sensitivity analysis, real power, total harmonic distortion, total demand distortion, harmonic weights*

Abstract: The nonsinusoidal regime is present in almost every power network, triggering implications that negatively affect the connected equipment and the power system. Consequently, researchers allocate significant resources to treat the effects of a nonsinusoidal regime. The quality of energy directly results from the variation of the quantities which define the nonsinusoidal regime. This paper proposes a new method for the determination of the dependency between the real power (P), total harmonic distortion of voltage (THDu), total demand distortion of current (THDi) and the magnitudes of the voltage and current harmonics. Once implemented into the MATLAB software package, the calculation algorithm presented in the method addresses a real-life application. The errors are minimal while evaluating the real power P, THDu, and THDi by applying the sensitivities and comparing them with the values obtained from the classical definitions. Consequently, one regards the method proposed in this paper as correct.

Transient Thermodynamic Modeling and Simulation of a Packed Bed Thermal Energy Storage System

Lahcen El-Mahaouchi, Mourad Yessef and Ahmed Lagrioui

Keywords: *Thermal energy storage, Packed bed thermal storage, CFD, Heat transfer fluid HTF, Local Thermal Non-Equilibrium*

Abstract: This research article studied and simulated a packed bed thermal energy storage system to elucidate its thermodynamic behavior. A transient mathematical model for turbulent flow in a hybrid media, comprising both porous and transparent components, incorporating forced and natural convection, has been formulated. Comsol Multiphysics CFD software was employed for the numerical solution. The Local Thermal Non-Equilibrium (LTNE) methodology was utilized to assess heat transfer in both solid and fluid phases and to ascertain the thermal exchange coefficient between them, which is a critical characteristic for evaluating stored energy. Simulations were conducted on an axisymmetric cylindrical tank filled with pebbles (solid material) and circulated by a thermal oil, serving as a heat transfer fluid (HTF). The presented model was validated and approved using experimental data. The velocity distribution and temperature profiles of the solid phase and fluid phase in the system during the charging process were ascertained and shown. The influence of porosity and particle size on the thermal performance of the TES system was assessed and reported. The findings indicated that the duration needed to charge the tank diminishes with an increase in both porosity and particle size

Identification of Vulnerabilities in RORIS-Type Systems – Case Study: AFDJ

Laura-Christiana Dobrescu, Ionut-Cosmin Chiva, Marius Minea and Valentin Alexandru Stan

Keywords: *RORIS system, navigation, vulnerability, resilience, LoRa, GSM, TETRA, IoT*

Abstract: This study allows for an analysis of the factors affecting the functioning of the Roris system, the Danube Ship Traffic Management System, and the Inland Waterway Transport Information System. The identification of vulnerabilities is analyzed from the perspective of the impact of environmental conditions on equipment and from the standpoint of the performance of communication networks. The study is conducted based on data provided by the Lower Danube River Administration, and it allows for the offering of solutions to maintain the resilience of the Roris system. By analyzing the specifics of the equipment, the operating conditions in critical situations, and identifying alternatives for field data communication, the study identifies the critical points of these components and proposes strategies to improve the system's resilience. The results impact the assurance of data reliability in dynamic conditions and the prevention of failures that could compromise both navigation security and environmental conservation efforts.

Analysis of defects in photovoltaic panels

Catalin Frincu, Nicu Bizon, Marian Raducu and Mihai Oproescu

Keywords: *PSpice software, increase series resistance between the two rows, short-circuited, photovoltaic cells*

Abstract: This article investigates methods for analysis of defects in photovoltaic panels with applications in identifying and diagnosing the type of defect for monitoring systems, also is useful in the field of photovoltaic research. Emphasis is placed on presenting many types of defects such as open circuit, cell is short-circuited, the rows of photovoltaic cells connected in parallel are short-circuited, system output is short-circuited, increase series resistance between the two rows, etc. The study highlights the contribution of multiple series of simulation in Matlab software which show the exactly value of results foe each case tested, also very similar with the results obtained in PSpice software. The focus is on the need to prevent and anticipate many types of photovoltaic defects.

ECG-Based Stress Surveillance using an Attention-driven Hybrid CNN-RNN Model

Ghofrane Mzoughi, Jaouhar Fattahi, Mohamed Mejri, Ridha Ghayoula and Sahbi Bahroun

Keywords: *Stress Detection, Occupational Safety, Workplace Accident Prevention, WESAD Dataset, Electrocardiogram (ECG), Hybrid CNN-RNN Architecture, BiLSTM, BiGRU, Attention Mechanism, Adversarial Robustness, Deep Learning*

Abstract: This paper presents a novel deep learning-based approach for anticipating workplace accident risks through artificial intelligence-driven stress monitoring. Our method focuses on the analysis of physiological signals, specifically electrocardiogram (ECG) data, using the publicly available WESAD dataset. We introduce a comprehensive framework that includes feature extraction from ECG segments and utilizes the combined strengths of one-dimensional convolutional neural networks (1D-CNNs) and recurrent neural networks (RNNs), particularly BiLSTM and BiGRU architectures, to capture temporal patterns in the data. Two hybrid models are proposed, both incorporating attention mechanisms that dynamically focus on the most informative parts of the input sequence. We further investigate adversarial robustness through perturbation experiments to assess model reliability under challenging conditions. Experimental results demonstrate strong performance and robustness, with the CNN-BiLSTM model with attention achieving superior results. This work contributes to the development of more effective and resilient stress monitoring systems for enhancing occupational safety.

DermNet-CNN: A Hyperparameter-Tuned CNN Model for Accurate Skin Disease Detection

Isha Das, Shomitro Kumar Ghosh, Mst. Sazia Tahosin, Md.Arshad Khan Sobuj, Tawhidul Islam Sazid and Aklima Akter

Keywords: *skin disease, hyperparameter tuning, deep learning, cnn, classification*

Abstract: The diagnosis of skin disease is a critical area in healthcare, requiring high accuracy and reliability to ensure effective treatment. Traditional diagnostic methods often struggle with the variability in the appearance of skin lesions and noise in medical images, leading to misdiagnosis. This study addresses these challenges by proposing a robust deep learning-based framework for accurate skin disease classification. Motivated by the need for precise and automated diagnostic tools, we focus on enhancing image quality and leveraging advanced convolutional neural networks (CNN) to improve classification performance. The methodology involves comprehensive data preprocessing, including image resizing, morphological black hat transformation, median filtering, and contrast adjustment to highlight fine details and reduce noise. Data augmentation techniques such as flipping, rotating, scaling, and shifting are employed to increase dataset diversity. A systematic evaluation of state-of-the-art and custom CNN architectures is conducted, with rigorous hyperparameter tuning to optimize performance. Our results demonstrate exceptional performance, achieving 98.57% accuracy, high specificity, precision, recall, and F1 score, supported by AUC-ROC analysis and 5-fold cross-validation. The proposed model outperforms existing architectures, showcasing its potential for precise diagnosis of skin disease. This study highlights the effectiveness of combining advanced preprocessing techniques with deep learning models to address the complexities of skin disease classification, paving the way for reliable automated diagnostic systems.

Study of the structure of navigation maps using fuzzy logic

Maria-Elena Stanciu, Silviu Ionita, Mihai Oproescu and Rodica-Mihaela Teodorescu

Keywords: *Fuzzy logic, Map structure, Automotive, Map testing, Map validation*

Abstract: The study aims to develop an application in MATLAB that uses fuzzy logic to analyze and interpret different features of navigation maps before they are released into production. The paper proposes an original approach to the process of creating, testing, and validating navigational maps, using fuzzy logic to analyze factors such as map size, complexity, and risk of corruption prior to release into production. Unlike existing studies, this method provides a predictive framework that allows you to anticipate problems and optimize the production process. Applied to real cases, it could reduce launch time by up to 30% and validation costs by about 20%, as it allows early identification of maps with a high risk of corruption or slow implementation, thus avoiding repeated testing and reconfiguration cycles.

Real-Time Pick-and-Place Digital Twin in Unity for Industry 4.0

Marius Constantin Marica, Nicu Bizon and Ionel Bostan

Keywords: *Digital Twins, Industry 4.0, Pick-and-Place, Real-Time Simulation, Automation Systems, FSM, PLC*

Abstract: In the context of Industry 4.0, the adoption of Digital Twins is an essential solution for the optimization, monitoring and control of complex industrial processes. This article presents the development and implementation of a real-time Digital Twin for an automated Pick-and-Place system, using the Unity simulation environment. The physical system is composed of two electric axes and one pneumatic axis, as well as a suction cup system for handling parts, controlled by a Siemens S7-1200 PLC. Communication between the physical and digital systems is achieved through industry-standard PROFINET and IO-Link protocols, ensuring a bidirectional exchange of data in real time. The digital model faithfully reproduces the mechanical structure and dynamic behavior of the physical system, including precise synchronization of movements on all axes and the state of the handling system. The complete simulation of the Pick-and-Place cycle in Unity allows for real-time visualization and monitoring of the process, providing a safe and flexible platform for testing, training and performance analysis without risk to the physical equipment. Experimental validation indicates a high correlation between the physical and simulated system performances, with differences below 5% for critical parameters such as cycling time and positioning accuracy. This solution brings major advantages, including reduced picking time, minimized downtime, improved process quality, and increased industrial digitalization. Furthermore, the implemented Digital Twin provides a solid foundation for expansion towards smart factories, with the possibility of integrating VR/AR technologies and adaptive control in the future. The article details the modeling methodology, communication and synchronization architecture, as well as the practical benefits of real-time digital simulation for Pick-and-Place systems in the context of Industry 4.0.

Review on the detection of persons in cargo and transport vehicles

Ilie Stelian, Gabriel Vasile Iana, Laurentiu Mihai Ionescu, Mihai Oproescu and Valentin Alexandru Stan

Keywords: *human trafficking detection, cargo inspection technologies, sensor fusion systems, terahertz and X-ray imaging, border security automation*

Abstract: The present paper provides an analysis of the technologies used for the detection of persons hidden in cargo vehicles and containers, in the context of preventing human trafficking. The need for effective control at border points is highlighted, given the transnational nature of these crimes and the major humanitarian impact. The study reviews three major categories of technologies: sensors for the detection of volatile compounds (CO_2, VOCs), imaging technologies (X-rays, terahertz, thermal), as well as systems for detecting vibrations generated by the human body. Each method is analysed from the perspective of operational advantages, technical limitations and conditions of applicability. It also stresses the importance of a multimodal approach combining multiple technologies into an integrated system to maximise accuracy and minimise false alarms. The paper argues that the future of effective detection of hidden persons is based on technological interoperability, standardization, portability, and compliance with ethical and legal norms. Thus, an applied research direction is proposed oriented towards smart, fast and sustainable solutions, capable of meeting the current requirements of border security

Fleet Management System's Attack Graph

Mariam Ibrahim and Ruba Elhafiz

Keywords: *attack graph, cyber-physical systems, fleet management system, Sustainable cities and communities, vulnerabilities*

Abstract: Fleet Management (FM) automation relies on preprogrammed systems to perform various functions continuously, minimizing human interaction and resulting in predictable actions that are vulnerable to manipulation. Integrating the Internet of Things (IoT) into the Fleet Management System (FMS) heightens its susceptibility to cyberattacks, which can be challenging to detect and comprehend. This paper highlights the security vulnerabilities within the FMS and presents a framework for utilizing and visualizing its Attack Graph (AG). The system is expressed with the Architecture Analysis and Design Language (AADL), while a model-checker, JKind is employed to continuously verify the model against the security criteria. The generated attack graph visualized with Graphviz provides a comprehensive view of potential attack paths and vulnerabilities of FMS. Furthermore, the AG helps suggest the optimal deployment of Intrusion Detection Systems (IDS) with minimal resources.

Comparative Study of Two Web Applications Developed Using MERN and MEAN Stacks

Ovidiu-Constantin Novac, Cornelia-Mihaela Novac, Ioan Mircea Gordan, Mircea Danut Pantea, Gyongyi Bujdoso and Andreea-Milena Suba

Keywords: *ReactJS, Angular, ExpressJS, NodeJS, MongoDB, Web development*

Abstract: This paper presents a comparative study of two popular JavaScript-based technology stacks, the MERN Stack and MEAN Stack, used in web application development. The comparative study highlights the significant similarities and differences between the two stacks, considering factors such as performance, scalability, security, community support, learning curve, and suitability. Additionally, this paper presents the MERN and MEAN stack architectures, providing information on the functionality and integration of each component.

Domain modeling using template metaprogramming

Adrian Beteringhe and Radu Bucea-Manea-Țoniș

Keywords: *compile-time computation, type safety, code generation*

Abstract: Template metaprogramming (TMP) offers a powerful computation and code generation mechanism. This paper explores its application to domain modeling, a critical aspect of software development. By leveraging TMP, we propose a novel approach to constructing intricate domain models using known techniques. To begin, we compare the built-in memory Abstract Syntax Tree (AST) at compile time with the memory footprint version of the same algorithm (BTree) at runtime. This analysis is carried out using the visualization tool from Microsoft Visual C++ alongside a dedicated memory tracking library (MemTracker). Following this initial optimization that saves 40 bytes of allocated memory, we implement further runtime optimizations that concentrate on trivalent logic through the use of specialized templates and recursion via variadic templates. Our methodology relies on standard C++ techniques, such as recursive templates, Pair structures, and metatypes, for modeling simple data structures like binary trees. It encapsulates domain concepts, relationships, and invariants within template metaprograms, enhancing type safety, performance, and code clarity. The approach relies heavily on popular and personal GitHub repositories, showcasing how TMP can streamline domain modeling while improving code quality and maintainability.

VirtuFit: Virtual Dressing Room

Parth Inamdar, Sanchitkumar Sharma, Dilip Sutar and Ajit Tatugade

Keywords*: Online Trial Room, Wearable Technology, Virtual Fitting Room, Video Capture Image Processing, OpenCV Flask Web Application, Real-time Visualization, Joint Detection, E-commerce, User Experience, Body Segmentation, Augmented Reality*

Abstract: The reluctance to purchase wearable items such as clothing and accessories online often stems from the difficulty in assessing their fit and appearance on the individual. To address this challenge, we propose the development of an Online Trial Room Application. This innovative solution leverages video capture technology to create a virtual fitting experience. The application records a video of the user through their device's camera, subsequently extracting individual frames to isolate the user's body. By employing advanced algorithms to identify joint placements, the application can dynamically transform, rotate, and scale images of wearables, allowing for real-time visualization on the user's figure. Our literature review explores various methodologies relevant to our project, highlighting their respective benefits and limitations. The implementation utilizes Flask for the web application framework, coupled with OpenCV, a powerful Python library for image processing. The application is designed to function seamlessly on devices equipped with a built-in or external camera, internet connectivity, and a web browser, thereby enhancing the online shopping experience for wearables.

Predictive Phase Shift Control based on Transformer Current Control for Dual Active Bridge

Pham Hong Duong, Nguyen Hoang Viet, Pham Duc Dai and Bui Van Dai

Keywords: *Dual Active Bridge Converter, Predictive Phase Shift Control, Transformer Current Control.*

Abstract: The Dual Active Bridge is a commonly used bidirectional DC/DC converter, ideal for high-power applications such as electric vehicles, charging stations, and renewable energy systems, to name a few. Being an advanced technique, predictive control is widely adopted in power electronic converters, and when combined with phase shift control, it opens up new possibilities for converter management. To design an effective phase predictive controller, it is important to opt for the right control variables and define their switching model and function. Unlike traditional DC/DC converters (e.g., buck or boost converters), determining the switching function in phase shift control converters is more complicated. In order to address this, the switching functions for the DAB converter are derived using mathematical methods. This paper presents a predictive phase shift controller design based on the transformer current switching model, featuring a cascade control structure for forward power flow. Simulations were conducted with varying setpoint values and load conditions, and the results, obtained with Matlab/Simulink, illustrate that the system responds dynamically with the actual voltage and current values consistently tracking the desired targets.

Performance Evaluation of a New Efficient Energy Management Strategy for Fuel Cell Hybrid Electric Vehicles

Sorin Ioan Sorlei, Bizon Nicu, Mihai Varlam, Mircea Raceanu, Elena Carcadea and Simona Maria Raboaca

Keywords*: fuel cell hybrid electric vehicles, energy management strategy, fuel economy, battery state of charge, oxygen excess ratio, electrical efficiency*

Abstract: In this paper, the performance indicators for fuel cell hybrid electric vehicles are evaluated using an energy management strategy based on a new algorithm (named SWA_RTO) proposed here. The analysis is done in comparison with a reference strategy (Static Feed Forward strategy) using performance indicators such as fuel economy, oxygen excess ratio, fuel efficiency, battery state of charge, and electrical efficiency of the fuel cell system. Significant fuel savings were achieved on the main European driving cycles (ECE-15, EUDC and NEDC), highlighting the potential of the new SWA_RTO strategy to choose the best strategy (which offers the lowest fuel consumption) based on the requested power. By controlling the air and hydrogen regulators, the fuel cell system generates a power that follows the requested power profile, so that the batteries operate in a sustained charge mode, increasing their lifespan.

Robust Control of Doubly Fed Induction Generator Based on Direct Field Oriented Control

Chahbi Aziz, Yessef Mourad, Amharech Amine and Ameziane Hatim

Keywords: *DFIG, Field Oriented Control, Sliding Mode, Control, Wind System*

Abstract: To solve the fluctuating nature of wind energy systems, this paper aims to design, analyze, and simulate a wind energy conversion system based on a Doubly Fed Induction Generator (DFIG) connected to a wind turbine. A wide range of wind speed fluctuations is possible with a Doubly Fed Induction Generator (DFIG) due to its ability to handle a wide range of rotation speed variation. Direct Field Oriented Control (DFOC) has been frequently used to decouple the active and reactive power control. Enhancing performance can be attained directly using controllers such as Proportional Integral (PI). However, this kind of controller heavily depends on parameter variations and frequently has difficulty dealing with nonlinear dynamics. Sliding Mode Control (SMC) provides robust performance. This work presents a comparative analysis between Proportional Integral (PI) control and Sliding Mode Control (SMC) in (DFOC) of a DFIG; the performances of both controllers are examined in terms of rapidity, precision, robustness, and power quality under parameter variations and strong disturbances. The findings confirmed that integration of SMC in DFOC improves robustness and power tracking even under uncertain conditions, whereas PI control allows good performance only under nominal conditions.

Comparative Analysis of Deep Learning Models for Long-Term Electricity Demand Forecasting in Bangladesh Using Web-Scraped Data

Sakif Yeaser, Tasnia Nafs and Md. Ikrama Hossain

Keywords: *Electricity demand forecasting, Long-term load prediction, Deep learning, LSTM, BiLSTM, GRU, BiGRU, Web-scraped data, Regional energy modeling, Bangladesh power system*

Abstract: As energy demand continues to rise in Bangladesh, there is a growing need for more accurate forecasting methods to improve the balance between electricity supply and consumption. Despite increased generation capacity, the country still experiences frequent disruptions due to limitations in prediction accuracy and structural inefficiencies within the power system. This study presents a comparative evaluation of advanced deep learning (DL) architectures such as Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Bidirectional LSTM (BiLSTM), and Bidirectional GRU (BiGRU), for forecasting daily peak electricity demand at both the national level and across the country's eight divisions. The dataset was compiled from the Bangladesh Power Development Board (BPDB) using an automated web scraping pipeline. All models were trained on four years of historical data and evaluated using a one-year testing set. Among the models assessed, the BiGRU architecture outperformed others, achieving the lowest testing Mean Absolute Percentage Error (MAPE) of 4.75%. The BiGRU model was also employed for division-wise forecasting, effectively capturing regional demand variations. Additionally, it was applied to unseen future dates, which are not included in the dataset, where it recursively predicted energy demand one day at a time and achieved an MAPE of 7.3%, demonstrating strong generalization capability. These results highlight the potential of deep learning-based models for delivering reliable, scalable energy demand forecasting.

New Wave Logistics Framework: Enabling Sustainable Practices in Road Transportation

Younesse Ouahbi and Soumia Ziti

Keywords: *Logistics Industry, Sustainable Logistics, Environmental Compliance, Real-Time CO2 Tracking, Route Optimization, Driver Behavior Monitoring, Individualized Driver Reports, Delivery Tracking Accuracy, Driver Safety, Efficiency Improvement, Transformative A*

Abstract: The logistics industry is focused on reducing carbon emissions and improving efficiency to meet environmental and regulatory requirements. NW Logistics, an AI-powered platform, aims to achieve these goals by integrating real-time CO2 emissions tracking, route optimization, and driver behavior monitoring. The system allows logistics managers to monitor fleet performance with increased accuracy and generates individualized reports for drivers. Early simulations show significant reductions in carbon emissions, improvements in route efficiency, delivery tracking accuracy, and driver safety, demonstrating the transformative potential of AI in sustainable logistics management

Field Tests of an Automated Solution for Traveler Flowing Measurement in Inner Spaces

Bogdan-George Popescu and Marius Minea

Keywords*: indoor localization, traveler flow analysis, automated monitoring, crowd management, smart indoor spaces, Bluetooth localization*

Abstract: This work is aimed at presenting a solution for automatic collection of travelers' data, intended to measure passenger flowing and/or density in specific indoor environments. The proposed solution integrates cost-effective sensing technologies, data processing algorithms, and real-time analytics to efficiently track and quantify the movement patterns of travelers in confined spaces such as subway stations, airports, or other transit hubs. The test bed consisted of strategically positioned sensors and a centralized processing unit deployed in a specific indoor facility. Key performance indicators (KPIs), such as number of detected devices, and RSSI (Received Signal Strength Indicator) were evaluated under varying environmental conditions. Results demonstrated that the proposed solution achieved satisfactory accuracy in detecting and counting individuals, with minimal latency and consistent performance across different scenarios. Conclusions drawn from the field tests indicate that the proposed solution offers significant advantages in automating traveler flow measurement, providing valuable insights for facility management and decision-making processes. Future work will focus on optimizing the system's scalability and integration with broader smart building frameworks.

Automating Digital Forensic Investigations: The Impact of Machine Learning on Electronic Evidence

Dr. Renu Mahajan and Kanika Pandit

Keywords*: machine learning, electronic evidence, automation, digital forensic investigation*

Abstract: Digital forensic investigations have become more complicated along with larger scales because of a dramatic expansion in digital data. Conventional data examination techniques depend on hand-based procedures that remain slow and need significant resources along with being prone to mistakes from human operators. Mobile technology has disrupted electronic evidence analysis by introducing machine learning (ML) which fundamentally upgrades the operational efficiency and measurement accuracy and data handling capability beyond traditional methods. Digital forensic automation can be achieved through ML algorithms when handling tasks which include identifying data sources and detecting anomalies and recovering evidence and analyzing networks and multimedia content. The implementation of ML as a digital forensics solution comes with multiple barriers that affect the results including inadequate data quality and biased algorithms and the need for explainability and the risk of adversarial attacks and legal and ethical restrictions. The research investigates machine learning effects on digital forensic investigations by discussing modern implementation together with obstacles faced in addition to expected research pathways. The proper resolution of these challenges remains vital to establish reliable and fair and lawful ML-based forensic instruments for criminal along with civil examination activities.

Digital Decoder from 16-Bit Binary Code to 7-Segment Quad LED Display

Mircea-Petru Ursu, Ovidiu-Constantin Novac and Cornelia-Mihaela Novac

***Keywords**: digital, binary, hexadecimal, converter, LED display, multiplexing, EEPROM*

Abstract: All digital systems handle information using bits grouped into words, and most of these words have the meaning of numbers. The users of digital systems may follow easily four bits at a time with the naked eye using four LEDs, but it becomes much harder with a larger number of bits. This is where 4-bit-to-7-segment display converters become useful, as each group of four bits ("tetrad") would be converted to a much easier-to-read hexadecimal digit. In case of longer words, each tetrad would need one such device. This paper presents a digital decoder for 16-bit binary words to four hexadecimal digits, using an EEPROM, a quad-multiplexed 7-Segment LED display, and two general-purpose digital integrated circuits.

A Comparative Study of Transformer-Based Models and Machine Learning Techniques for Enhancing Bangla Sentiment Analysis

Md. Saimim Islam Khan Hamim, Ishtiaque Ahmed, Tawhidul Islam Sazid, Faria Haque, Md. Najimul Hossain, Suborna Rani Pal, Mst. Sazia Tahosin and Md. Alif Sheakh

Keywords: *Flair, TARS, Bangla BERT base, customer sentiment, sentiment analysis*

Abstract: Social media monitoring alongside business intelligence needs accurate sentiment analysis because the digital activity of Bangla-speaking communities keeps expanding. The current classification models do not deliver effective Bangla context analysis mainly because of insufficient annotated datasets when processing rare languages. The research examines sentiment classification through the combination of deep learning transformers, Flair, Task-aware representation of sentences, and Generative Pre-training Transformer with traditional machine learning algorithms such as Logistic Regression, Support Vector Classifier, Random Forest, XGBoost, Decision Tree, K-Nearest Neighbors, and Naive Bayes. During tests on our Bangla dataset, the Flair model implementing Bangla BERT Base embeddings produced the best performance of 94.21% accuracy, which surpassed both TARS at 88.5% and traditional classifiers. Embedded into contexts selects complex sentiment patterns efficiently, which proves integral to boosting low-resource Natural Language Processing task performance. For better sentiment classification in practical settings, researchers will concentrate on enhancing the efficiency and diversity of datasets and implementing crosslingual capabilities.

Fractal-Slotted Microwave Bandpass Filter Designs for Wireless Applications

Karthie Sugumarasamy, Namratha Muralidharan and Mithila Jagennathan

Keywords: *microwave, bandpass filter, dual-mode fractal filter, flexible substrate*

Abstract: This paper presents three novel dual-mode microstrip bandpass filter designs featuring fractal slot patterns on a polyimide substrate. The goal is to develop a filter that meets the demands of high-frequency wireless communication applications. The dual-mode resonator, serving as the foundation for the filter, incorporates symmetric fractal slotted structures with perturbations. The performance of the filter on polyimide substrate is evaluated using 3D electromagnetic simulation tool CST Studio Suite. A comparative analysis of snowflake, cross, and star-fractal tree structures offer valuable insights into optimal configurations for achieving the desired filter characteristics. The performance evaluation of the fractal filters involves the key simulation parameters such as insertion loss and return loss. The three fractal filter designs obtained using the 3D simulation tool provide a thorough understanding of the filter's behavior and effectiveness. Simulation results demonstrate the effectiveness of the proposed filters, with the cross-fractal design exhibiting a notable insertion loss of 1.38 dB and return loss of 13.78 dB at 2.35 GHz. The proposed dual-mode bandpass filters with fractal slots on a polyimide substrate represents an innovative and promising solution for high-frequency applications in wireless communication systems.

Efficient Database Management System for Organizing Activity using Android Technology

Andreea Popa, Florentina Magda Enescu and Nicu Bizon

Keywords: *android, mobile development, database management, relational databases, security*

Abstract: In the context of rapid technological evolution and the continuous rise in popularity of mobile devices, Android applications have become indispensable tools for users of all types. This research aims to demonstrate the benefits of integrating database management systems with mobile platforms to create an efficient and organized work environment. This paper proposes a practical solution for data management on mobile devices while exploring the advantages and challenges associated with using the latest Android development technologies. By developing this application, we aim not only to solve practical problems but also to contribute to the specialized literature by providing a detailed and well documented case study. The results of this project are intended to be useful both for IT professionals and for organizations seeking efficient data management solutions.

Coffee maker prototype based on automotive sensory and communication systems

Radu-Andrei Tunsoiu and Cristina Saracin

Keywords: *Electronic Control Unit, communication interfaces, Engine Control Module*

Abstract: This paper presents a prototype coffee maker system that can be integrated inside of a vehicle. The prototype is based on the existing monitoring and control system within a vehicle that receives information from electronic control units (ECU). The transmission of information between ECUs is based on the various communication protocols present in the automotive industry (CAN, LIN, FlexRay and Ethernet). The actual implementation of the program underlying the operation of the prototype is described in this paper based on the functions within the ECUs. In order to validate the proposed system, simulations of the various types of signals existing on the communication buses were carried out. These signals describe: the state of the ignition, the percentage of battery charge, the presence of the driver in the passenger compartment, the status of the vehicle and the proposed prototype system.

Design of Current Mode Active filters Using CCCII for Biomedical Applications

Syed Zahiruddin, Poola Subbarayudu, Prof. Avireni Srinivasulu, Cristian Ravariu, Bhargav Appasani and Musala Sarada

Keywords*: CCCII, Transient analysis, Montecarlo analysis, Cadence, Orcad Tool, Biomedical applications*

Abstract: Current-mode filters have garnered significant attention in biomedical applications due to their inherent advantages, including low power consumption, wide bandwidth, high slew rate, and compact circuitry. These characteristics make them particularly suitable for processing low-frequency biomedical signals such as electrocardiograms (ECG), electroencephalograms (EEG), and electromyograms (EMG). First order Low Pass Filter (LPF), High Pass Filter (HPF) and All Pass Filters are designed using Second Generation Current Controlled Conveyor (CCCII) in this work. The proposed designs are tested using Transient analysis, AC analysis and Montecarlo analysis. The simulation is carried out using Cadence Orcad Tool of 17.2 version. The proposed topologies are experimentally verified using commercially available ICs AD 844AN, called as CFOA (Current Feedback Operational Amplifier) and LM 13700, termed as OTA (Operational Transconductance Amplifier). The novelty of proposed configurations is, it needs a simple circuit utilizing single CCCII and very less external passive components for realization. Filters find the applications in the field of Biomedical applications, analog signal processing, communication systems, Audio processing, Sensor interfaces, Image processing, Industrial automation, Neuromorphic circuits, Space and defense, Optical communication, and in many more areas.

Machine Learning-Based Prediction of S11 for a 5G Antenna Using Gaussian Process Regression

Bilal Aghoutane, Hamid Bezzout, Houda Hiddar, Badre Bossoufi, Mohammed El Ghzaoui and Hanan El Faylali

Keywords: *Machine Learning, 5G, S11, Regression*

Abstract: This paper presents 5G antenna design with a approach machine learning-based to predict the S11 parameter . The input data, generated using ANSYS HFSS, includes the final geometric parameters such as patch antenna dimensions and slots. Three regression models used, Fourier Series Regression (FSR), Sum Sine Regression (SSR), and Gaussian Process Regression (GPR), were used to predict the S11 parameter. for the fisrt model FSR with Coefficient of Determination (R2) of 0.9444, Root Mean Squared Error (RMSE) egual 0.9801, Sum of Squared Errors (SSE) of 108.5365. than the second model SSR, R2 of 0.9131, RMSE of 1.2593, SSE of 169.6838. the final model GPR is the best model for predicting S11 with R2 of 0.9886, RMSE of 0.4374, and SSE of 22.1961 . FSR and SSR also showed excellent performance, qualifying them for regular data analysis. The study demonstrates how machine learning can accurately predict antenna performance and provides a reliable alternative to traditional simulation techniques.

Optimal Stochastic Virtual Power Plant Dispatch with Carbon and Green Certificate Trading

Hossein Shayeghi, Iraj Faraji Davoudkhani, Fardin Hashemzadeh and Nicu Bizon

Keywords: *Virtual Power Plant, Corona Virus Search Optimizer, Renewable energy, Carbon and Green Certificate Trading*

Abstract: This paper presents an optimal dispatch model for a Virtual Power Plant (VPP) that integrates carbon trading and green certificate trading mechanisms. The primary objective function is to maximize the net profit of the VPP by reducing operational costs and enhancing revenue from carbon and green certificate trading. The dispatch model incorporates a diverse mix of energy sources, including gas turbines, solar power, wind farms, and storage systems, to achieve a balanced and sustainable operation. To address the complexities of the optimization, the Coronavirus Search Algorithm (CVSA) is applied. The optimization is conducted under two scenarios: a deterministic and a stochastic scenario, enabling the model to account for uncertainties in renewable energy production and market prices. Simulation results indicate that both deterministic and stochastic optimizations enhance profitability, reduce operational costs, and support a low-carbon approach, making the VPP framework viable and adaptable in real-world applications.

Improving Personalized Customer Engagement in E-Commerce through Distributed Web Systems and Advanced CRM Solutions

Vassil Milev, Marian Ileana and Pavel Petrov

Keywords: *customer engagement, e-commerce, distributed web systems, semantic web, advanced crm*

Abstract: This article explores the opportunities for improving personalized customer experience in e-commerce through the integration of distributed web systems and advanced Customer Relationship Management (CRM) solutions based on the semantic web. The proposed model combines technologies from the semantic web, artificial intelligence, and machine learning to create an intelligent and adaptive environment for managing customer relationships. The results indicate that this approach significantly improves the personalization and efficiency of customer service, providing real added value to the business through personalized interactions and strategic customer relationship management.

Design and Development of Corn Disease Detection with UAV-based Deep Learning Technology

Vrian Jay Ylaya, Lourd April Pecante and Dave Sherich Andit

Keywords: *Unmanned Aerial Vehicle (UAV), Deep Learning, Corn Leaf Diseases, Precision Agriculture, Disease Detection*

Abstract: Corn diseases significantly reduce agricultural productivity, posing a critical threat to food security, particularly in tropical countries like the Philippines, where corn is a staple crop. Traditional disease detection methods rely heavily on manual inspection and are time-consuming, labor-intensive, and prone to inaccuracies. To address these challenges, this research developed an innovative corn disease detection system integrating Unmanned Aerial Vehicle (UAV) technology with deep learning models specifically optimized for tropical agricultural conditions. The researchers compared four pre-trained deep learning architectures—EfficientNetB0, ResNet50, InceptionV3, and VGG16—to determine the most effective model for identifying leaf spot and sunscald diseases in corn plants from UAV-acquired imagery. EfficientNetB0 emerged as the superior model, achieving an impressive accuracy rate of 90.89%. Field implementation of the developed system involved systematic testing across five rows of corn crops, with multiple repetitions conducted for each row to ensure reliability. Results demonstrated consistent and precise detection rates with minimal variation in identifying healthy leaves (84.66%), leaf spots (2.86%), and sunscald (12.48%). These findings validate the robustness and accuracy of the EfficientNetB0-based UAV system as a practical solution for early disease monitoring in corn fields. The proposed technology offers farmers an accessible and cost-effective tool that significantly enhances crop management decisions through timely disease identification and intervention. This UAV-based deep learning approach represents a substantial advancement toward sustainable precision agriculture practices in the Philippines, with the potential for broader adoption that could positively impact agricultural productivity and food security globally.

Evaluation of IoT Network Security Against Botnet Attacks Through Simulation in NetSim

Andrei Claudiu Frâncu, Gabriel Predusca, Liana Denisa Circiumarescu, Nicoleta Angelescu and Dan Constantin Puchianu

Keywords: *Attack mitigation, Botnet, DDoS, IoT vulnerability, NetSim, UDP flood*

Abstract: This study investigates the performance degradation of IoT networks under distributed denial-of-service (DDoS) attacks, using the NetSim simulator to model botnet-based threats. Four scenarios were simulated: one without attackers and three with 1–3 malicious nodes launching UDP flooding. The results show that the throughput dropped by up to 67% and the latency increased by over 350% as the number of attackers rose. These findings highlight the vulnerability of IoT networks in the absence of protection mechanisms and underscore the importance of security-by-design principles. Future research will integrate detection and mitigation algorithms into the simulated environment.

Parabolic Modulation Based Non-singular Fast Terminal Sliding Mode Control for Single-Phase Stand-Alone Inverters

Guven Balta, Cagdas Hisar, Necmi Altin and Ibrahim Sefa

Keywords: *Non-singular fast terminal sliding mode, fast terminal sliding mode, parabolic modulation, fixed switching frequency, hysteresis modulation*

Abstract: Upgraded sliding surfaces are used to control the output voltage of a single-phase stand-alone inverters. As a new generation of sliding surfaces, terminal sliding surfaces, fast terminal sliding surfaces and non-singular fast terminal sliding surfaces are available in the literature. While quicker dynamic results can be obtained with the fast terminal manifolds, the surface-induced chattering effect is very high. Chattering with the non-singular surface is minimal, but dynamic reactions are also sluggish. In comparison to the other two structures, the nonsingular fast terminal manifold produces more desirable results. In this paper, a non-singular fast terminal structure is compared with other ones using various visualizations, and its strengths are displayed in detail. On the other hand, the parabolic modulation (PM) approach, which was newly described in the literature, is utilized to ensure that the generated switching signals had a constant frequency. To demonstrate the efficacy of PM and to encourage its adoption in further research, this approach is contrasted with the hysteresis modulation (HM) method under various circumstances.

Architecture, Performance, and Economic Assessment of Light Urban EVs: A Case Study on Central vs. In-Wheel Motors

Burcea Victor Florin, Gabriel-Vasile Iana, Emil Pricop, Mihai Oproescu, Valentin Alexandru Stan, Nistor Gheorghe, Ovidiu Constantin Novac, Coman Andreeea and Cornelia Mihaela Novac

Keywords: *Electric vehicles, in-wheel motor, central motor, energy efficiency, urban mobility*

Abstract: This paper presents a comparative analysis of two architectures for low-power urban electric vehicles: one with a central electric motor and the other with in-wheel motors. Both systems are designed with a total power of 4.5 kW, 48 V supply voltage, and 6 kWh Li-ion batteries. The study includes energy and cost evaluations, estimating real-world urban autonomy, average consumption, and operating time under full load. Architectural differences are examined in terms of energy efficiency, mass distribution, drivetrain complexity, and controller integration. The acquisition costs of key electrical components are compared, and investment payback is assessed based on the savings generated compared to internal combustion engine vehicles. Results indicate that the central motor configuration reaches full amortization after approximately 31,900 km, while the in-wheel motor configuration requires over 36,000 km, both under exclusive urban usage. This study provides an objective foundation for selecting the appropriate configuration based on application context, performance, and cost criteria.

An Analysis of Genetic Algorithms in Cryptography

Veronica Cornaciu and Ciprian Racuciu

Keywords: *genetic algorithms, cryptography, pseudorandom generators*

Abstract: Pseudo-random number generators are essential in various fields of computer science, such as cryptography, numerical simulations, gaming, and algorithm testing. This article explores the use of genetic algorithms—heuristic methods based on the principles of natural evolution—to optimize pseudo-random number generators. The main approaches presented include optimizing generator parameters, identifying complex structures to improve unpredictability, and periodically assessing the uniformity of the generated numbers through specific fitness functions. The results indicate a significant improvement in the quality of generated numbers, thus providing efficient solutions to challenges in cybersecurity and numerical simulations.

A Low Rank Adaptation-Based Convolutional Neural Network and Transformer Model for Cervical Cancer Detection in Histopathological Images

Bhaswati Singha Deo, Mayukha Pal, Prasanta K. Panigrahi and Asima Pradhan

Keywords: *Low-rank adaptation, Transformer, histopathological images, cervical cancer, image classification.*

Abstract: Cervical cancer is the fourth common cancer among women worldwide. The diagnosis and classification of cancer are extremely important, as it influences the optimal treatment and length of survival. Histopathological image analysis, recognized as the gold standard for cervical cancer diagnosis, is vital for its early detection. However, the varied morphological characteristics of cervical cancer make accurate manual classification challenging. Traditional diagnostic methods employed by clinicians are often time-consuming and susceptible to errors. Computer-Aided Diagnosis (CAD) systems can assist in the accurate and efficient detection of cancer in histopathological images. This study introduces an automated classification network leveraging a Low Rank Adaptation-based CNN-Transformer (LoRaCT) model. The LoRaCT model integrates convolutional neural networks (CNNs) for extracting local features with Vision Transformers (ViTs) for capturing global context. To address computational efficiency, Low Rank Adaptation (LoRa) layers are employed, significantly reducing the number of parameters while maintaining model performance. The LoRaCT model achieved an average accuracy of 95.23% accuracy on the Caishi dataset, demonstrating its potential for effective and efficient AI-driven cervical cancer detection. The LoRaCT model has achieved comparable accuracy to the standard ViT model, which used the same hyperparameters in this study, with approximately 98.34\% fewer parameters. This approach not only achieves high accuracy but also offers a computationally efficient solution, advancing the field of automated histopathological image analysis.

Reversible Contrast Stretching for Digital Images

Isabela Elena Banescu, Alina Mihaela Badea, Liviu Andrei Necula, Ioan Catalin Dragoi, Henri-George Coanda and Dinu Coltuc

Keywords*: image proccesing, reversible contrast enhancement, reversible data hiding*

Abstract: This paper deals with reversible contrast enhancement for digital images. Image enhancement is directly approached by the classical contrast stretching. The information necessary for original image recovery is reversibly embedded in the enhanced version. The sparsity of the enhanced image histogram ensures reversible embedding at the cost of least significant bit substitution. Experimental result for classical low contrast test images are provided.

Next-Gen Microfluidics: Reinforcement Learning Driven Droplet Size Precision System

Sameer Dubey, Tvs Ramarao, Arshad Javed, Satish Dubey, Sanket Goel and Badar Ali

Keywords: *Droplet microfluidics, Reinforced Learning, Artificial Intelligence based Drop size control*

Abstract: This study introduces a novel microfluidic device designed for precise droplet size control using reinforcement learning (RL) algorithms in water-in-oil microfluidic setups. The device employs a pressure by-pass valve to regulate the flow rate of continuous fluid, ensuring droplet generation of the desired size. The system is equipped with an onboard computer for RL code execution and image processing, a RaspberryPi-4 is utilized for a stepper motor interface, mini syringe pumps for versatile flow rates, a digital microscope lens for droplet observation, and an integrated power supply. The device operates iteratively, running RL algorithms to achieve a user-defined target droplet size. After set iterations, the device prompts the user for permission to increase the iteration count or alter dispersed fluid viscosity. The effectiveness and versatility of the device in achieving precise droplet size control through reinforcement learning algorithms are evaluated using experiments. The findings from these experiments will contribute to the advancement of microfluidic technologies for various applications, including drug delivery, diagnostics, and chemical analysis.

Predictive Current Control with Preselection Vector Scheme for Matrix Converter

Nguyen Hoang Viet, Pham Duc Dai and Hoang Khac Nhiem

Keywords: *Matrix Converter, Preselection Vector, Predictive Current Control, Computational burden, Cost Function*

Abstract: In current research, one of the most often used AC/AC converters is the Matrix Converter (MC). It can adjust the frequency and amplitude of the output voltage while ensuring the input sinusoidal current and the unity power factor. The predictive current control scheme is simple, effective and flexible. It has been successfully applied to the voltage source converter. When this scheme is applied to control the MC, the computational burden is huge because the 27 output voltage vectors of the MC are used in the calculation of the predictive model. This study suggests a way to preselect the vectors utilized in the predictive model in order to lessen the computational burden in the predictive current control scheme for an MC with RL load. According to the simulation findings, the suggested technique in this research performs similarly to the original predictive current control scheme

A review of MPPT techniques for wind energy systems : Offshore Challenges and Solutions

Souhayla El Ouardi, Mourad Yessef, Yassine Chaibi and Zakaria Chalh

Keywords: *Wind Energy Conversion system, DFIG, MPPT, P&O, TSR, ANN, FLC*

Abstract: This paper presents a comparative review of four main algorithms used for Maximum Power Point Tracking (MPPT) in wind energy conversion systems namely Perturb and Observe (P&O), Tip Speed Ratio (TSR), Fuzzy Logic (FLC) and Artificial Neural Networks (ANN). These techniques were compared in terms of efficiency, simplicity, adaptability and cost. Each method has its advantages and its limitations, based on wind variations. And a particular attention is given to the offshore wind systems, where the conditions are more challenging because of the structure movements, the strong wind and the maintenance difficulties. The research shows that these environments require more intelligent and more adaptive control solutions, and it concludes that the hybrid approaches that combine conventional and intelligent methods may offer better performance in the offshore environments.

Real-Time Implementation and Performance Comparison of Neural Network and Sliding Mode MPPT Controllers for Wind Turbines

Yassine Seghrouchni, Mourad Yessef and Badre Bossoufi

Keywords: *wind energy, wind turbine, SMC, ANN, dSPACE, MPPT*

Abstract: This study presents a detailed comparison between Sliding Mode Control (SMC) and Artificial Neural Network (ANN)-based Maximum Power Point Tracking (MPPT) methods for wind energy conversion systems (WECS). With the global push toward maximizing renewable energy efficiency, improving power extraction under varying wind conditions is a critical challenge. The study develops both control strategies under MATLAB/Simulink under dynamic wind profiles, with a focus on improving the response time, steady-state error, and power coefficient (Cp). Experimental results reveal that the ANN-based controller achieves better response time (0.0016 s) and minimal steady-state error (0.3069 rad/s), outperforming the SMC controller in terms of fast response and maximizing the power coefficient (0.4799). While the ANN controller demonstrates improved adaptability and energy capture efficiency, practically a steady-state error of about 0.0749 is maintained. Later, both controls were implemented into dSPACE 1104 for hardware testing and validation.

Enhanced Micro-Vessel Image Segmentation Using the Advanced EyeU-Net Model

Mariem Qaddour, Yassine Benjelloune Touimi and Khalid Minaoui

Keywords: *segmentation of retinal vessels, deep learning, intersection of the union (IoU), retinal imaging.*

Abstract: Segmenting blood vessels in medical images is critical for applications such as disease diagnosis and treatment planning. This study introduces EyeU-Net, a novel deep learning model based on the U-Net architecture, specifically designed for vessel segmentation. EyeU-Net utilizes an encoder-decoder structure with skip connections to capture both fine details and global context, enabling precise segmentation. The model was trained and evaluated on the dataset Drive, It achieved an accuracy of 0.8662 and an IoU of 0.6645, with also 0.8333 in Precision, outperforming existing approaches in vessel segmentation tasks. The results highlight the effectiveness of EyeU-Net as a robust and accurate solution for this challenging task, demonstrating its potential for clinical applications .

Enhancing DICOM Security in Medical Imaging Networks using Software-Defined Networking

Ovidiu Păscutoiu, Maria Daniela Tache, Iulian Teodor Ciolacu and Sorin-Aurel Moraru

Keywords: *DICOM, security, encryption, protocol, watermark, image, authentication, integrity, SDN, controller*

Abstract: Abstract— In this study, we perform an in-depth analysis of Digital Imaging and Communications in Medicine (DICOM) security. The study begins by offering an overview of DICOM standards from a security standpoint. A comparative evaluation of selected DICOM techniques is provided, considering not only technical performance metrics but also implementation feasibility and complexity. Beyond the protocol-level analysis, we propose an experimental framework that leverages Software-Defined Networking (SDN) to optimize the transport of DICOM traffic across hospital networks. As the volume of medical imaging data continues to grow and the demand for real-time diagnostic access increases, traditional network architectures face limitations in delivering timely and reliable performance. In response, our experiment simulates a healthcare network environment in which DICOM traffic is dynamically prioritized using an SDN controller based on OpenFlow rules. Performance metrics including end-to-end latency, packet loss, and delivery time are collected and compared with and without SDN flow-based prioritization, under controlled background congestion. The results demonstrate how SDN-driven traffic engineering can significantly enhance Quality of Service (QoS) for critical healthcare applications. By combining DICOM security considerations with programmable network optimization, this work contributes a holistic approach to strengthening both the protection and performance of imaging workflows in clinical environments.

Creating an Artificial Evolutionary Intelligence Using a Graphic Engine

Alexandru Mihai Enache, Florentina Magda Enescu, Nicu Bizon and Alexandra Andreea Chiriță

Keywords*: Artificial Intelligence, Evolution, Simulation, Obstacle, Unreal engine, Ecosystem, Results*

Abstract: Any living thing, both animal and plant, develops depending on the environment and their interaction. This article will talk about the development of an evolutionary system for simulating scenarios, and the main objective is to determine whether the individual is adaptable to the ecosystem. In general, such simulations have two parts: An evolutionary part and a genetic part, but for a better understanding it was chosen to focus only on the evolutionary part. This will create an artificial intelligence that, based on the surrounding ecosystem, will evolve to achieve a final goal. Such a system is very important because it can be added as a distinctive feature in the computerized simulation of living beings or real ecosystems.

An approach to implementing a 3D Stealth Game in Unreal Engine

Rotaru Adrian and Savulescu Corina

Keywords: *3D Model, Skeletal Mesh, Blueprints, Behavior Tree, Boolean, Artificial Intelligence*

Abstract: In this paper, we present the design and implementation of a video game developed in Unreal Engine. The game contains a variety of challenges to stimulate the user's imagination. The action takes place in a technological, dark, and cold world. The player can control the avatar, which has access to a wide range of advanced combat and movement abilities. The main character also fights against artificial intelligence implemented as enemy troops populating the world. The user must acquire knowledge throughout the game about the geometric complexity of each level to solve the mission efficiently. Various weapons can be found and equipped in the user's arsenal. The implemented weapons have the functionality of shooting bullets, simulating recoil. At the end of each level, after overcoming all the challenges, the player can interact with the door at the end of the room to teleport to the next level. As levels progress, the game's difficulty and the geometric complexity of the space become increasingly harder to navigate.

Energy Performance Monitoring Solutions for Fuel Cell/Battery Hybrid Power Systems – short analysis

Mihai Oproescu, Nicu Bizon, Alin Gheorghita Mazare, Maria Simona Raboaca and Claudiu Ioan Abrudan

Keywords: *fuel cell, battery, hybrid power system, performance monitoring*

Abstract: This article investigates advanced monitoring solutions for hybrid fuel cell and battery-based systems, with applications in hybrid electric systems and shipping. Emphasis is placed on presenting intelligent energy performance monitoring strategies, using technologies such as artificial intelligence (AI), machine learning (ML) algorithms to optimize energy flows, increase efficiency and extend the life of components. At the same time, an optimized energy management strategy is proposed, integrating real-time monitoring with predictive analytics and optimization algorithms. The study highlights the contribution of advanced diagnostic and prognostic algorithms, as well as innovative sensors, in optimizing component performance and safety. The paper supports the development of an integrative framework for energy management in complex systems, highlighting promising prospects for the decarbonization of transport and the transition to the use of renewable energy sources. The focus is on the need to integrate these technologies into real applications, with additional testing to validate the performance and scalability of the proposed solutions.

Fault-Tolerant Actuator in Reliable Workcell with Video Sensor

Alyaa Ismaeil, Manar Rashad, Ramez Daoud, Hassanein Amer, Tarek Refaat and Hany Elsayed

Keywords: *networked control system, reliability, sensor, actuator, fault tolerance*

Abstract: Reliability and availability are becoming more and more important nowadays in to decrease system downtime. In the context of Networked Control System (NCS) workcells, this paper focuses on two of its main components, namely smart sensors and smart actuators. The first contribution is the design of a fault-tolerant solenoid operating in a cold stand-by mode. The second contribution focuses on workcells equipped with a video sensor along with fault-tolerant sensors. Riverbed simulations are used to show that the proposed design succeeds in meeting real time deadlines despite the extra traffic due to the redundant sensors and the heavy load introduced by the video sensors. The third contribution is the development of a tool which relates the cost of fault tolerance to system downtime and hence, profit loss. In the context of current supply chain problems, this tool can be used by system managers in order to make appropriate design choices regarding the quality/price of the redundant components they plan to incorporate in the workcell.

Compressive Imaging based Floating Debris Detection using YOLOv8

Aswathy Kp and M Sabarimalai Manikandan

Keywords: *Floating debris detection, YOLOv8, Compressive imaging, DBBD sensing matrix, Gaussian noise, Speckle noise, Salt and pepper noise, Gaussian filter, Moving average filter*

Abstract: It is essential to minimize model size while preserving high detection accuracy in order to optimize storage and processing efficiency, particularly for real-time applications on devices with limited resources. The deterministic block binary diagonal (DBBD) sensing matrix for image compression is used with a compressed YOLOv8 model in this study to offer a floating debris detection approach. The DBBD matrix efficiently minimizes memory use while maintaining essential characteristics when reducing image dimensions to 128×128 pixels. This makes it a highly efficient processing methodology. A unique data set of 16,000 identified debris images divided into four categories: dense, sparse, single, and piece of debris was used to train the YOLOv8 model. The accuracy, precision, and recall of the model are 95.96%, 97.94% and 99.77% respectively, indicating high quality performance. The values illustrate the reliability with which it can locate floating debris in a variety of environmental scenarios. The final model size is under 5 MB, which allows it to function effectively on devices with constrained computational resources despite its superior performance. Fast processing and effective memory utilization are made possible by the inclusion of DBBD compression, which makes this method appropriate for real-time monitoring systems, especially when used in internet of underwater things (IoUT) applications. For the purpose of observing and managing marine pollution and protecting fragile aquatic ecosystems, this innovative approach offers a practical solution for floating debris identification that strikes a balance between high detection accuracy and computing economy.

An Enhanced MPPT Algorithm Based on Adaptive Linear Regression with Contextual Weight Memory (ALR-CWM) for PV Systems

Rida Amine, Noureddine El Barbri and Hatim Ameziane

Keywords: *Linear Regression, PV systems, MPPT, Gaussian functions, Machine Learning*

Abstract: This paper presents an Adaptive Linear Regression With Contextual Weight Memory (ALR-CWM) model to use for Maximum Power Point Tracking (MPPT) control in photovoltaic (PV) systems. The proposed approach employs a linear regression model with a similarity-based memory mechanism to use irradiance and temperature measurements to yield predictions of Vmp, enabling direct estimation of operating voltage without extensive training. On a realistic dataset over three years, the ALR-CWM model under various irradiance levels leads to a voltage prediction mean absolute error (MAE) of 0.00124 V and a tracking efficiency above 97\%. MATLAB/Simulink simulations reveal the system model's correctness, fast convergence, and advantages in embedded MPPT applications. ALR-CWM realizes an interpretable and computationally efficient option for dynamic energy optimization of PV systems relative to conventional and machine learning-based methods.

Clustering-based Decision-Making Support System for Optimal Location of Electric Vehicle Charging Stations in Low-Voltage Distribution Networks

Chelaru Ecaterina, Gheorghe Grigoras, Bogdan-Constantin Neagu and Ștefania-Loredana Gălbău

Keywords: *Decision making, Clustering, Electric vehicles, Charging stations, Electric distribution networks*

Abstract: The technical issues faced by Distribution Network Operators (DNOs) regarding the distribution infrastructure, particularly at the low-voltage level, are becoming increasingly urgent due to the rising number of integrated prosumers and the growing demand for electric vehicles, which necessitate additional load for charging. To address these challenges, DNOs can take proactive measures by optimising the placement of electric vehicle charging stations (EVCSs) as close as possible to the power injections of prosumers. In this context, the paper proposes an engaging and effective clustering-based decision-making support system (DMSS) specifically designed to locate electric vehicle charging stations within low-voltage electrical distribution networks (LV-EDNs) in rural and peri-urban zones. The proposed DMSS integrates the K-means clustering algorithm, which identifies candidate zones based on hourly power flows and average phase voltages at each node, calculated for reference operating regimes, prioritising both practicality and reliability in LV-EDNs. Strategically, the EVCSs are positioned in nodes located within "candidate" zones, focusing on those with minimal average percentage errors for both hourly power flows and phase voltages. The optimal location is achieved by comparing them to a virtual node that represents the zone's characteristics. The objective is to determine the optimal number of EVCSs and their placement by minimising energy losses and voltage deviations, taking into account various typical power demand profiles for the EVCSs. The proposed DMSS has been tested in an LV-EDN with 36 nodes in a peri-urban zone of northwestern Romania. The findings were quite promising; four EVCSs were optimally located without requiring additional investment from the DNO for network reinforcement.

Improving the Contextual Understanding of LLMs through Multi-Teacher Knowledge Distillation and RAG

Yashaswini Ippili, Vruddhi K Jain, Yash Dixit, Gautam Saraf and V.R. Badri Prasad

Keywords: *Natural Language Processing (NLP), MultiTeacher Knowledge Distillation (MTKD), Simple Knowledge Distillation (SKD), Large Language Models (LLM)*

Abstract: Large-scale language models (LLMs) excel in various NLP tasks but face challenges in resource-constrained environments due to high computational and memory demands. To address these limitations, we propose an innovative architecture that combines Multi-Teacher Knowledge Distillation (MTKD) and Retrieval-Augmented Generation (RAG) to enhance the performance of smaller, efficient models without compromising accuracy. By utilizing multiple teacher models, we transfer diverse knowledge to a student model, ensuring its ability to manage complex tasks. Additionally, RAG enhances accuracy by dynamically retrieving relevant context during inference. Experimental results demonstrate that this approach outperforms traditional distillation methods, delivering precise, context-aware responses while maintaining computational efficiency. The model is specifically optimized for deployment on consumer-grade GPUs, making it suitable for real-world, resource-constrained applications.

Design and Optimization of a Constant-Frequency Dual-Loop Control Strategy for a PFC Rectifier in Solid-State Transformers

Hossein Shayeghi, Hamed Mojarad, Alireza Rahnama, Sina Tamaddoni, Farzad Shahi and Nicu Bizon

Keywords: *Solid-State Transformer, PFC Rectifier, Constant-Frequency Dual-Loop Control, Great Wall Construction Algorithm*

Abstract: Solid-State transformers (SSTs) are emerging as next-generation substitutes for the traditional Line-Frequency transformers due to the rapid expansion of power electronics, which has evolved the distribution network operation. Among various SST configurations, the three-stage topology is characterized by a considerable number of semiconductor switches and bulky passive components such as capacitors. These elements give rise to complex nonlinear dynamics, posing significant challenges for system modeling and control. Therefore, achieving robust and optimal system performance requires implementing an efficient control mechanism. In this paper, a constant-frequency dual-loop control method is applied to a power factor correction (PFC) rectifier in the SST rectification stage. The coefficients of both controllers are optimized using the great Wall construction algorithm, with the ISTSE index as the objective function, to ensure voltage and current quality during load or reference variations and to maintain clean power delivery for the DC-DC stage. The proposed control strategy is evaluated in comparison with the conventional single-loop control method under various conditions, and the results indicats a significant improvement in transient performance while maintaining acceptable output voltage ripple.

Optimization of a Photovoltaic Pumping System Using a Modified ABC Algorithm

Abdelkarim Ballouti, Mohamed Chouiekh, Hatim Ameziane, Hassane Latrach, Youness El Mourabit and Alia Zakriti

Keywords: *Photovoltaic (PV), Renewable energy, Maximum Power Point Tracking (MPPT), Modified Artificial Bee Colony (ABC), Three-phase induction motor, Pumping systems*

Abstract: The renewable energy sector continues to deliver sustainable solutions for critical industrial applications, particularly in water pumping systems. Our research introduces an enhanced Artificial Bee Colony (ABC) optimization approach specifically designed to boost the performance of solar-powered pumping systems. Through comprehensive MATLAB simulations of a complete PV system incorporating a three-phase induction motor and DC-DC boost converter, our modified ABC algorithm successfully achieved exceptional 98% maximum power point tracking efficiency. The system demonstrates remarkable torque stabilization capabilities while reliably maintaining consistent pump flow rates. These significant improvements clearly establish the advantages of our proposed method over conventional MPPT approaches. The findings strongly support the practical potential of ABC-based optimization in renewable energy applications, presenting industries with an effective and dependable sustainable energy solution.

Valorization of Biogenic Waste Shells:Mytilus edulis and Rapana venosa for Controlled Elaboration of Calcium Carbonate

Adriana-Gabriela Schiopu, Alexandru Berevoianu, Raluca Marginean, Mihai Oproescu, Paul Mereuta, Kim Keunhwan, Valentin Bugaescu and Stefan Mira

Keywords: *shells, calcium carbonate, elaboration and characterization*

Abstract: This study investigates the elaboration and characterization of calcium carbonate ($CaCO_3$) from two biogenic sources collected from the Black Sea coast: Mytilus edulis and Rapana venosa shells. The shells were cleaned, dried, ground and thermally treated at 900°C for 2 hours, and analyzed using XRF, SEM, EDS and FTIR techniques. XRF results indicated a high $CaCO_3$ content in both samples, with $CaCO_3$ purity of 98.2% for Mytilus edulis and 97.4% for Rapana venosa and lower levels of $MgCO_3$ and metal oxides. SEM analysis revealed that $CaCO_3$ derived from Mytilus edulis exhibited a rough and aggregated morphology, while Rapana venosa resulted in more ordered, granular structures, suggesting higher crystallinity. EDS spectra confirmed a Ca:O:C ratio closer to theoretical values for Rapana venosa, which also exhibited a lower carbon content (3.6%) compared to Mytilus edulis (6.3%), indicating more efficient thermal decomposition. The study proposes an optimized process for producing fine, morphologically controlled $CaCO_3$ from marine waste shells, offering a comparative approach for sustainable raw material valorization with potential applications in environmental, pharmaceutical and industrial domains.

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Academic Pressure
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activated sludge
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actuator
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SDN architecture
Security
security
security and privacy
segmentation of retinal vessels
selected switching state table selection
semantic web
sensitivity analysis
sensor
sensor fusion systems
sensor interfaces
Sentiment Analysis
sentiment analysis
shells

shipping
short-circuited
Side lobe suppression
Signal to noise ratio
signals
Simple Knowledge Distillation (SKD)
Simulation
simulation
simulator
single pixel camera
Skeletal Mesh
skin disease
Sliding Mode
smart city
smart connector
Smart Contracts
smart device
Smart grid
smart indoor spaces
Smart justice
smart solutions
SMC
SMOTE
Soft Computing
software development
Solar energy optimization
Solid-State Transformer
Speckle noise
spectral analysis
Spectral Centroid
speech transcription
SPI
Spoof attacks
Stacking
Standards
State of charge prediction
Stepped Carbon Trading Constraints
Stochastic gradient descent
Stress Detection
string current
Supercapacitor (SC)
surveillance
sustainability
Sustainable aerospace innovation
Sustainable aviation
Sustainable cities and communities
sustainable development
Sustainable Logistics
Sustainable organic waste management
Sustainable Transport Solutions
Swarm robotics
Synthetic Aperture Radar (SAR)
synthetic fuels
System simulation
SystemC
TARS
Technological Advancements
Technology
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TensorFlow.js
terahertz and X-ray imaging
TETRA
text-to-image generation
Thermal energy storage
thermomechanical stress
thin-walled tubes
Three-phase induction motor
Threshold Optimization
Through-Wall Imaging
tone classification
total demand distortion
Total Harmonic Distortion
total harmonic distortion
total harmonic distortion (THD).
tourism
traditional fashion
traffic prediction
Training and Development
trait extraction
transconductance
Transfer learning
Transformative AI in Logistics
Transformer
Transformer Current Control.
Transformer Model
transformers
Transient analysis
Transport
Transport Vehicles
traveler flow analysis
Trustworthy AI
TSR
Type 2 diabetes
type safety
UART communication
UDP flood
ultrasonic measurements
ultrasonic technology
ultrasonic transducer
ultrasound
UNET
unknown environments
Unmanned Aerial Vehicle (UAV)
Unmanned Aerial Vehicles
Unreal engine
urban mobility
Urban Scene
Urban Search and Rescue (SAR)
URL classification
User Experience
V2V communication
VARIATIONAL AUTOENCODER
Vermicomposting phase classification
version control
VGG-16 convolutional neural network
Video Capture Image Processing
VIDEO GENERATION
video metadata protection
Video steganography
Virtual Fitting Room
virtual instrumentation
Virtual Power Plant
Visibility Graph
vision
Vision Transformer
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VLSI
voice assistance
voters decision
vulnerabilities
vulnerability
Vulnerability Modelling
Washroom hygiene
waste heat recovery
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Water Purification
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