AICONF2026

4th Cognitive Models and Artificial Intelligence Conference

Abstracts Book

April 24-25, 2026, Prague-Czech Republic

www.ai-conf.com

CONTENTS

Conference Chair

Prof. Dr. Köksal Erentürk, Atatürk University, Turkiye

Technical Program Chairs

- Serhii Yevseiev, National Technical University "Kharkiv Polytechnic Institute", Ukraine
- Turgut Özseven, Tokat Gaziosmanpaşa University, Turkiye

Publication Chairs

- Ebubekir Yasar, Tokat Gaziosmanpaşa University, Turkiye
- Korhan Cengiz, University of Fujairah, UAE

Advisory Committees

- Abdullah Başçi, Atatürk University, Turkiye
- Ali Durmuş, Kayseri University, Turkiye
- Büşra Özdenizci Köse, Gebze Technical University, Turkiye
- Kamil Dimililer, Near East University, TRNC, Mersin 10 – Turkiye
- Kazım Hanbay, İnonu University, Turkiye
- Oleksandr Laptiev, Taras Shevchenko National University of Kyivi, Ukraine
- Rıfat Kurban, Abdullah Gül University, Turkiye
- Serkan Şenkal, Tokat Gaziosmanpaşa University, Turkiye
- Tanupriya Choudhury, Informatics Cluster,SoCS, University of Petroleum and Energy Studies, India
- Zaza Davitadze, Batumi Rustaveli State, Georgia

Technical Committee Members

- Aamir Saeed Malik, Brno University of Technology, Czech Republic
- Abdullah Orman, Ankara Yıldırım Beyazıt University, Türkiye
- Ahmet Nusret Toprak, Erciyes University, Türkiye
- Aliihsan Şekertekin, Iğdır University, Türkiye
- Andrii Musienko, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Ukraine
- Arun Prakash Agrawal, Sharda University, India
- Bilal Babayiğit, Erciyes University, Türkiye
- Crescenzo Pepe, Università Politecnica delle Marche, Italy
- Debao Zhou, University of Minnesota Duluth, USA
- Emre Dandıl, Bilecik Şeyh Edebali University, Türkiye
- Emrullah Acar, Batman University, Türkiye
- Ercan Karaköse, Kayseri University, Türkiye
- Erkut Tekeli, Adana Alparslan Türkeş Science and Technology University, Türkiye
- Ertuğrul Ayyıldız, Karadeniz Technical University, Türkiye
- Eyüp Burhan Ceyhan, Bartın University, Türkiye
- Faruk Serin, Mersin University, Türkiye
- Filiz Kalelioğlu, Baskent University, Türkiye
- František Zbořil, Brno University of Technology, Czech Republic
- Gyu Myoung Lee, Liverpool John Moores University, UK
- Hamid Mcheick, University of Quebec at Chicoutimi, Canada
- Hilal Arslan, Ankara Yıldırım Beyazıt University, Türkiye
- İlyas Özer, Bandırma Onyedi Eylül Üniversitesi, Türkiye
- Isa Maleki, Science and Research Branch, Iran
- José Alfredo F. Costa, Federal University, UFRN, Brazil
- Karam Hatem Alkhater, Al-Maarif University College, Iraq
- Ljiljana Trajkovic, Simon Fraser University, Canada
- Manuel G. Gericota, Polytechnic of Porto, Portugal
- M. Gokhan Bakal, Abdullah Gül University, Türkiye
- Mariofanna Milanova, University of Arkansas Little Rock, USA
- Mark Anthony Camilleri, University of Malta, Malta
- Mehmet Bahadır Çetinkaya, Erciyes University, Türkiye
- Mehmet Bilen, Burdur Mehmet Akif Ersoy University, Türkiye
- Mehmet Fatih Amasyalı, Yıldız Technical University, Türkiye
- Mete Çelik, Erciyes University, Türkiye
- Mohd Helmy Abd Wahab, Universiti Tun Hussein Onn Malaysia, Malaysia
- Mu-Song Chen, Da-Yeh University, Taiwan
- Murat Beken, Bolu Abant Izzet Baysal University, Türkiye
- Murat Karakoyun, Necmettin Erbakan University, Türkiye
- Mustafa Şinasi Ayas, Karadeniz Technical University, Türkiye
- Nadiia Kazakova, Odessa State Environmental University, Ukraine
- Ömer Türk, Mardin Artuklu University, Türkiye
- Ömür Şahin, Erciyes University, Türkiye
- Oleg Barabash, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Ukraine
- Rodrigo Pérez Fernández, Technical University of Madrid, Spain
- Selami Parmaksızoğlu, Antalya Bilim University, Türkiye
- Selen Ayas, Karadeniz Technical University, Türkiye
- Sercan Demirci, Ondokuz Mayıs University, Türkiye
- Sinem Akyol, Fırat University, Türkiye
- Sobchuk Valentyn, Taras Shevchenko National University of Kyiv, Ukraine
- Yasin Kaya, Adana Alparslan Türkeş Science and Technology University, Türkiye
- Taner Çokyaşar, Tarsus University, Türkiye
- Tolga Ensari, Arkansas Tech University, USA
- Tzung-Pei Hong, National University of Kaohsiung, Taiwan

TOPICS

Track 1: Artificial Intelligence & Machine Learning
Machine Learning Algorithms and Applications
Deep Learning Architectures
Explainable and Interpretable AI
Reinforcement Learning
Generative AI Models
Transfer and Federated Learning
Optimization Techniques in AI
AI for Decision Support Systems
Hybrid AI Systems

Track 2: Robotics & Autonomous Systems
Autonomous Robot Design
Human–Robot Interaction
Mobile and Aerial Robotics
Swarm Robotics
Robot Perception and Sensing
Control Systems for Robotics
Industrial and Service Robots
Medical and Rehabilitation Robotics
Ethical and Safety Issues in Robotics

Track 3: Computer Vision & Image Processing
Image and Video Analysis
Object Detection and Recognition
Medical Image Processing
3D Vision and Reconstruction
Multimodal Vision Systems
Vision-Based Robotics
Facial and Gesture Recognition
Remote Sensing and Vision
Real-Time Vision Applications

Track 4: Natural Language Processing & Speech Technologies
Language Models and Transformers
Speech Recognition and Synthesis
Multilingual and Low-Resource NLP
Sentiment and Emotion Analysis
Conversational AI Systems
Information Extraction and Retrieval
Speech Emotion Recognition
Ethical Challenges in NLP

Track 5: Data Science & Intelligent Analytics
Big Data Analytics
Data Mining Techniques
Time Series Analysis
Data Visualization and Visual Analytics
Intelligent Recommendation Systems
AI-Driven Business Analytics
Privacy-Aware Data Analytics

Track 6: Electronics, Embedded Systems & IoT
Smart Embedded Systems
AI on Edge Devices
Internet of Things Architectures
Sensor Networks
Low-Power and Energy-Efficient Systems
Cyber-Physical Systems
FPGA and ASIC Based AI Systems
Intelligent Control Electronics

Track 7: Cognitive Science & Computational Intelligence
Computational Models of Cognition
Brain-Inspired Computing
Cognitive Robotics
Perception and Attention Mechanisms
Neural and Cognitive Architectures
Emotion and Affective Computing
Cognitive Decision-Making Systems
Neurosymbolic Intelligence

Track 8: Human-Centered AI & Interaction
Human–AI Collaboration
User-Centered Intelligent Systems
Trust and Transparency in AI
Adaptive User Interfaces
Affective and Emotional AI
Accessibility and Inclusive AI
UX Design for AI Systems
Ethical Human-Centered Design

Track 9: AI in Engineering, Health & Smart Systems
AI in Healthcare Systems
Biomedical Signal Processing
Smart Cities and Infrastructure
Intelligent Transportation Systems
AI for Energy Systems
AI in Manufacturing and Industry 4.0
AI-Based Environmental Monitoring
Wearable and Smart Devices

Track 10: Ethics, Security & Future AI Technologies
AI Ethics and Responsible AI
Fairness and Bias in AI
AI Security and Adversarial Attacks
AI Governance and Regulations
Sustainable AI Technologies
Quantum AI and Computing
Emerging AI Paradigms
Future Trends in Intelligent Systems

Zero-Shot Environmental Sustainability Text Classification Based on an Adapted Bechdel Test Using LLMs

Selin Büyüktaş
Department of Electrical and Electronics Engineering, Başkent University, Ankara, Turkey selinbuyuktas@baskent.edu.tr

Pelin Büyüktaş
Ekofilm: Sustainable Production Platform ekofilmplatformu.com pelinbuyuktas.pb@gmail.com

***Abstract*—** Large Language Models (LLMs) have an outstanding capability of understanding the meaning of a given text and therefore, they can be used in Natural Language Processing (NLP) tasks that include text generation or answering, text classification and sentiment analysis. In this study, we leverage a zero-shot learning method on four widely used LLMs to analyze gender bias and environmental sustainability with green storytelling approach (ecocinema) in a given text, using two measures related to cinema and fiction. We achieved 90.00% accuracy with *MoritzLaurer/DeBERTa-v3- base-mnli-fever-anli* model for gender bias classification tasks and 91.43% with *Bart-large-mnli* model for environmental sustainability classification tasks.

Keywords— LLM, NLP, NLI, Text Classification, Zero-Shot Classification, Gender Bias, Environmental Sustainability, Bechdel Test, The Planet Test, Ecocinema

Evaluation of Linear and Nonlinear Correlated Features for Enhanced Heart Disease Classification

PRANAV BHARADWAJ[1], PRAJWAL B[2], RAGHAVENDRA RA[3], SHRUTHI M L J[4]

Department of Electronics and Communications Engineering, PES University, Bengaluru 560085, India
[1]pranavb2k3@gmail.com, [2]praejwael@gmail.com, [3]ragha11122003@gmail.com, [4]shruthimlj@pes.edu

***Abstract*—**The evaluation of different feature selection techniques has been carried out in this study to improve the machine learning performance on the two clinical datasets namely Stroke Prediction and Framingham Heart Study. Preprocessing and class balancing were done first, and then the four methods: ANOVA F-test, Recursive Feature Elimination (RFE), LASSO, and Mutual Information (MI) were employed to produce smaller feature sets. The performance of a total of eleven classifiers was evaluated based on accuracy, recall, F1-score, and area under the curve (AUC). The outcomes of the research revealed that combined LASSO and MI surpassed the baseline ANOVA method in terms of recall and also presented a more consistent performance, hence proving their capability in the detection of clinically significant features. The study also emphasizes that the use of different feature selection methods is likely to result in better predictive accuracy and interpretability of medical risk prediction models.

Keywords—Feature Selection, Machine Learning, LASSO, Recursive Feature Elimination (RFE), Mutual Information (MI), Disease Prediction, Stroke Dataset, Framingham Heart Study, Clinical Decision Support.

Integrating AI and IoT (AIIoT) for Modern Traffic Systems

Rotimi-Williams Bello
Department of Computer Systems Engineering, Tshwane University of Technology Soshanguve South, South Africa, sirbrw@yahoo.com

Etienne A. van Wyk
Faculty of Information and Communication Technology, Tshwane University of Technology, Soshanguve South, South Africa, vanwykea@tut.ac.za

Roseline Oluwaseun Ogundokun
Department of Computer Systems Engineering, Tshwane University of Technology Soshanguve South, South Africa, ogundokunroseline1@gmail.com

Chunling Tu
Department of Computer Systems Engineering, Tshwane University of Technology Soshanguve South, South Africa, duc@tut.ac.za

Pius A. Owolawi
Department of Computer Systems Engineering, Tshwane University of Technology Soshanguve South, South Africa, owolawipa@tut.ac.za

Odunayo Imoru
School for Continuing Education Red River College Polytechnic Winnipeg, Manitoba, Canada aymorus@gmail.com

***Abstract*—** Artificial Intelligence of Things or AI plus IoT represents the paradigm leap for intelligent traffic control and transportation. The problems related to the modern city, such as traffic congestion, pollution, deteriorating infrastructure, and safety, have become beyond the scope of traditional traffic-control techniques. In this study, research on incorporating AIIoT technology into a contemporary, environmentally friendly traffic system is presented. This paper focuses more on how IoT and AI are expected to enhance sensing of data, communication, autonomous decision-making, and predictive analysis. The various components of smart traffic networks include cloud and edge computing, machine learning techniques, computer vision regarding objects and vehicle identification, and V2X communication. Some of the challenges the study emphasizes are data privacy, cybersecurity, interoperability, physical infrastructure costs, real-time route optimization, smart junctions, adaptive signal management, and accident prediction. The paper further looks at case studies, emerging trends of research, and recommendations on how such issues can be resolved. In summary, these elements present how AIIoT transforms transport networks into the safest, most efficient, and ecologically friendly forms, thus unlocking the route to autonomous and sustainable urban mobility.

Keywords— Artificial Intelligence, Cities, Internet of Things, Traffic Systems, Vehicle

AI-Based Network Traffic Modeling & Synthetic Data Generation

Ali Berkol
Projects and Business Development Aselsan-Ulak Haberlesme Ankara, Türkiye ali.berkol@yahoo.com

***Abstract*—**Realistic network traffic data is a fundamental requirement for the design, evaluation, and optimization of modern communication systems. However, access to real-world traffic traces is often limited due to privacy, security, and operational constraints, particularly in large-scale and critical communication infrastructures. This limitation poses a significant challenge for data-driven network analysis and AIbased optimization methods. This paper presents an AI-based framework for network traffic modeling and synthetic data generation that aims to capture the statistical and temporal characteristics of real communication networks. Network traffic is represented as multivariate time-series data, and generative learning models are employed to produce realistic synthetic traffic patterns under different operational conditions, such as normal load and burst traffic scenarios. The quality of the generated synthetic traffic is evaluated using statistical similarity metrics and temporal correlation analyses. In addition, the usefulness of the synthetic data is assessed through downstream network analysis tasks. Experimental results indicate that the proposed approach can generate high-fidelity traffic patterns suitable for network simulation, performance evaluation, and AI model training, without requiring access to sensitive real traffic data. The proposed framework provides a practical and reproducible solution for AI-driven traffic modeling in modern communication networks.

Keywords—Network Traffic Modeling, Synthetic Data Generation, Artificial Intelligence in Communications, TimeSeries Modeling, Communication Networks

AI-Driven Aerial Base Stations for Adaptive UAV-Based Connectivity

Ali Berkol
Projects and Business Development Aselsan-Ulak Haberlesme Ankara, Türkiye ali.berkol@yahoo.com

İdil Gökçe Demirtaş
Projects and Business Development Aselsan-Ulak Haberlesme Ankara, Türkiye idil.demirtas@ulakhaberlesme.com.tr

***Abstract*—** The increasing demand for flexible and resilient communication infrastructures has motivated the use of unmanned aerial vehicles (UAVs) as temporary or complementary base stations. Unlike conventional terrestrial deployments, UAV-based base stations operate under strict energy, mobility, and coverage constraints, requiring adaptive and intelligent control mechanisms. This work presents a conceptual AI-driven framework for UAV-based aerial base stations, where artificial intelligence functions as a decision and orchestration layer rather than a data-centric prediction model. The proposed framework enables UAVs to dynamically adjust their positioning, service duration, and operational modes based on real-time network conditions and mission constraints. Instead of focusing on physical-layer optimization, the study emphasizes system-level intelligence, highlighting how AI can support adaptive connectivity in scenarios such as disaster response, rural coverage, and temporary traffic overloads. The work provides architectural insights and discusses key design trade-offs, offering a foundation for future implementations of intelligent aerial communication systems.

Keywords—UAV-Based Base Stations, Aerial Communication Systems, Artificial Intelligence, Adaptive Connectivity, Intelligent Network Architecture

The Silent Erosion of Governance: Unmasking the Suppression Effect of AI Catastrophizing on Public Trust via Hierarchical SEM

Panagiotis Tsarouhas
Department of Computer Science and Biomedical Informatics University of Thessaly Lamia, Greece ptsarouhas@uth.gr

Konstantinos Grigoriadis
Department of Computer Science and Biomedical Informatics, University of Thessaly Lamia, Greece kongrigor80@gmail.com

Abstract: The integration of Artificial Intelligence into public administration is frequently obstructed not by technical limitations, but by a complex, multi-layered psychological barrier defined as AI Catastrophizing. While existing literature often treats public resistance as a linear function of distinct variables like technophobia, this study posits that the mechanism is structurally complex and operates latently. Utilizing a robust dataset of 687 participants within a rapidly digitizing European public sector context, we employed a rigorous Hierarchical Structural Equation Modeling (Hierarchical SEM) approach to map the cognitive architecture of citizens. We successfully validated a secondorder latent construct representing the Socio-Institutional Context, proving that transparency, participation, and institutional competence do not act in isolation but function as a unified antecedent. Most critically, our analysis uncovers a profound suppression effect. While the direct impact of catastrophizing on the intention to use AI appears statistically moderate (beta = -0.127), its indirect impact mediated through the erosion of trust is devastating (beta = -0.506). This finding suggests that catastrophic thinking functions as a silent corrosive agent, suppressing the generation of trust required for sustainable adoption. The study contributes a statistically robust framework for understanding the hidden cognitive dynamics of the digital era, offering actionable insights for policymakers to mitigate resistance through explainability and cognitive alignment.

Keywords: Hierarchical SEM, AI Catastrophizing, Trust Suppression, Socio-Institutional Context, Second-Order Factor Analysis, Cognitive Barriers, Public Administration.

Health Practitioners' Encouragement to Apply Artificial Intelligence Technologies in Health Services

Alsaleh Saad
Hail Health Cluster Hail Health Cluster Hail Health Cluster, saabalsalsaleh@moh.gov.sa

Talal Alzabni
Saudi Ministry of Health Saudi Ministry of Health Saudi Ministry of Health, talazabni@moh.gov.sa

Maram Alawad
Hail City, Kingdom of Saudi Arabia Hail City, Kingdom of Saudi Arabia Hail City, Kingdom of Saudi Arabia, Manalawad@moh.gov.sa

Abstract— Artificial intelligence (AI) has emerged as a crucial tool in the healthcare sector, particularly in the implementation of electronic health systems to enhance patient care and facilitate the early detection and diagnosis of illnesses. This study investigated the impact of healthcare practitioners' encouragement to implement AI technologies in the health services they provide. All public hospitals in Hail City, Kingdom of Saudi Arabia, were selected as research sites. A total of 328 healthcare providers participated in the study. The findings revealed that the majority of participants reported receiving encouragement from their leaders to use AI technologies. A quantitative descriptive research design was employed to achieve the objectives of the study.

Keywords— healthcare practitioners, healthcare system, artificial intelligence, innovation, information technology, health institutions.

AI-Driven Test Case Generation Using RetrievalAugmented Enterprise Knowledge

Rajesh Kumar
Siemens Technology & Services Private Ltd. Bangalore, India. kumar.rajesh@siemens.com

Shweta Rani Padhy
Siemens Technology & Services Private Ltd. Bangalore, India. shweta.padhy@siemens.com

***Abstract**:* Software testing accounts for nearly 50% of overall software development cost, with system-level testing contributing substantially due to large test suites, repeated regression cycles, and extensive manual effort. While recent advances in Large Language Models (LLMs) suggest potential for automating test case generation from natural language requirements, existing approaches remain limited by hallucination, weak risk awareness, shallow coverage, and insufficient grounding in historical defect behavior. System testing requires requirement-specific reasoning, business context awareness, and defect-driven insight capabilities that generic LLM-based solutions do not reliably provide. This paper proposes a novel multi-hop RAG framework for intelligent system test case generation, which integrates requirements, historical defects, and existing test artifacts through a structured, risk-aware retrieval pipeline. The architecture employs a three-stage semantic retrieval process Requirement Retrieval, Defect Retrieval guided by a Component Dependency Score, and Test Case Retrieval to progressively enrich contextual input before test generation. This design enables the LLM to generate test cases that are explicitly aligned with high-risk components, historically defect-prone areas, and uncovered functional paths. Experimental evaluation conducted on industrial-scale datasets demonstrates that incorporating component dependency and defect intelligence improves defect retrieval precision by approximately 12% and increases relevant test case recall by approximately 15% compared to single-stage retrieval baselines.

Keywords: Large Language Models, Retrieval-Augmented Generation, Defect-Driven Testing, Knowledge-Aware Test Generation, Testing efficiency, Component Dependency Analysis, Text similarity, Test Prioritization.

Digital Twin Guided ACT-R Modeling of Dual-Task Timing

Sonay Duman
Department of Software Engineering Toros University, Mersin, Turkey sonay.duman@toros.edu.tr

Behiye Şahin
Department of Psychology Toros University, Mersin, Turkey behiye.sahin@toros.edu.tr

***Abstract*—** Digital twins are extensively utilized in modeling and simulation; however, their application to experimental cognitive data is still constrained. This research introduces a proof-of-concept cognitive Digital Twin developed from a threephase dual-task experiment, wherein participants and a cognitive architecture predicted a 7-second target time interval. The dataset consists of four conditions that merge Letter (L) and Addition (A) tasks (LLL, AAA, AAL, LLA), with Phase1– Phase3 values indicating deviations from 7 seconds. The Digital Twin was used as a phase-level predictor that could be understood by using task identity, phase position, and directionspecific switching. Five-fold grouped cross-validation and leaveone-condition-out have been used for testing to see how well the system worked. The Digital Twin achieved MAE = 302.50 ± 61.11 and RMSE = 430.45 ± 96.55 for predicting phase-level deviation for participants and MAE = 43.67 ± 7.59 and RMSE = 54.56 ± 9.86 for the model. Separate analyses demonstrated significantly greater predictability for model-generated data compared to participant data, underscoring human variability. Overall, the results demonstrate that digital twin principles can be applied to experimental timing data to produce interpretable, validated models of sequential behavior, supporting future integration of cognitive theory into digital twin-based simulation frameworks.

Keywords— ACT-R, digital twin, cognitive architecture, time perception

Gaussian Regression Process Modeling of Bioconvective Nanofluid Flow in a Magnetically Driven Square Cavity

Ummuhan Yirmili
Applied Data Science Master Program, TED University, Ankara, Turkiye ummuhan.yirmili@tedu.edu.tr

Bengisen Pekmen
Department of Mathematics TED University, Ankara, Turkiye, bengisenpekmen@gmail.com

Merve Gurbuz-Caldag
Department of Mathematics TED University, Ankara, Turkiye, merve.gurbuz@tedu.edu.tr

***Abstract*—**This study develops a Gaussian process regression (GPR) model to predict the buoyancy-driven bioconvection behavior of an Fe3O4-water nanofluid containing magnetotactic bacteria in a unit square cavity subject to externally applied and induced magnetic fields. The steady, two-dimensional governing equations are formulated in dimensionless stream function-vorticity form, coupled with equations for temperature, iron concentration, bacteria density, and magnetic potential. A radial basis function (RBF) collocation method is employed to generate a comprehensive dataset covering wide ranges of Rayleigh, bioconvective Rayleigh, Peclet, Lewis, Hartmann, magnetic Reynolds, and buoyancy ratio numbers. For each parameter combination, the average Nusselt number, Sherwood number and bacteria density along the heated wall are recorded. Using this dataset, data-driven GPR model is constructed for each of the output quantities. Model performance is assessed through mean squared error (MSE) metrics, hyperparameter sensitivity analysis, and residual plots. The results demonstrate that the proposed GPR model with RBF kernel accurately captures the multiphysics relationships, achieving test MSEs on the order of 10-3 for the averages. The developed framework offers an alternative prediction modeling for bioconvection systems.

Index Terms—Bioconvection, nanofluid, induced magnetic field, Gaussian regression process modeling.

Decoding the Neural Architecture of AI-Mediated Mental Healthcare: A Paradigm Shift in Telehealth and Cognitive Neuroscience

Saket Ganti
San Joaquin Delta College, sganti933@mustangs.deltacollege.edu

***Abstract*—**Mental health disorders, including depression, anxiety, and post-traumatic stress disorder, represent a growing global crisis, worsened by a shortage of mental health professionals and inequities in access to care. The integration of artificial intelligence into telehealth has been positioned as a scalable solution, leveraging machine learning, natural language processing, and affective computing to deliver personalized, datadriven interventions. AI-powered chatbots, virtual therapists, and emotion recognition systems have demonstrated promise in replicating aspects of human therapeutic engagement. However, the underlying neural mechanisms through which AI-mediated therapy influences cognitive and affective processes remain poorly understood. This paper examines the interaction between AIdriven interventions and neurobiological systems, focusing on the prefrontal cortex, amygdala, default mode network, and dopaminergic pathways implicated in emotion regulation and cognitive control. Despite advancements, significant challenges persist in AI's ability to replicate human empathy, mitigate algorithmic bias, and ensure ethical deployment in mental healthcare. To bridge this gap, we propose a neuroscience-informed framework for AI-driven mental health interventions, integrating real-time neural monitoring, adaptive machine learning models, and ethical guidelines for responsible AI deployment. This synthesis of computational psychiatry, affective neuroscience, and AI ethics shows both the transformative potential and the critical limitations of AI in reshaping the future of mental healthcare.

Index Terms—Artificial Intelligence, Mental Healthcare, Telehealth, Cognitive Neuroscience, Computational Psychiatry, Ethical AI

Resistance and Care: Co-Creating Secure Telehealth Practices Between Humans and AI in Surveillance Societies

Saket Ganti
San Joaquin Delta College, sganti933@mustangs.deltacollege.edu

***Abstract*—**In an era of pervasive digital surveillance, marginalized patients often face acute privacy risks when accessing telehealth services [1]. We propose a novel conceptual system in which patients co-create privacy-preserving rituals with an AI partner during telehealth conversations. Drawing on cultural studies of subversive communication (e.g., code-switching, metaphor, secret argots), our system uses generative AI to help users embed their messages in culturally rooted metaphors and codes. For example, like Harriet Tubman's "Underground Railroad" vocabulary or LGBTQ cryptolects, the AI suggests phrases and signals that obscure sensitive content to outsiders but are meaningful to the patient and clinician. We outline a modular architecture: a cultural knowledge base, an adaptive ritual generator (a fine-tuned LLM), and a user–AI co-creative interface that implements real-time message obfuscation. We frame this as a human–AI creative collaboration: patients and AI jointly author coded language, raising questions of authorship, trust, and agency. We discuss the implications for design ethics — ensuring transparency, user control, and non-coercion — as well as the environmental cost of privacy-enabled AI. By fusing technology, care, and cultural wisdom, our Rituals of Resistance and Care system offers a blueprint for empowering privacy in telehealth while acknowledging trade-offs in sustainability and ethics.

Index Terms—Telehealth, Privacy, AI, Human-AI Co-Creation, Cultural Codes, Ethics

Neuro-Oscillatory Generative Architecture: A Modular Brain-Inspired Framework for Creative AI and Hypothesis Generation

Saket Ganti
San Joaquin Delta College, sganti933@mustangs.deltacollege.edu

***Abstract*—**We propose a novel theoretical framework for creative AI that synthesizes modules inspired by computational neuroscience. Our architecture integrates oscillatory networks (e.g., coupled Hopf oscillators), chaotic dynamics, and feedback loops across multiple timescales to generate rich, unpredictable output. Biological motifs—including cortico-basal ganglia loops and neurons–glia–vascular modulation—are abstracted into mathematical modules that can operate both independently and cooperatively. This modular architecture can produce diverse creative outputs (images, text, multimodal artifacts) and propose novel scientific hypotheses by discovering non-obvious associations. Ethical considerations remain important to ensure responsible use. We describe the system design and present example usecases illustrating its creative capacities.

Index Terms—Creative AI, Neuro-inspired AI, Oscillatory Networks, Chaotic Dynamics, Basal Ganglia, Astrocytes

Diabetic Retinopathy Classification with EfficientNetB0 Model with Attention Mechanism: An Approach on OCT Images

Fatma Nur Ortataş
Department of Computer Engineering Yozgat Bozok University, Yozgat, Turkiye f.nur.ortatas@yobu.edu.tr

Zeliha Açıkgöz
Department of Computer Engineering Yozgat Bozok University, Yozgat, Turkiye, zeliha.acikgoz@yobu.edu.tr

Ayça Dolar
Department of Computer Engineering Yozgat Bozok University, Yozgat, Turkiye, ayca.dolar@yobu.edu.tr

***Abstract*—**Diabetic retinopathy (DR) is a significant contributor to visual impairment globally, impacting more than 103 million individuals as of 2020. Timely identification is essential to avert visual impairment; yet, conventional diagnosis depends on the manual assessment of retinal images by experts. In this study, we propose an attention-enhanced transfer learning framework based on EfficientNetB0 for binary diabetic retinopathy classification using OCT images. To improve the model's ability to focus on clinically relevant regions, Convolutional Block Attention Modules (CBAM) are integrated after the MBConv blocks of the backbone network. The proposed model is trained and evaluated on a publicly available OCT dataset consisting of 2,838 images categorized as diabetic retinopathy and non-diabetic retinopathy. Hyperparameters are optimized using grid search, and the model performance is assessed through accuracy, precision, recall, F1- score, and ROC-AUC metrics. Experimental results demonstrate that the proposed EfficientNetB0+CBAM architecture achieves a test accuracy of 97%, outperforming several existing approaches on the same dataset. The findings indicate that incorporating spatial and channel-wise attention mechanisms significantly enhances feature representation for OCT-based DR classification. This work highlights the effectiveness of lightweight attentionaugmented models for medical image analysis and their potential to support early diagnosis in clinical decision-making systems.

Index Terms—Diabetic retinopathy, OCT, transfer learning, EfficientNetB0, CBAM

Enterprise AI Upskilling via Synthetic Workforce Simulation of Cognitive Learning States

Claudio Ricci
AI Academia Strategy and Research UBS Business Solutions AG, Lugano, Switzerland, claudio.ricci@ubs.com

Rolands Repetto
AI Academia Strategy and Research UBS Business Solutions AG, Lugano, Switzerland, rolands.repetto@ubs.com

Marzio Lunghi
AI Academia Strategy and Research UBS Business Solutions AG, Lugano, Switzerland, marzio.lunghi@ubs.com

Stefania Andreea Stan
AI Academia Strategy and Research Team Lead UBS Business Solutions AG, Zurich, Switzerland, stefania.stan@ubs.com

***Abstract*—**Large organizations face increasing pressure to upskill global workforces in artificial intelligence while ensuring scalability, personalization, and data privacy. This paper presents a cognitive learning simulation framework that models engagement dynamics and self-regulated learning behaviors using a fully synthetic workforce of over 100,000 agents. Based exclusively on non-identifying organizational attributes, such as role family, job function, seniority, tenure, and region, we generate a realistic large-scale workforce and simulate individual learning trajectories across recurring AI training sessions.

The framework explicitly models cognitive state variables and learning update dynamics. This enables estimation of engagement, knowledge gain, and knowledge decay over time. Behavioral clustering of simulated agents is used to identify distinct learning strategy archetypes aligned with SRL theory. Model realism is assessed by comparing simulated engagement metrics with aggregated real-world participation data, demonstrating the framework's ability to reproduce key empirical patterns. The results provide a scalable and privacy-preserving approach for studying workforce learning at scale and offer a practical blueprint for applying cognitive modeling to training design in regulated organizational environments.

Index Terms—Self-regulated learning, workforce upskilling, agent-based simulation

Bridging the Gap: An Agentic AI Framework for Reverse-Engineering Automated Test Scripts into Natural Language Requirements

Furkan BODUR
Grid Simulation, SIEMENS Foundational Technologies, Ankara, Turkey furkan.bodur@siemens.com

***Abstract*—**Automated tests are major in today's industrialscale software systems, yet they frequently create a lot of documentation debt in the production environments. In large real-world applications, the automated test scripts operate as the default system specification, while manual test cases and business requirements corrupt or vanish. This article introduces an Agentic AI framework that turns automated test scripts back into structured, Jira-compatible manual test cases. The framework is tested on a real-world industrial repository of more than 300 python-based TestComplete (Test Automation Tool) scripts. A comparative study of three big language models Gemini 2.5 Pro, GPT-5.2, and Claude Opus 4.5—across the complexity levels of the task shows that agentic workflows, which contain contextual artifacts, very much exceed the performance of the context-free code summarization. The results point out the different model advantages and, thus, support a hybrid, ensemble-based approach for the high fidelity documentation recovery in closed-loop AI-driven testing pipelines.

Index Terms—Agentic AI, Test Automation, Reverse Engineering, LLM, Jira, TestComplete, Documentation Debt

Dual Stream Attention Fusion Network Based on Physical Information (DSAF-Net): Research on Automated Quantitative Mineralogy and Mechanical Property Prediction for Rocks

Jiaxing Sun
Intermediate Engineer, Jiangsu Coal Geological Exploration Team III, Changzhou,China, sunjiaxing202112@163.com

Feng Chen
Senior engineer, Jiangsu Coal Geological Exploration Team III Changzhou,China, 18094445898@163.com

***Abstract*—**In response to the challenges of traditional quantitative methods for rock minerals and mechanical property prediction, which involve high time consumption, reliance on expert experience, and the lack of physical interpretability in purely data-driven models, this paper proposes a dual-stream attention fusion network (DSAF-Net) based on physical information. This framework constructs a dual-stream encoder to process X-ray diffraction (XRD) and infrared spectroscopy (IR) data in parallel, and utilizes a cross-modal attention mechanism to dynamically capture the deep correlation between structural diffraction and chemical bond vibration features, effectively solving the problem of ambiguous single-modal information. To overcome data scarcity, the study constructed a high-fidelity synthetic dataset based on physical principles and introduced the Simto-Real transfer learning strategy; at the same time, prior knowledge such as mineral content conservation and mechanical monotonicity was embedded in the loss function to force the model to optimize within the physically feasible domain. Real core experiments demonstrated that the average absolute error (MAE) of mineral quantification of DSAF-Net was reduced to 2.3%, and the prediction R2 of uniaxial compressive strength (UCS) reached 0.94, significantly outperforming traditional CNN methods, and eliminating abnormal predictions that violate physical laws, providing a reliable end-to-end solution for geological intelligent analysis.

Keywords- Deep learning, X-ray diffraction (XRD), Infrared spectroscopy (IR), Multimodal fusion, Physical information neural network (PINN), Rock mechanical properties, Automated mineralogy

Smart Sports App Design and Development: With the Digital Enabling National Fitness Behavior Change as the Core

Qian Chen
Physical Education Institute of Jimei University Xiamen, China qianchen202408@163.com

Abstract—Across the globe, although the number of mobile health (mHealth) applications has increased significantly, the high user churn rate and the low success rate of habit formation in physical activities remain major challenges. Existing exercise apps often focus on passive data recording, lacking real-time feedback on the quality of users' exercise and precise intervention at the behavioral and psychological stage. This paper proposes a new intelligent exercise system named CogniFit-Twin, aiming to bridge the gap between short-term exercise behaviors and long-term habit formation through digital means. The system integrates a real-time posture estimation model based on the improved YOLOv11 architecture and a deep reinforcement learning intervention engine based on the cross-theory model (TTM). By constructing the "digital cognitive twin" of users, the system can perceive the biomechanical quality of exercise in real time and dynamically predict the migration of users' behavioral stages. We compared the effectiveness of this system with traditional rule-based apps in a 180-day simulation experiment. The results showed that CogniFit-Twin increased the 180-day retention rate of users from the baseline group's 2.1% to 22.4%, and significantly increased the average weekly active time to 148 minutes, approaching the recommended standard of the World Health Organization (WHO). Moreover, survival analysis and state transition matrices revealed the effective mechanism of the system in providing precise psychological intervention during users' "burnout period". This research provides a theoretical framework and empirical basis for the next generation of human-centered intelligent sports engineering.

Keywords—Artificial intelligence, behavioral change, transtheoretical model (TTM), deep reinforcement learning, computer vision, all-round fitness, IEEE SMC

Scalable Big Data Analytics for Social Media Sentiment Mining: A Multi-Algorithm Framework Applied to COP29 Climate Discourse

Oluwole Fagbohun
Carbonnote Maryland, USA, oluwolefagbohun077@gmail.com

Ilemona Abutu
Carbonnote Maryland, USA, abutumona@gmail.com

Bisola Kayode
Independent Researcher Coventry, UK, kayodebisola22@gmail.com

Chukwuka Michael Oforgu
Readrly Ltd London, UK, chukwuka.oforgu@gmail.com

Ifeoluwa Wuraola
University of Hull Hull, UK, wuraolaifeoluwa@gmail.com

Temitope Kadri
Readrly Limited Bristol, UK, temitopekadri@gmail.com

Okiki-Jesu Timothy Olumide
Independent Researcher London, UK, ddonolu@yahoo.com

Olanrewaju Odunowo
TechCabal Insights Kent, UK, olanrewaju@bigcabal.com

Sadeeq Akintola
Universidade NOVA de Lisboa Lisbon, Portugal, sadeeq2@gmail.com

Joshua Obodai
University of Hertfordshire Hertfordshire, UK, obodaij@gmail.com

Peter Adetola Adetunji
Independent Researcher Kent, UK, Adetunjipeter02@gmail.com

Tewogbade Shakir
Independent Researcher London, UK, stewogbade@capeeconomicconsult.com

Nelson Ogbeide
Independent Researcher Birmingham, UK, ogbeide331@gmail.com

Anuoluwapo Gabriel
Pavolera Technology Limited Portsmouth, UK, gabrielanuoluwapojoshua@gmail.com

Mgbame Michael
Hankali Intel Lagos, Nigeria, michael.m@hankaliapp.com

David Uno
Readrly Limited London, UK, dee.uno@outlook.com

***Abstract*—**This study presents a scalable big data analytics framework for processing large-scale social media datasets, demonstrated through analysis of 182,610 COP29-related tweets collected from October 11 to December 10, 2024 (61 days). We develop and evaluate multi-algorithm sentiment analysis methodologies combining VADER, TextBlob, and NRC Emotion Lexicon for distributed processing of social media text data. The framework addresses key big data challenges including automated data cleaning pipelines, bot detection algorithms, and temporal pattern mining across massive datasets. Our distributed computing approach processes data across three temporal segments: preevent (30 days, 76,240 tweets), during-event (12 days, 38,326 tweets), and post-event (18 days, 68,044 tweets). Performance evaluation demonstrates processing capabilities of 3,000+ tweets per minute with 89.2% sentiment classification accuracy. The system identifies distinct discourse phases: pre-event awarenessbuilding (41.7% engagement), during-event policy focus (21.0% engagement), and post-event solutions orientation (37.3% engagement). Sentiment analysis reveals predominantly neutralto-positive patterns (68.4%), with hashtag frequency analysis showing #climateaction (31,410 mentions) and #sustainability (23,823 mentions) as dominant themes. This work contributes a reusable big data processing framework for social media analytics with demonstrated scalability and accuracy for large-scale text mining applications.

Index Terms—Big Data Analytics, Social Media Mining, Sentiment Analysis, Distributed Computing, Natural Language Processing, Temporal Pattern Mining, Data Processing Algorithms, Scalable Text Analytics

Textile Surface Defect Detection under Low FalseAlarm Constraints: CNNs and PaDiM

Anday Duru
Department of Biomedical Engineering Karabuk University, Karabuk, Turkiye

Eftal Sehirli
Department of Computer Engineering Karabuk University, Karabuk, Turkiye

Abstract— Automated defect inspection is critical in textile manufacturing, yet manual visual quality control remains labor-intensive and prone to error. This study benchmarks supervised patch-level classification against unsupervised anomaly detection for textile surface defect inspection using the public Sarga woven-fabric dataset. High-resolution grayscale fabric images acquired under controlled illumination were provided in processed 8-bit format and partitioned into overlapping 365 × 365 patches, resulting in a highly imbalanced patch set of 173 defect and 18,403 control patches. To ensure a fair comparison, all methods were evaluated on the same unseen test split and assessed using ROC analysis together with lowfalse-alarm operating points reflecting industrial inspection constraints at approximately 1% false positive rate. Three backbones, ResNet-18, EfficientNet-B0, and ConvNeXt-Tiny, were examined in both settings: supervised fine-tuning for defect probability estimation and PaDiM for modeling normal texture distributions using only defect-free training patches. On the common test set, the best supervised model, ResNet-18, achieved an AUROC of 0.970, with recall of 0.943 and specificity of 0.988 at the selected low-FPR operating point, whereas the best PaDiM configuration with a ConvNeXt-Tiny backbone achieved an AUROC of 0.971, with recall of 0.886 and specificity of 0.990. Overall, the two paradigms showed highly comparable discrimination on the same unseen test set, with the differences mainly reflecting an operating-point trade-off between defect sensitivity and false-alarm control. These findings suggest that PaDiM is a practical label-efficient alternative when defect annotations are limited, whereas supervised fine-tuning may be preferred when labeled defects are available and higher sensitivity is prioritized.

Keywords— Textile defect detection, Surface defect detection, artificial intelligence, unsupervised learning, PaDiM

Enterprise Digital Management Strategy under the Data Lake Architecture: Multi-Dimensional Management Covering Data Quality, Security, and Compliance

Liyong Liao
Guangzhou Vocational University of Science and Technology, Guangdong Province, China
liaoliyong@gkd.edu.cn

Abstract-- Facing the exponential growth of unstructured and semi-structured data, the traditional data warehouse architecture has failed to meet the agility and scalability requirements of modern enterprises. Therefore, the Data Lake and Data Lakehouse architectures have gradually become the core infrastructure for digital transformation. However, the openness and flexibility of this architecture have also led to data flooding, security vulnerabilities in multitenant environments, and increasingly strict compliance requirements related to data protection regulations (such as the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA)). This paper proposes a "Unified Data Governance (UDG)" framework specifically designed for the data lake environment. This framework integrates three core dimensions: adaptive data quality assessment based on multiple standards, zero-trust security architecture combined with subjective logic, and automated compliance mechanism based on deletion vectors. We propose a new dynamic trust scoring model (Dynamic Trust Score) and develop a weighted data quality indicator (Data Quality Indicator, DQI) to optimize governance decisions. Through large-scale simulation experiments on a 10TB dataset using the TPC-DS benchmark test in the Spark and Delta Lake environment, the research proves that the UDG framework can increase the detection rate of abnormal data by 22%, reduce the latency of compliance deletion operations by 40% using the deletion vector technology, and still maintain extremely high analytical usability under strict cost constraints. This research provides a practical path for enterprises in the industrial 4.0 and fintech fields to achieve digital governance in the era of AI-driven analysis.

Keywords—Data lake architecture, zero trust security, data quality governance, GDPR compliance, dynamic trust scoring, deletion vector, multi-objective optimization

Gamma2Patterns: Deep Cognitive Attention Region Identification and Gamma-Alpha Pattern Analysis

Sobhana Jahan
Department of Computer Science The University of Alabama, Tuscaloosa, USA sjahan2@crimson.ua.edu

Saydul Akbar Murad
School of Computing Sciences and Engineering The University of Southern Mississippi, Hattiesburg, USA saydulakbar.murad@usm.edu

Nick Rahimi
School of Computing Sciences and Engineering The University of Southern Mississippi, Hattiesburg, USA nick.rahimi@usm.edu

Noorbakhsh Amiri Golilarz
Department of Computer Science The University of Alabama, Tuscaloosa, USA noor.amiri@ua.edu

***Abstract*—**Deep cognitive attention is characterized by heightened gamma oscillations and coordinated visual behavior. Despite the physiological importance of these mechanisms, computational studies rarely synthesize these modalities or identify the neural regions most responsible for sustained focus. To address this gap, this work introduces Gamma2Patterns, a multimodal framework that characterizes deep cognitive attention by leveraging complementary Gamma- and Alpha-band EEG activity alongside Eye-tracking measurements. Using the SEED-IV dataset [1], we extract spectral power, burst-based temporal dynamics, and fixation–saccade–pupil signals across 62 channels or electrodes to analyze how neural activation differs between high-focus (Gamma-dominant) and low-focus (Alpha-dominant) states. Our findings reveal that frontopolar, temporal, anterior frontal, and parieto-occipital regions exhibit the strongest Gamma power and burst rates, indicating their dominant role in deep attentional engagement, while Eye-tracking signals confirm complementary contributions from frontal, frontopolar, and frontotemporal regions. Furthermore, we show that Gamma power and burst features provide more discriminative markers of deep focus than Alpha power alone, demonstrating their value for attention decoding. Collectively, these results establish a multimodal, evidence-based map of cortical regions and oscillatory signatures underlying deep focus, providing a neurophysiological foundation for future brain-inspired attention mechanisms in AI systems.

Index Terms—Cognitive Attention, Multimodal Framework, Gamma, Alpha, EEG, Deep Focus, Brain-inspired, Attention Mechanism.

Revisiting Day-Ahead Electricity Load Forecasting: The Effectiveness of Chronos Zero-Shot Models

İlayda Kaptan
Department of Information Security Technology Adana Alparslan Türkeş Science and Technology University, Adana, Türkiye, ikaptan@atu.edu.tr

Sina Ghaemi
Department of Energy (AAU Energy) Aalborg University, Aalborg, Denmark sigh@energy.aau.dk

İnayet Özge Aksu
Department of Artificial Intelligence, Adana Alparslan Türkeş Science and Technology University, Adana, Türkiye oaksu@atu.edu.tr

Amjad Anvari-Moghaddam
Department of Energy (AAU Energy) Aalborg University, Aalborg, Denmark aam@energy.aau.dk

***Abstract*—** In today's power systems, accurate load forecasting has become essential due to the increasing presence of flexible and highly fluctuating loads, which challenge grid stability and efficient resource management. In this regard, this study presents a comprehensive analysis of day-ahead forecasting performance, comparing zero-shot forecast models with locally trained machine learning and statistical approaches, using real hourly electricity load data from Türkiye. Five different architectures belonging to the Chronos model family, named Chronos-Bolt-small, Chronos-Bolt-base, Chronos-T5-small, Chronos-T5-base, and Chronos-T5-large, were comparatively evaluated with CatBoost, LightGBM, and Holt–Winters methods. The performance analysis of the evaluated models includes point accuracy metrics as well as probabilistic prediction behavior. The results show that the zero-shot prediction approach can deliver superior performance compared to locally trained traditional machine learning and statistical methods. In particular, Chronos T5- large stood out as the most powerful model by achieving the lowest error values and the highest accuracy metrics. This model was able to handle uncertainties and sudden changes by providing a high fit to the actual load demand profile around peak load hours with narrow and well-calibrated uncertainty intervals. The findings reveal that architectural design and appropriate inductive bias selection are more decisive than model size in electricity load forecasting. This study demonstrates that zero-shot time series models offer a powerful and practical alternative for day-ahead energy forecasting applications without the need for feature engineering or retraining.

Keywords—energy load forecast, day-ahead prediction, zeroshot forecasting, time series analysis, chronos.

Analyzing Eco-Innovation Performance With Tree-Based Machine Learning and SHAP Analysis

Miraç Tuba ÇELİK
Department of Industrial Engineering, Bursa Technical University, Bursa, Türkiye Bursa, Türkiye, tuba.celik@btu.edu.tr

Asude DEMİR
Department of Industrial Engineering, Bursa Technical University, Bursa, Türkiye,asude.demir@btu.edu.tr

Yunus DEMİR
Department of Industrial Engineering, Bursa Technical University, Bursa, Türkiye, yunus.demir@btu.edu.tr

Aytaç YILDIZ
Department of Industrial Engineering, Bursa Technical University, Bursa, Türkiye, aytac.yildiz@btu.edu.tr

***Abstract*—** Eco-innovation is a multidimensional policy domain that reflects how countries transform their energy systems and enhance their innovation capacity while addressing environmental pressures. This study examines the predictive drivers of the Eco-Innovation Index (EII) for European Union member states using tree-based machine learning and explainable artificial intelligence techniques. Categorical Boosting (CatBoost), Random Forest, and Adaptive Boosting (AdaBoost) models are implemented and evaluated using validation metrics that assess model performance and generalization capability. The results indicate that CatBoost provides a more balanced and stable predictive performance compared to the alternative methods. Shapley Additive Explanations (SHAP) analysis is employed to interpret model outputs and quantify feature contributions. The findings show that energy consumption structure, renewable energy share, and Research and Development (R&D) expenditures exhibit strong predictive relevance for eco-innovation scores. These results suggest that eco-innovation performance is closely associated with integrated energy and innovation dynamics rather than isolated environmental measures. Overall, the study supports the importance of coordinated policy frameworks that simultaneously address energy efficiency, renewable energy investments, and R&D expenditures.

Keywords— eco-innovation, explainable artificial ıntelligence, shap, tree-based machine learning models, renewable energy, r&d expenditures

GPT-Eval: A Unified Evaluation Framework for Tools and Text Responses

Farhana Kabir, Tabassum Islam, Per Bækgaard, Mohammadreza Fani Sani†
Technical University of Denmark (DTU), Copenhagen, Denmark {farhanakabir58@gmail.com, tabassum.islam009@gmail.com, pgba@dtu.dk}
†Microsoft, mfanisani@microsoft.com

***Abstract*—**Evaluating planning agents remains a challenge, especially when their outputs combine structured tool calls with free-form text. Existing evaluation methods often emphasize task completion or surface-level metrics, lacking consistency and interpretability. We present GPT-Eval, a unified framework for assessing both tool-based and text-based responses using structured schema prompts. The framework supports various response types, including multi-turn planning, refusals, and hybrid responses. It applies a type-specific evaluation schema and produces structured judgments with satisfaction scores and explanatory feedback. We evaluate GPT-Eval on 450 user queries across domains such as healthcare, finance, and utilities, using responses from both proprietary and open-source agents. Our findings indicate that GPT-Eval produces reliable verdicts, identifies subtle failure cases, and aligns well with human-annotated ground truth. It also reveals inconsistencies between agent versions and limitations in traditional success-based metrics. By offering structured and interpretable evaluations at scale, GPTEval supports more interpretable evaluation of planning agents that integrate external tools.

Index Terms—Agent evaluation, human alignment, multi-turn conversations, planning agents, structured response, schemabased evaluation, trustworthy AI

AI-Powered Attack Surface Discovery: Analyzing SSL Pinning Bypass Capabilities with an LLMBased Model

Hüseyin Enes Okutan
Faculty of Engineering, Software Engineering, Inonu University, Malatya, Turkey enes.okutan@inonu.edu.tr

Muhammet Baykara
Faculty of Technology, Software Engineering, Firat University Elazığ, Turkey mbaykara@firat.edu.tr

Engin Avcı
Faculty of Technology, Software Engineering, Firat University Elazığ, Turkey enginavci@firat.edu.tr

***Abstract*—**With the advancement of artificial intelligence technologies, new challenges have emerged across various domains where technology is employed, and novel solution approaches have been developed to address these challenges. In the context of cybersecurity, this transformation manifests itself through both the expansion and the increasing complexity of attack surfaces. Alongside the development of artificial intelligence, intelligent solutions integrated into defensive security technologies have become more prominent; however, the growing extent to which malicious actors exploit artificial intelligence has also introduced new threat vectors, including the malicious use of static and dynamic analysis techniques. One of the critical issues in the field of cybersecurity is the identification of attack surfaces, as this process can provide information about the core assets of systems and thereby lead to a reduction in overall security levels. A commonly used approach in attack surface discovery involves analyzing network traffic to determine which systems endpoint devices communicate with, as well as the protocols and endpoints used for data exchange. To prevent such analyses, various security measures are implemented in applications running on endpoint devices. One such measure is the SSL pinning mechanism, which aims to prevent the conversion of encrypted HTTPS traffic into plaintext HTTP traffic. However, several classical techniques exist for bypassing this mechanism. In this study, the capabilities of ChatGPT, an LLM-based model, in relation to SSL pinning bypass on the LinkedIn mobile application are analyzed, and the potential of artificial intelligence technologies to be applied to current challenges in the cybersecurity domain is examined. The results of the analyses indicate that ChatGPT possesses the capability to generate code via the Frida tool that can bypass SSL pinning mechanisms and, in this context, can produce effective outcomes in attack surface discovery processes.

Keywords—Artificial Intelligence, Cybersecurity, SSL Pinning, Large Language Models, Context Manipulation

Unimodal Speech Emotion Recognition with Signal-to-Image Transformation and Deep Learning on the KTU-MEDAFE Dataset

Betul Mumcu
Department of Software Engineering Karadeniz Technical University, Trabzon, Turkiye betulmumcu@ktu.edu.tr

Bahar Hatipoglu Yilmaz
Department of Computer Engineering Karadeniz Technical University, Trabzon, Turkiye baharhatipoglu@ktu.edu.tr

***Abstract*—**Emotions are a central aspect of human experience, profoundly influencing communication, decision-making, and social interaction. In this study, we employed the Karadeniz Technical University Multimodal Emotion Dataset using Audio, Facial Images, and EEG (KTU-MEDAFE), focusing on the speech recordings collected while participants read text-based emotional stimuli. The recorded audio signals were converted into spectrogram-like images using a signal-to-image transformation technique, allowing the application of deep neural networks for visual-based analysis. These images were subsequently used to train and evaluate models for speech-based emotion recognition, considering the four emotional categories defined in the dataset: funny, surprising, sad, and neutral. This approach demonstrates the potential of utilizing unimodal speech signals extracted from a multimodal corpus to achieve reliable and robust emotion classification.

Index Terms—KTUMEDAFE, speech signals, emotion recognition.

Smart Cyber Learning: A Multi-Agent, AI-Driven Gamified Platform for Cybersecurity Awareness Education

Abdel Rahman AlKharabsheh
Information Technology-Security and Forensics, Higher Colleges of Technology, Abu Dhabi, United Arab Emirates, akharabsheh@hct.ac.ae

Azza Saeed Alhajri
Information Technology-Security and Forensics, Higher Colleges of Technology, Abu Dhabi, United Arab Emirates, azzas.alhajri@gmail.com

Hadil Abdulqader Al Masaabi
Information Technology-Security and Forensics, Higher Colleges of Technology, Abu Dhabi, United Arab Emirates, hadil200310@gmail.com

Fatima Talal Alruwaihi
Information Technology-Security and Forensics, Higher Colleges of Technology, Abu Dhabi, United Arab Emirates, Fatematalal@hotmail.com

Maitha Mustafa Alhadhrami
Information Technology-Security and Forensics, Higher Colleges of Technology, Abu Dhabi, United Arab Emirates, maithaalhadrami59@gmail.com

Lina Momani
Engineering Technology and Science Higher Colleges of Technology, Dubai, United Arab Emirates, lmomani@hct.ac.ae

***Abstract*—**There are several pedagogical approaches in cybersecurity education that not only enhance students' knowledge of the content but also assess students' knowledge and skills, help students become experts in the content, and help students develop proven, practicable skills for the content. The mastery-based training, personalized feedback, and progressive mastery evaluation are frequently not effective in traditional academic curricula, lecture-based models, and rigid assessment methods. The paper introduces Smart Cyber Learning, a competency-oriented platform that uses Artificial Intelligence (AI) as part of a comprehensive educational framework designed to meet this challenge. This tool delivers cybersecurity education solutions specifically designed for Computer Information Science programs. To support this, the platform integrates the Competency-Based Learning (CBL) system and the 5E instructional model (Engage, Explore, Explain, Elaborate, and Evaluate), and allows for a structured, inquiry-based, outcomefocused learning environment. To help organize a sequential timeline of instruction to build students' interest, to conduct adaptive assessments, and to provide feedback to educators, we have developed a Multi-Agent System (MAS). Through AI, the platform analyzes learner data to determine competency mastery scores and proficiency levels, where it adapts assessments based on the dynamism applied by the AI within the system. It also produces actionable data for learning analytics that educators can use. This web-based platform, which works offline, supports classrooms, labs, and low-capacity settings. The architecture of the system is described in terms of its connection with teachinglearning design, MAS coordination, and AI-informed adaptive assessment. The findings indicate that such a design can promote progress toward mastery and adaptive instruction according to data-driven modus operandi in teaching. Accordingly, learnercentered cybersecurity education could be developed in a scalable model by combining the CBL, 5E pedagogy model, MAS, and explainable AI.

Keywords—Cybersecurity education, competency-based learning, 5E instructional model, multi-agent systems, artificial intelligence, adaptive assessment.

Multi-Agent Reasoning Framework for Consumer Sentiment Intelligence

Francis Umo
Independent Researcher, United Kingdom
Francisumoh360@yahoo.com

Okwuchi Uzoigwe
Independent Researcher, United Kingdom
okwuchi.uzoigwe@gmail.com

Adewole Akinyemi Ampitan
Independent Researcher, United Kingdom
adewole@descinder.com

Oluwaseun Adepegba
Independent Researcher, United Kingdom
seun.adepegba@gmail.com

Onyekachukwu Orji
Independent Researcher, United Kingdom
Oonyekaorji@gmail.com

Victor Chukwuemeka Mbachu
Independent Researcher, United Kingdom
victor.c.mbachu@gmail.com

Eneremadu Nnadozie Anthony
Independent Researcher, United Kingdom anthony
eneremadu@yahoo.com

Shirley Ugwa
Independent Researcher, United Kingdom
shirley.abaegbu@gmail.com

Oluwole Ilesanmi
Independent Researcher, United Kingdom
oluwoleilesanmi@gmail.com

***Abstract*—**Consumer sentiment intelligence has become increasingly critical for brands to understand market perception, competitive positioning, and consumer preferences. Traditional sentiment analysis approaches often fail to capture the nuanced, multi-faceted nature of consumer opinions across diverse data sources. This paper presents a novel multi-agent reasoning framework that leverages large language models (LLMs) to analyze consumer sentiment through specialized agents: a Brand Agent, Competitor Agent, and Consumer Voice Agent. Each agent focuses on specific aspects of sentiment analysis while collaborating through a structured communication protocol to provide comprehensive insights. Our framework demonstrates superior performance in capturing brand perception, competitive dynamics, and authentic consumer voices compared to traditional single-model approaches. Experimental results show significant improvements in sentiment classification accuracy, aspect-based sentiment analysis, and actionable insight generation for brand strategy development.

Index Terms—Multi-agent systems, sentiment analysis, consumer intelligence, large language models, brand perception, competitive analysis

Agentic Narrative Generation: Personalised Storytelling for Brand Communication

Oluwaseun Adepegba
Independent Researcher, United Kingdom
seun.adepegba@gmail.com

Oghenerukevwe Juliet Toje
Independent Researcher, United Kingdom tojeruky@gmail.com

Lanre Shittu
Vuhosi Limited, United Kingdom hr.lanreshittu@gmail.com

Shirley Ugwa
Independent Researcher, United Kingdom
shirley.abaegbu@gmail.com

Francis Umo
Independent Researcher, United Kingdom
Francisumoh360@yahoo.com

Christian Chimezie
Independent Researcher, United Kingdom
chimeziechristiancc@gmail.com

Oluwole Ilesanmi
Independent Researcher, United Kingdom
oluwoleilesanmi@gmail.com

Victor Chukwuemeka Mbachu
Independent Researcher, *United Kingdom*
victor.c.mbachu@gmail.com

Babatunde Solomon Jaiyesimi
Independent Researcher, United Kingdom
tundes.jaiyesimi@gmail.com

***Abstract*—**Personalised storytelling has become central to effective brand communication, yet current AI systems often fail to balance creativity, factual grounding, and ethical alignment. This paper introduces an agentic narrative generation architecture based on Large Language Model (LLM) multi-agent collaboration, designed to construct adaptive and culturally resonant brand narratives. The system comprises three cooperating agents: an Emotion Agent that models audience affective states, a Fact Agent that validates content accuracy, and a Creative Agent that synthesises narrative flow optimised for engagement. Through iterative reflection and consensus-building, the agents produce coherent, emotionally aligned messages tailored to audience segments. We evaluate the framework on cross-cultural marketing datasets using metrics for trustworthiness, emotional resonance, and engagement potential, showing measurable improvements over single-agent baselines.

Index Terms—Agentic AI, Multi-agent Systems, Large Language Models, Narrative Generation, Brand Communication, Personalization, Emotion Modeling

The Interactive Emergence of Word Order: A Model of Cognitive Biases, Social Networks, and Cultural Transmission

Burcu Çınar
Cognitive Science Department Middle East Technical University Ankara, Türkiye cinarb@metu.edu.tr

***Abstract*—**This paper presents a computational model that simulates the emergence and stabilisation of dominant word orders (such as subject-object-verb and subject-verb-object) in human languages. Despite the strong cross-linguistic prevalence of SOV and SVO orders, the mechanisms behind this convergence remain debated. Drawing on emerging sign languages, gesturebased communication studies, and cognitive science findings, an agent-based simulation is proposed that incorporates iterated and frequency-based learning mechanisms. The model explores how initial bias distributions, individual learning rates (personality), community sizes, and communication network structures jointly influence the evolution of word order preferences. Our results align with recent neural-agent and efficiency-based typological studies, highlighting the joint role of cultural transmission, communication efficiency, and social structure. The results demonstrate that small variations in cognitive and communicative environments can lead to distinct dominant word orders over generations, supporting accounts that attribute syntactic regularities to the interaction of cognitive and social pressures. Unlike prior iterated learning or agent-based models that focus on isolated factors, this work systematically examines the interactions among cognitive bias, learner flexibility, semantic ambiguity, and social network structure within a single, interpretable simulation framework. This work contributes to the interdisciplinary understanding of language evolution by offering a dynamic, customisable framework for testing the emergence of linguistic structures.

Keywords— language evolution, agent-based modelling, word order, iterated learning, communication networks, cognitive bias

StoryCheck: A Scalable Framework for Automated Evaluation of Creative Writing using AI Agents

Lanre Shittu
Independent Researcher, *United Kingdom*
hr.lanreshittu@gmail.com

Onome Laura Owah
Independent Researcher, United Kingdom
Onomeowah@gmail.com

Michael Akintayo
Independent Researcher, United Kingdom
michaelakintayo24@gmail.com

Olusegun Akinfenwa
Independent Researcher,United Kingdom,
Segunakinfenwa@gmail.com

Oluwole Fagbohun
Plotweaver Limited, United Kingdom, wole@plotweaver.app

Akinyemi Arabambi
Independent Researcher, United Kingdom
yemiarabambi@gmail.com

Ajibola Olajide-Shokunbi
University of Derby, United Kingdom ajiboyshokunbi@yahoo.com

Raheemat Adetola Adetunji
Independent Researcher, United Kingdom icontola@gmail.com

Fatimat Okeleye
Independent Researcher, United Kingdom bimpe51@gmail.com

Babatunde Solomon Jaiyesimi
Independent Researcher, United Kingdom
tundes.jaiyesimi@gmail.com

***Abstract*—**The evaluation of creative writing has long eluded scalable automation due to its inherently subjective nature, spanning dimensions such as narrative coherence, character development, emotional arc, originality, and audience resonance. In this paper, we propose StoryCheck, a novel multi-agent framework that operationalises the assessment of creative writing at scale using large language models (LLMs) enhanced with domain-specific memory, evaluative alignment, and multiperspective critique protocols. Unlike traditional rule-based rubrics or surface-level metrics (e.g., readability or sentiment), StoryCheck deploys a network of specialised LLM-based agents: Narrative Analysts, Character Evaluators, Genre Stylists, Cultural Authenticity Checkers, and Market Fit Predictors, each grounded via instruction tuning and tailored evaluative criteria. These agents independently assess creative works along their assigned axes and then communicate via a dynamic Model Context Protocol (MCP) to produce holistic, explainable evaluations. Our experimental results demonstrate that StoryCheck achieves a Pearson correlation of 0.847 with expert human evaluators across multiple dimensions of creative writing quality, significantly outperforming single-agent baselines and rule-based approaches. The framework processes creative works at scale while maintaining interpretability, providing actionable feedback that supports both educational and publishing applications.

Index Terms—automated writing evaluation, creative writing assessment, multi-agent systems, large language models, narrative analysis, natural language processing

A Comparative Study of Machine Learning for Detecting Suspicious Student Behaviors in Online Examinations

Beyza Esin Ozseven
Republic of Turkey Ministry of National Education Tokat, Turkiye beyza_esin@hotmail.com

Turgut Ozseven
Department of Computer Engineering, Tokat Gaziosmanpasa University Tokat, Turkiye turgut.ozseven@gop.edu.tr

***Abstract*—**The rapid proliferation of online education platforms has made maintaining academic integrity in remote examinations a critical challenge. This study presents a comprehensive performance analysis of the current Suspicious Student Behaviors dataset, introduced to the literature in 2025 and currently the subject of a limited number of studies, to identify factors threatening academic integrity in online exams. The research compares the classification success of Random Forest, Extreme Gradient Boosting, Gaussian Naive Bayes, kNearest Neighbor, and Support Vector Machine models using facial and hand movement, gaze tracking, head posture, and phone interaction data. Experimental results show that all models achieved high success rates, but tree-based ensemble learning methods demonstrated a significant advantage. The XGBoost model stood out as the most successful and stable, achieving 99.64% accuracy, 99.62% F1 score, and 0.9999 ROCAUC. The statistical significance of the performance differences between the models was confirmed using the Friedman and Nemenyi post hoc tests. XGBoost and Random Forest have been proven to have a mathematically significant advantage over other algorithms. This study serves as a benchmark for this new dataset in the literature and presents the optimal machine learning approach for online exam security within a methodological framework.

Keywords—online exam security, cheating detection, machine learning, XGBoost, statistical analysis

Smart Material Systems in Intelligent Robotic Automation: A Bibliometric Review of Sensor– Actuator Integration, Intelligent Control and Soft Robotics

Roseline Oluwaseun Ogundokun
Department of Computer Systems Engineering, Tshwane University of Technology Soshanguve South, South Africa, ogundokunroseline1@gmail.com

Etienne A. van Wyk
Dean of the Faculty of Information and Communication Technology Tshwane University of Technology Soshanguve South, South Africa vanwykea@tut.ac.za

Rotimi-Williams Bello
Department of Computer Systems Engineering, Tshwane University of Technology Soshanguve South, South Africa sirbrw@yahoo.com

Chunling Du
Department of Computer Systems Engineering, Tshwane University of Technology Soshanguve South, South Africa duc@tut.ac.za

Pius A. Owolawi
Department of Computer Systems Engineering, Tshwane University of Technology Soshanguve South, South Africa owolawipa@tut.ac.za

Abstract— Smart materials enable robots to sense, actuate, and compute within their own structures, giving rise to intelligent "robotic materials" that blur the boundary between hardware and control. While recent surveys describe advances in soft actuators and sensing technologies, few studies systematically quantify the research landscape or examine how these materials are integrated into intelligent robotic systems. This study conducts a bibliometric analysis of the Web of Science Core Collection using the search string "Smart materials AND Robotic systems AND Smart sensors AND Actuators AND Intelligent control AND Intelligent systems AND Robotic materials AND Embedded sensing AND Soft robotics" to identify publications through November 2025. We apply inclusion/exclusion criteria focused on robotics and intelligent systems and analyse 98 included papers using citation statistics, research-area profiling, keyword co-occurrence, and authorship and venue metrics. The results reveal rising interest since 2020, with engineering and robotics as the dominant research areas. Author keywords highlight the prominence of soft robotics, soft actuators, and soft sensors, while top authors come from Asia, Europe, and North America. Co-occurrence analysis shows strong links between soft robotics and machine learning and between shape memory and piezoelectric. We summarise current smart materials used as sensors and actuators, integration strategies with intelligent control, performance improvements over rigid systems, challenges such as hysteresis and durability, and emerging paradigms, such as metamaterials and self-healing robots. Our review identifies research gaps, including the need for unified control frameworks and scalable manufacturing, and suggests future directions for intelligent robotic automation.

Keywords— Smart material systems, Intelligent robotic automation, Sensor–Actuator Integration, Intelligent Control, Soft Robotics

PRDTrace: A GenAI-Powered Tool for Automated Requirements-to-Code Traceability Analysis

Sri Tejaswi Gattupalli
Independent Researcher, Seattle, USA gsteja1234@gmail.com

Bhavya Paliwal
Independent Researcher, Seattle, USA bhavyapaliwal5@gmail.com

***Abstract*—**Requirements traceability is defined as the ability to trace relationships between product requirements and their implementation in the source code. Manually tracing requirements is a laborious and time-consuming process, with a high potential for errors. In this paper, a web-based tool called PRDTrace is proposed to automatically evaluate the consistency between Product Requirements Documents and source code repositories using Large Language Models and semantic embeddings. PRDTrace generates reports on the implementation status of specific requirements and code functionality. An application scenario based on an open-source software is used to show the applicability of PRDTrace, to transform a previously laborious process into a new automated process. This work contributes a practical tool to make the application of requirements traceability using Large Language Models accessible to product managers.

Index Terms—requirements traceability, large language models, generative AI, product management, software engineering

Comparative Analysis of Supervised Learning Models in Identifying Parkinson's Disease Patients Using Prodromal Symptoms

Jarod Lopez
School of Arts and Sciences – Newark Rutgers University, Newark Campus Bayonne, United States jel250@scarletmail.rutgers.edu

Emily Claros
School of Arts and Sciences – Newark Rutgers University, Newark Campus Moonachie, United States, egc59@scarletmail.rutgers.edu

Galathara Kahanda
Department of Mathematics and Computer Science, Rutgers University, Newark Campus galathara.kahanda@rutgers.edu

***Abstract*—** Parkinson's Disease (PD) is a progressive neurodegenerative disorder with an unknown cure, making early and accurate diagnosis crucial. Delayed and inaccurate diagnoses of PD are the result of standard testing methods that often rely on motor symptoms, clinical observations, and patient history, making it important to create tools that target prodromal symptoms of PD. An absence of accurate and reliable testing also contributes to these difficulties. To eliminate these issues and improve on PD diagnosis, this study dives into the application of machine learning algorithms: decision tree, support vector machines (SVM), random forest, logistic regression, k-nearest neighbors (KNN), neural networks (NN), and boosting algorithms such as XGBoost, Gradient Boosting, and AdaBoost. The models were then trained on datasets which comprise of demographics and prodromal symptom questionnaire scores. The assessments considered included University of Pennsylvania Smell Identification Test (UPSIT), Montreal Cognitive Assessment (MoCA), REM Sleep Behavior Disorder Questionnaire, and the Epworth Sleepiness Scale. After identifying the patterns of the collected data, the machine learning models achieved high diagnostic accuracy ranging from 0.85745 (±) 0.02185. The highest performing model, XGBoost, achieved an accuracy of 0.8644 and an AUC of 0.6922, placing high consideration on its use in a clinical setting.

Keywords—Parkinson's Disease, supervised learning, artificial intelligence, machine learning, neurodegenerative diseases, prodromal symptoms, boosting algorithms

Preventing Wrong Work Item Retrieval in LLM-Based MCP Systems Through Multi-Agent Validation

Burcu Gokbulut
Research and Development Siemens A.S., Istanbul, Turkey burcu.sipahioglu@siemens.com

***Abstract*—**Model Context Protocol (MCP) systems lack validation layers, potentially returning incorrect work items when handling ambiguous queries or conversation context. We present, to the best of our knowledge, the first validation middleware for MCP servers, using a multi-agent architecture to reduce retrieval errors through intelligent disambiguation. Our system employs three specialized agents (Executor, Validator, Refiner) that intercept and validate every query before returning results. When encountering ambiguous queries that match multiple items, the system presents relevant options and requests user clarification rather than guessing.

We tested our approach with 120 real queries against the GitHub MCP server, spanning explicit ID lookups, semantic searches, context-dependent queries, and adversarial cases. The results demonstrate a 0% hallucination rate (zero incorrect results returned) across all 120 queries in our evaluation. For semantic searches (50 queries, the most challenging ambiguous cases), the system achieved perfect disambiguation: all 50 correctly triggered clarification requests instead of guessing. When query patterns were recognized, context tracking and disambiguation worked correctly. The validation overhead is minimal at less than 2 milliseconds (0.09% of total query time). Our middleware is designed to work transparently with any MCP-compliant server without requiring modifications, as demonstrated with the GitHub MCP server, facilitating adoption in enterprise environments. This work addresses a critical gap in the MCP ecosystem since its 2024 introduction, providing what is, to the best of our knowledge, the first validation layer specifically designed for LLM-based tool calling protocols.

Index Terms—Model Context Protocol, LLM Hallucination, Multi-Agent Systems, Validation Middleware, Enterprise AI Safety, Work Item Retrieval

Hybrid Damping Strategies with Buckling-Restrained Braces and Viscous Dampers for High-Rise Seismic Protection

Rongchen Qi
Master's School of Architecture and Construction, Southwest Forestry University, Kunming, China grc18035532023@163.com

***Abstract*—**The growing sensitivity of the high-rise to high ground motions has enhanced the necessity of super-seismic response control systems that will be able to meet the demands of deformation and energy dissipation. This paper intends to assess the seismic performance of hybrid damping systems that use buckling-restrained braces (BRBs) and viscous dampers in seismic protection of high-rise buildings. They adopted a numerical research methodology whereby the nonlinear time-history analysis was performed, in which a model of 30-story buildings had been subjected to simulated earthquake ground motion with a ground acceleration of 0.35g, and responses of bare systems, BRB, and viscous dampers and hybrid systems were compared systematically. The findings show that the hybrid system experienced a significant drag relative to the bare frame, the peak drift ratios dropped to 0.00152 to an average of 0.00048, as shown in Fig. 1 and the overall seismic performance was better than single-device systems, as shown in Fig. 2. The hybrid setup also had the quickest vibration attenuation, and the least cumulative energy dissipation index though peak floor acceleration grew up to 0.47g owing to the stiffness input of BRBs. The paper concludes that hybrid damping systems offer a fair and strong response to the improvement of seismic resiliency of high-rise buildings. It is suggested that the design of the future should be aimed at maximising the device parameters to put the number of drift and acceleration requirements against each other. The results are applicable in real practice in performancebased seismic design of high-rise buildings in hybrid damping strategies. The major weakness of the research is the use of simulated seismic input and one structure model, which implies the necessity to further experimental and parametric research.

Keywords—hybrid damping systems, buckling-restrained braces, viscous dampers, high-rise buildings, seismic performance

A Doctor Dialogue Model Based on Vector Quantisation

Xiaoyu Chen
Herbert Wertheim College of Engineering, University of Florida, USA xychentom@126.com

***Abstract*—**The current models of doctor-patient dialogue generation applied in intelligent healthcare settings tend to have semantically drifting behaviour, role confusion, and incompatible behaviour with medical reality; they are not suitable for the needs of high-risk clinical settings that require high levels of safety and control. To solve such obstacles, we introduce a medical response generation model grounded on the use of the Vector Quantisation (DDM-VQ), a semantically controllable medical dialogue generation model, which is developed on the premises of the Variational Auto Encoder (VQ-VAE), that is a Vector Quantisation framework. In the same vein, DDM-VQ allows high-level control over meaningful semantic features, e.g. doctor-patient relationships, medical objects, and even emotional tone by discretising the continuous latent space into structured semantic indices. It is a two-stage model training where stage one is the discovery of stable discrete semantic representations, and the second phase is related to the consistency of medical knowledge and dialogue reasoning based on masked reconstruction and semantic alignment loss. Downstream datasets experiments indicate that DDM-VQ is far superior to representative models in terms of BLEU, ROUGE-L, GLEU, and Distinct, and successfully curbs medical hallucinations and enhances role consistency. The importance of discrete latent spaces in promoting medical semantic control and medical generation stability is also further proved by the ablation studies. The work will offer a fresh avenue to a constructive, safe, reliable and interpretive intelligent doctor-patient dialogue systems.

Keywords—vector Quantisation, medical QA, dialogue generation, VQ-VAE, semantic consistency

An Automated Configuration Verification Framework for Substation Equipment Based on Security Baseline Compliance

Wei Xiong
Cybersecurity Department of Power Monitoring System, State Grid Chongqing Electric Power Company, Chongqing, P.R. China,
xiongw1226@outlook.com

Wen Zhou
Cybersecurity Department of Power Monitoring System, State Grid Chongqing Electric Power Company, Chongqing, P.R. China,
zhouym1125@outlook.com

Fei Li
Cybersecurity Department of Power Monitoring System, State Grid Chongqing Electric Power Company, Chongqing, P.R. China
lifei1226@outlook.com

Yachao Zhang
Cybersecurity Department of Power Monitoring System State Grid Chongqing Electric Power Company Chongqing, P.R. China,
zhangyachao1226@outlook.com

Shuchun Liu
Cybersecurity Department of Power Monitoring System State Grid Chongqing Electric Power Company Chongqing, P.R. China,
liushuchun1226@outlook.com

Abstract--With the comprehensive implementation of the smart grid, digital substations based on the IEC 61850 standard have become the core nodes of the power system. However, the deep integration of industrial control systems (ICS) and information technology (IT) has introduced complex cybersecurity threats, with attackers increasingly inclined to exploit the configuration flaws (Misconfiguration) of intelligent electronic devices (IEDs) for infiltration. The traditional configuration verification is highly dependent on manual auditing, facing challenges such as low efficiency, narrow coverage, and difficulty in dealing with unstructured security baselines (such as NERC CIP, IEC 62351). This paper proposes a substation equipment automated configuration verification framework (ACVF-SEC) based on security baseline compliance. This framework integrates natural language processing (NLP) and knowledge graph (Knowledge Graph) technologies, constructing a multidimensional semantic network of "device - configuration - rule". Firstly, it uses a large language model (LLM) to automatically extract compliance rules from heterogeneous security standard documents; secondly, it designs a deep parsing algorithm for SCL (Substation Configuration Language) files, mapping them to domain knowledge graphs; finally, it combines digital twin (Digital Twin) technology to pre-verify configuration changes in a virtual test bed. Experimental results in a simulated 220kV smart substation scenario show that the ACVF-SEC framework achieves an accuracy rate of 96.6% in detecting port exposure, weak authentication, and encryption absence, with a false alarm rate of less than 1.2%, and its efficiency is approximately 86 times higher than traditional manual auditing. This research provides an efficient, interpretable, and closed-loop automated solution for the active defense of critical power infrastructure.

Keywords—Substation automation system, IEC 61850, configuration verification, security baseline, knowledge graph, NERC CIP, digital twin, natural language processing

Energy-Efficient Formation Flying of Biomimetic Flapping-Wing Drones: A Case Study on Leader-Follower Topologies with Adaptive Wingbeat Frequency Tuning

Yihan Pei
Innovation and Entrepreneurship College, Beijing University of Science and Technology, Beijing, China, u202541542@xs.ustb.edu.cn

***Abstract*—**With the increasing application of micro aerial vehicles (MAVs) in fields such as reconnaissance, environmental monitoring, disaster rescue, and communication relay, due to the physical limitations of battery energy density (currently, the energy density of lithium polymer batteries is generally lower than 200 Wh/kg), improving their endurance has become a key technical bottleneck that urgently needs to be addressed. In this context, bionic flapping-wing unmanned aerial vehicles (FWUAVs) imitate the flight mechanisms of birds and insects, utilizing the unsteady aerodynamic characteristics of flexible wings, demonstrating unique high maneuverability, low noise, and concealment. However, in terms of energy efficiency, they still have a significant gap compared to flight organisms that have undergone millions of years of natural selection. This paper deeply explores the energy-saving formation flight strategies of bionic flapping-wing unmanned aerial vehicle clusters, especially for the "leader-follower" (Leader-Follower) topological structure, and proposes an adaptive wing frequency regulation scheme that combines aerodynamic interaction modeling and extremum search control (ESC). Inspired by the biological mechanism of large migratory birds (such as the red-crowned crane, pelican) using the "upwash" from the tail of the leading aircraft to reduce induced drag during V-shaped formation migration, this study constructs a high-fidelity mathematical model that includes unsteady aerodynamics, multi-body dynamics, and wake interaction, focusing on solving the problem of low efficiency of traditional fixed-frequency control in dynamic flow fields. The research designs a hierarchical control architecture: the outer loop uses a distributed formation controller based on consensus protocols to maintain the optimal aerodynamic formation through local information interaction; the inner loop integrates an unmodel-based adaptive ESC algorithm that optimizes through real-time detection of power gradients to minimize total power consumption. Simulation results based on typical bionic flapping-wing platform "Dove" parameters show that compared to single aircraft flight, this adaptive formation strategy can achieve approximately 15%-23% net energy savings, and demonstrates robust stability in the face of external wind field disturbances. This report not only verifies the reproducibility of the aerodynamic energy-saving mechanism in robot clusters but also provides a solid theoretical basis and technical path for the engineering deployment of long-endurance bionic unmanned aircraft groups.

Keywords—Flapping-wing unmanned aerial vehicle, formation flight, energy efficiency, extremum seeking control, bionics, aerodynamic interaction, unsteady fluid mechanics, and multi-agent system

Interference Mitigation in Offshore USV Networks: A Hybrid Spread Spectrum and Adaptive Beamforming Approach

Youcai Xu
Senior Engineer, CSSC 723 Institute Yangzhou, China, XGDXYC@sohu.com

***Abstract*—**With the advancement of the "blue economy" strategy, the cluster of unmanned surface vessels (USVs) plays an irreplaceable role in marine environment monitoring and rights protection. However, the near-shore communication environment faces unique dual challenges: one is the drastic changes in antenna orientation caused by sea surface wave fluctuations, leading to rapid changes in channel parameters; the other is the increasingly complex electromagnetic environment, especially malicious broadband barrage jamming and tracking jamming, which seriously threaten the survivability of communication links. Traditional single antiinterference methods are difficult to balance high dynamic adaptability and a strong interference suppression ratio. This paper proposes a cross-layer joint anti-interference architecture based on hybrid spread spectrum (HSS) and robust adaptive beamforming (ABF) (HSS-ABF). Firstly, based on the physical characteristics of the near-shore environment, an improved three-path channel model including evaporation duct effect and dynamic Ricean fading was established. Secondly, a physical layer system combining direct sequence spread spectrum (DSSS) and frequencyhopping (FHSS) was designed, using time-frequency twodimensional expansion to provide basic processing gain. To address the problem of steering vector mismatch caused by USV swaying, a diagonal loading (DL-INC-MVDR) algorithm based on interference plus noise covariance matrix reconstruction was proposed, effectively overcoming the "signal self-cancelation" phenomenon in the traditional MVDR algorithm. Simulation results show that in a four-level sea state and a jammer-to-signal ratio (JSR) as high as 50 dB, under extreme conditions, this scheme can form a null depth of more than -45 dB, and the output signal-to-interferencenoise ratio (SINR) is approximately 15 dB higher than the traditional method, significantly enhancing the survivability and resilience of the USV network.

Keywords—Surface unmanned vessel (USV), hybrid spread spectrum, robust adaptive beamforming, evaporation waveguide, anti-interference, array signal processing

Personalized Game Interface Design via AI-Driven User Profiling: A Case Study on Mobile RPG Applications

Jiaqing Jin
Dept Ind Design Hanyang University Ansan South Kore jinjq_2002@163.com

Yixin Hong
Dept Ind Design Hanyang University Ansan South Korea, hongyixin11@163.com

***Abstract*—** User interaction and retention in mobile gaming can be improved through personalized game interfaces, whereas a standard approach to designing a game cannot be easily changed dynamically to the preferences and behavior of a specific player. In this paper, a framework of AI-driven user profiling is suggested through a Neural Collaborative Filtering (NCF) method based on clustering to personalize the game interface items of mobile Role-Playing Games (RPGs). The structure gathers the interaction information of the players, such as in-game behaviours, time spent on the session, and taste patterns, and uses NCF to produce latent representations of user preferences. Representations are grouped to form specific segments of players, which direct customization of the adaptive interface, including menu structures, skill displays and in-game suggestions. A case study that was done on a commercial mobile RPG shows that the AI-based profiling system creates better user interaction, less interface-based friction, and longer session time than the interface designs that have standard interfaces. The quantitative analysis provided by the engagement measures and qualitative responses of the players proves that the custom interface adaptations depending on NCF-based user profiling contribute greatly to the overall experience playing a game. The paper identifies the opportunities of integrating deep learningbased collaborative filters and clustering algorithms to provide dynamic and player-focused game interfaces as a scalable approach to adaptive UI design in mobile games.

Keywords: Personalized Game Interface, AI-Driven User Profiling, Neural Collaborative Filtering, Mobile RPG, Adaptive UI Design

Dynamic Deformation Monitoring in Landslide-Prone Areas Using Network-Based RTK-GNSS and UAV Photogrammetry: A Geospatial Data Integration Framework

Junze Gong
School of Geotechnical Engineering Qinghai University Xining City,Qinghai Province China a18253308208@outlook.cl

***Abstract*---**In the context of intensified global climate change and frequent human engineering activities, the concealment, suddenness, and destructive power of landslide geological disasters have become increasingly prominent, posing unprecedented challenges to geotechnical engineering monitoring and disaster prevention and mitigation. Traditional discrete-point monitoring techniques (such as single-point GNSS and crack gauges) are unable to capture the full deformation characteristics of the landslide body, while a single remote sensing method is limited by its discontinuous time resolution and environmental interference. Based on the cutting-edge perspective of Artificial Intelligence Engineering, this paper proposes a heterogeneous geospatial data deep integration framework based on network real-time dynamic positioning (Network RTK) and unmanned aerial vehicle (UAV) photogrammetry. This paper designs a physics-informed spatio-temporal graph neural network (PI-STGNN), embedding the Richards equation of unsaturated soil seepage as a physical constraint into the loss function, achieving precise spatiotemporal prediction of the landslide displacement field, and constructed a "SynLand-2025" high-fidelity synthetic dataset that incorporates complex geological structures and multi-source sensor noise. The simulation experiment results show that the fusion framework achieves monitoring accuracies of 4.2mm in the horizontal direction and 6.5mm in the vertical direction, representing more than 38% improvement over traditional single-modal methods. Meanwhile, the PI-STGNN model has a prediction determination coefficient ( ) of up to 0.96 during the acceleration deformation stage of landslides, significantly outperforming traditional LSTM and Transformer models.

Keywords—Landslide Dynamic Monitoring; Network RTK; UAV Photogrammetry; Multi-sensor Tight Coupling; Physical Information Neural Network (PINN); Artificial Intelligence Engineering; Spatio-Temporal Graph Convolutional Network; Digital Twin

Cross-Modal Shape Matching for Aluminum Profile Recognition

Duygu Cakir
Department of Software Engineering Bahc¸es¸ehir University, Istanbul, Turkiye, duygu.cakir@bau.edu.tr

Azhar Murzaeva
Research and Development Department IBSS Software and Technology, Istanbul, Turkiye azhar.murzaeva@ibss.com.tr

Resul Tama
Enterprise Resource Planning Department Sistem Aluminium Industry and Trade Inc., Istanbul, Turkiye resul.tama@sistemal.com

***Abstract*—**Shape matching between technical drawings and real-world photographs is fundamentally challenging due to the domain-specific problems: drawings are clean line art while photographs contain texture, lighting variations, and noise. This problem is critical in industrial settings where aluminum profile cross-sections must be matched against design specifications for quality control and inventory management. This study presents a systematic benchmark comparing different computer vision algorithms: classical feature matching (SIFT, ORB, AKAZE), shape-based methods (Contour Matching, Hu Moments, Template Matching), deep learning approaches (VGG16, ResNet50, Vision Transformer), and perceptual similarity (SSIM). Using Leave-One-Out Cross-Validation on 50 aluminum profile pairs, it is found that Vision Transformer achieves 72% Top-1 accuracy, substantially outperforming ResNet50 (52%), VGG16 (48%), shape-based methods (32-38%), and classical feature matchers (20-25%). The results show that learned representations effectively align with the drawing-photo domain when sufficient training data is available, while traditional shape descriptors offer faster but less discriminative alternatives.

Index Terms—Computer Vision, Shape Matching, Vision Transformer, Industrial Automation, Deep Learning, Feature Matching, Cross-Domain Matching.

An Explainable Machine Learning Framework for Network-Based Drug Repurposing Across Neurological Disorders

Akshaj Goel
Inventure Academy, Bangalore, Karnataka, India, goelakshaj@gmail.com

Nirupma Singh
Department of Biological Sciences and Engineering, Netaji Subhas University of Technology (Formerly NSIT), Dwarka, Delhi, India, nirupmajadaun21@gmail.com

Abstract – Neurodegenerative diseases affect an estimated 57 million people worldwide, a number projected to double every 20 years. Current therapeutic approaches remain limited due to disease heterogeneity and absence of curative treatments. Existing drug repurposing frameworks for neurodegenerative disorders often suffer from black-box predictions, single-disease focus, and lack of systematic evaluation strategies that prevent information leakage. It was hypothesized that integrating network-based feature engineering with interpretable machine learning could enable systematic identification of repurposing candidates across multiple neurodegenerative conditions while providing mechanistic justification for predictions. Gene-drug-disease associations were extracted from curated databases (DGIdb, CTD) for 221 genes, 1,501 drugs, and eight neurodegenerative diseases. A bipartite network was constructed and analyzed for centrality metrics, generating 30 features per drug-disease pair including Jaccard similarity, fractional gene set coverage, and mean-aggregated network properties. Edge masking withheld 20% of known associations before feature computation to simulate realistic evaluation. A Random Forest classifier trained on 2,828 pairs achieved ROC-AUC of 0.975 and average precision of 0.958 on held-out data. SHAP analysis identified Jaccard similarity (mean absolute value: 0.089) as the dominant predictor, validating gene set overlap as the primary driver of therapeutic associations. Top-scoring candidates largely rediscovered known drugs (tacrine for Alzheimer's, clozapine for Huntington's), with occasional novel predictions (isocarboxazid). Future work should integrate structural docking data, employ disease-specific training, and validate candidates through prospective experimental screening to establish clinical relevance beyond network-derived predictions.

Keywords – Neurodegenerative disorders, Drugs, Targets, Machine learning, Interactions

Ethical-Aware Narrative Agents for Responsible Brand Communication: A Framework and Empirical Validation

Oghenerukevwe Juliet Toje
Independent Researcher, London, United Kingdom
tojeruky@gmail.com

Christian Chimezie
Independent Researcher, United Kingdom
chimeziechristiancc@gmail.com

Emeka Emmanuel Oziri
Independent Researcher, Aberdeen, United Kingdom
oziriemeka@gmail.com

Uchenna Ejike
Independent Researcher, Manchester, United Kingdom
uchennaejike80@gmail.com

Chukwunonso Ikemba
Independent Researcher, Preston, United Kingdom
chukwunonsoikemba@gmail.com

Dunsin Fatuase
Independent Researcher, Coventry, United Kingdom
dunsinfatuase.uk@gmail.com

Itohowo Effiong Charles
Independent Researcher, Leeds, United Kingdom
Itohowo.charles@yahoo.com

Peggy E. Elijah
Independent Researcher, London, United Kingdom
Pevinnie2016@gmail.com

***Abstract*—**This paper presents the Ethical-Aware Narrative Agent (EANA) framework, a concrete implementation for promoting responsible brand communication in automated content generation. We describe a fully implemented system integrating ethical reasoning modules with GPT-4-based narrative generation through a Python-based middleware architecture. Our approach combines deontic logic for constraint-based ethical validation with embedding-based ethical scoring. We conducted empirical experiments using 200 real brand communication scenarios across five industry verticals, comparing EANA against three baseline approaches. Results demonstrate that EANA achieves a 94.7% constraint satisfaction rate while maintaining narrative quality (coherence score 4.0/5.0). We provide transparent descriptions of our ethical knowledge base containing 847 formalized constraints, detailed computation procedures for ethical compliance metrics, and results from a human evaluation study with 45 domain experts. This work offers both a theoretical framework and a validated implementation for organizations seeking to leverage AI for brand communication while maintaining ethical standards.

Index Terms—narrative agents, ethical AI, brand communication, responsible AI, computational ethics, natural language generation, marketing ethics

ThreatFormer-IDS: Robust Transformer Intrusion Detection with Zero-Day Generalization and Explainable Attribution

Srikumar Nayak
Sr Member IEEE Incedo Inc, USA, srikumar.nayak2025@gmail.com

***Abstract*—**Intrusion detection in IoT and industrial networks requires models that can detect rare attacks at low false-positive rates while remaining reliable under evolving traffic and limited labels. Existing IDS solutions often report strong in-distribution accuracy, but they may degrade when evaluated on future traffic, unseen (zero-day) attack families, or adversarial feature manipulations, and many systems provide limited evidence to support analyst triage. To address these gaps, we propose ThreatFormerIDS, a Transformer-based sequence modeling framework that converts flow r ecords i nto t ime-ordered w indows a nd learns contextual representations for robust intrusion screening. The method combines (i) weighted supervised learning for imbalanced detection, (ii) masked self-supervised learning to improve representation stability under drift and sparse labels, (iii) PGDbased adversarial training with scale-normalized perturbations to strengthen resilience against feature-level evasion, and (iv) Integrated Gradients attribution to highlight influential time steps and features for each alert. On the ToN IoT benchmark with chronological evaluation, ThreatFormer-IDS achieves AUCROC 0.994, AUC-PR 0.956, and Recall@1%FPR 0.910, outperforming strong tree-based and sequence baselines. Under a zero-day protocol with held-out attack families, it maintains superior generalization (AUC-PR 0.721, Recall@1%FPR 0.783). Robustness tests further show slower degradation in AUCPR as the adversarial budget increases, confirming improved stability under bounded perturbations. Overall, ThreatFormerIDS provides a unified, d eployment-oriented I DS p ipeline that balances detection quality, zero-day behavior, robustness, and explainability.

Index Terms—Intrusion detection, transformer, zero-day attacks, self-supervised learning, adversarial robustness, explainable AI

An AI-Based Spoken English Evaluation System Using Speech Recognition Technology: A Reproducible Pipeline and Evidence from ArL2Eng

Xiaoyu Yu
Faculty of Education, Taylor University Subang Jaya, Malaysia, yuxiaoyu654321@163.com

Abstract: Artificial intelligence (AI) has become central to large-scale language assessment, particularly for evaluating spoken English, yet reliability and fairness remain constrained by recognition errors on non-native speech and weak links between model outputs and interpretable speaking constructs. This paper proposes an AI-based spoken English evaluation system that combines an automatic speech recognition (ASR) front-end with a modular scoring and feedback layer designed around intelligibility, fluency, and lexical–syntactic adequacy. To provide a reproducible empirical baseline without relying on proprietary test data, we analyze publicly available supplementary outputs from the ArL2Eng L2-English corpus (n = 627 recordings with Whisper transcripts and word error rates). Results show substantial dispersion in ASR error (median WER ≈ 0.232;

IQR ≈ 0.174–0.348) and systematic differences across regional speaker groups. A length-adjusted model indicates that transcript length is negatively associated with WER even after region fixed effects (β ≈ -0.0107 WER per additional word, $p < 0.001$), highlighting that naive score pipelines may confound speaking proficiency with recognition artifacts. We conclude with an implementation blueprint and governance recommendations for deploying AI spoken evaluation with calibrated scoring, bias diagnostics, and human-in-the-loop monitoring.

Keywords automated speaking assessment, ASR, pronunciation scoring, fairness, intelligibility, CEFR, L2 speech, reproducibility.

Comparative Evaluation of Different YOLO Architectures for Drone Detection

Muhammad Nadeem
College of Engineering and Technology American University of the Middle East Kuwait muhammad.nadeem@aum.edu.kw

***Abstract*—**The increasing prevalence of drones in recreational and malicious applications necessitates the development of real-time detection systems to ensure their security and safety. This paper presents a robust methodology for real-time drone detection using video camera feeds and the You Only Look Once (YOLO) object detection framework. We designed and implemented a detection system that leverages deep learning models of YOLO to identify and track drones with high accuracy and speed. Our approach involves training YOLO models on a comprehensive dataset of drone images and videos, thereby enhancing its ability to detect various types of drones under diverse environmental conditions. The performance of the system was rigorously tested in real-world scenarios, and high precision and recall rates with minimal false-positive rates were achieved. Key innovations include the integration of advanced preprocessing techniques to enhance detection accuracy and the deployment of real-time processing algorithms to ensure low latency. The findings establish that our YOLO-based framework, especially YOLOv12, significantly enhances the effectiveness of drone surveillance and offers a scalable and efficient solution for applications ranging from urban security to wildlife protection. This study underscores the potential of YOLO in revolutionizing drone detection technology, contributing to the development of advanced automated surveillance systems.

Keywords—drone detection; UAV surveillance; object detection; YOLO; deep learning

Governance-Driven Ontology Engineering: A Workflow-Centric Framework for Education Technology Environments

Kaneeka Vidanage
Department of Computer Science General Sir John Kotelawala Defence University, Colombo, Sri Lanka vidanage bvki@kdu.ac.lk

Akshaan Bandara
AI R&D Department Kerner Norland, Colombo, Sri Lanka akshaan@kernernorland.com

Dharani Abeysinghe
Department of Computer Science General Sir John Kotelawala Defence University, Colombo, Sri Lanka abeysinghe.dvds@kdu.ac.lk

Sanduni Sathsara
Business School Informatics Institute of Technology, Colombo, Sri Lanka sathsara.d@iit.ac.lk

Tharani Kawya
Department of Information Technology General Sir John Kotelawala Defence University, Colombo, Sri Lanka mvtkawya@kdu.ac.lk

MWP Maduranga
Centre for Next Generation Communication Systems, Faculty of Engineering, University of Sri Jayewardenepura, Mattegoda, Sri Lanka pasanm@sjp.ac.lk

***Abstract*—**Collaborative ontology engineering remains a complex challenge due to the cognitive and procedural divide between educators, domain specialists, and ontologists. Existing methodologies such as Methontology and NeOn provide general guidance but lack enforceable workflows to ensure traceable collaboration, often resulting in semantic ambiguity and inconsistent ontologies. This research introduces a governance-driven, workflow-centric framework for collaborative ontology engineering, integrating principles inspired by the Lisbon Strategy, the Bologna Process, and the 4C Framework. The proposed framework is particularly relevant for education technology environments, where governed ontologies support curriculum modeling, learning analytics, and AI-driven educational systems. Furthermore, the framework formalizes stakeholder interaction through structured dialectics, transparent task protocols, and traceable knowledge alignment mechanisms that collectively prevent the Tragedy of the Commons in ontology construction. The framework was empirically validated through a university-domain case study involving participants representing heterogeneous educational backgrounds, mirroring real-world interdisciplinary teaching teams. Quantitative evaluation using 50 competency-based SPARQL queries achieved a Precision of 92.3%, Recall of 88.7%, and F1-score of 90.4%, while qualitative assessments confirmed enhanced interoperability and knowledge alliance. These results demonstrate that governance-based workflow enforcement substantially improves collaborative efficiency and semantic accuracy in applied ontology development.

Index Terms—Collaborative Ontology, Semantic Web, Ontology Framework

NeurAI Art: Client-side Neural Stylization for Web Navigable 360° Environments

Hana Novakova
Faculty of Applied Informatics Tomas Bata University in Zlın, Nad Stranemi 4511, 760 05 Zlın, Czech Republic h1 novakova@utb.cz

Michal Pluhacek
Center of Excellence in Artificial Intelligence AGH University of Krakow, al. Mickiewicza 30, Krakow, 30-059, Poland mpluhacek@agh.edu.pl

***Abstract*—**We present NeurAI Art, a hybrid client-side pipeline that integrates neural style transfer into the generation of immersive, web-navigable 360° environments from a single panoramic photograph. Unlike stochastic, GPU-centric 3D reconstruction pipelines (e.g., NeRF, 3D Gaussian Splatting, or commercial "image-to-3D" services) that require paid APIs and long processing times, our approach performs CNN inference entirely in the browser using ml5.js/TensorFlow.js, orchestrated by a deterministic tiled compositor and delivered via A-Frame/WebXR. On a dataset of 63 panoramas, the prototype achieves mean generation times of 28.5 s (Hokus AI), 30.3 s (Picass AI), and 29.6 s (Picab IA); tiled inference ensures reproducibility while enabling practical resolutions on mid-range hardware. In contrast, NeRF-based and commercial image-to-3D reconstruction pipelines typically require tens of minutes per scene (e.g., reported ~30min for cloud-based 3D capture services), compared to our median latency of 31.4s (HokusAI), yielding an order-of-magnitude reduction in time-to-interaction. We further analyze trade-offs in tile width, overlap, and resolution caps, and quantify visual quality using SSIM/PSNR metrics. These results demonstrate that client-side neural stylization can be integrated cost-effectively, maintaining rapid time-to-interaction and predictable deployment.

Index Terms—Neural style transfer, WebXR, A-Frame, clientside AI, deterministic pipelines, immersive environments, tiled inference, reproducibility

Explainable Transformer-Based Speech Emotion Recognition Using Benchmark Datasets

Turgut Ozseven
Department of Computer Engineering Tokat Gaziosmanpaşa University Tokat, Turkiye

***Abstract*—**Although Speech Emotion Recognition plays a critical role in human-computer interaction, the opaque "black box" nature of deep learning models poses significant challenges for reliability and interpretability. This study utilizes a hybrid SER system based on Explainable Artificial Intelligence, combining high accuracy and transparency. The methodology involves extracting contextual features from raw audio signals using the Wav2Vec 2.0 architecture and processing them with a multilayer Transformer classifier. The model was trained and tested on the IEMOCAP dataset and evaluated on the RAVDESS dataset. Experimental results showed that the model performed successfully in its in-domain with 66.91% WA and 70.30% UA. However, in cross-dataset tests, performance decreased to 31.70% WA due to domain shift. A comprehensive XAI analysis was conducted to improve transparency into the model's decision-making process. While the quantitative effects of features on prediction were determined using the SHAP method, the model's temporal focal points in the audio signal were visualized using attention-weight analysis. The analyses revealed that the model could distinguish emotions such as "anger" with high confidence, especially by focusing on highenergy segments and sentence-end intonations. This study provides a methodological contribution to the literature by demonstrating that both high performance and interpretability can be offered together in SER systems.

Keywords—Speech Emotion Recognition, Wav2Vec2, Transformer, Explainable Artificial Intelligence (XAI), SHAP, cross-dataset

Sentiment Shift and Narrative Divergence as Early Indicators of Coordinated Influence in Online News Discussions

Artūras Serackis
Vilnius Gediminas Technical University, Lithuania, arturas.serackis@vilniustech.lt

Dalius Matuzevičius
Vilnius Gediminas Technical University, Lithuania, dalius.matuzevicius@vilniustech.lt

Gabriela Vdoviak
Vilnius Gediminas Technical University, Lithuania, gabriela.vdoviak@vilniustech.lt

Henrikas Giedra
Vilnius Gediminas Technical University, Lithuania, henrikas.giedra@vilniustech.lt

Ervinas Gisleris
Vilnius Gediminas Technical University, Lithuania, ervinas.gisleris@vilniustech.lt

Tomyslav Sledevič
Vilnius Gediminas Technical University, Lithuania, tomyslav.sledevic@vilniustech.lt

***Abstract*—*Online news discussions evolve dynamically as readers react to published content and to each other. This study examines the relationship between individual comments and shifts in collective discussion sentiment by integrating semantic similarity, temporal engagement, and comment-level sentiment analysis. We analyze articles and user comments from five Lithuanian news portals, combining multilingual sentence embeddings with sentiment scoring to quantify the relationship between comment relevance and subsequent sentiment reconfiguration. A central focus is the identification of "narrative injections" as highly engaging comments that serve as focal points for redirecting the collective sentiment and semantic focus of a thread. The results show that while most discussions remain sentiment-stable, a subset exhibits measurable directional change following these injection events. These shifts are linked to engagement intensity and semantic positioning, providing early indicators of potential coordinated influence. The proposed framework offers a reproducible, language-agnostic methodology for monitoring sentiment dynamics and identifying discussion reconfiguration points in non-English media environments.*

Keywords—sentiment dynamics, semantic similarity, engagement-based influence detection

Modelling Eye Mechanics Using Eye-tracking Glasses and Deep Learning

Konstantinos Roumpas
Computer Engineering and Informatics Department, University of Patras, Patras, Greece

Michalis Xenos
Computer Engineering and Informatics Department, University of Patras, Patras, Greece

***Abstract*—**Physics-Informed Neural Networks (PINNs) have gathered a lot of attention in the past years, as they have shown promising results in Physics, Chemistry, and other science-related projects. The application of such networks has also been explored in Human-Computer Interaction (HCI), and there is a lot of interest around eye-tracking (ET), as the partial differential equations (PDEs) that describe their movement are simplistic and can be easily applied in a PINN. Past research showed that with wearable ET devices, the PDEs that were described showed better results; however, there was no further study on them. Also, the potential of exploring different types of deep learning neural networks was discussed, although it was not elaborated further. In this work, we aim to apply Graph Neural Networks, Temporal Convolutional Networks, and their PINN-hybrid counterparts to explore if higher accuracy can be achieved in predicting a user's gaze. The results showcased that the pure PINN is the best solution to tackling this problem, with the other neural networks falling shortly behind it. This is a significant finding for HCI research, as it showcases the most effective method for predicting a user's gaze using ET data and deep learning, while also providing insight into the mechanics of eye movement itself.

Keywords—Human-Computer Interaction, Deep Learning, EyeTracking, Cognitive Modelling

Spatiotemporal Convolutions on EEG signal - A Representation Learning Perspective on Efficient and Explainable EEG Classification with Convolutional Neural Nets

Laurits Dixen, Stefan Heinrich, Paolo Burelli
IT University of Copenhagen, Denmark.

Abstract-- Classification of EEG signals using shallow Convolutional Neural Net (CNN) is a prevalent and successful approach used in a variety of fields. Most of these models use independent one-dimensional (1D) convolutional layers along the spatial and temporal dimension, that are concatenated without a non-linear activation layer between. In this paper, we investigate an alternative encoding that operates a bi-dimensional (2D) spatiotemporal convolution. While 2D convolutions are numerically identical to two concatenated 1D convolutions along the two dimensions, what impacts on learning is still uncertain. We test 1D and 2D CNNs and a CNN+transformer hybrid model in a low-dimensional (3-channel) and a highdimensional (22-channel) BCI motor imagery classification task. We observe that 2D convolutions significantly reduces training time in the high-dimensional task, while keeping performance identical. We investigate the root of this improvement and find no difference in spectral feature importance. However, a clear pattern emerges in representational similarity across models, where 1D and 2D models result in vastly different representational geometries. Overall, we suggest an improved model using a 2D convolutional layer for improved training and inference speed. We also highlight the importance of architecturally-driven encoding when processing complex multivariate signals, only to be seen internal representations rather than purely performance metrics.

Keywords: EEG, CNN, brain-computer interface, Representation Learning

Automating Web UI Test Maintenance for Angular Framework Migration Using GitHub Copilot

Aysu Gokkaya Karabulut
Grid Simulation, SIEMENS Foundational Technologies, Ankara, Turkey aysu.gokkaya@siemens.com

Canberk Ünlüer
Grid Simulation, SIEMENS Foundational Technologies, Ankara, Turkey canberk.unluer@siemens.com

Merve Nergiz Afatsun
Grid Simulation, SIEMENS Foundational Technologies, Ankara, Turkey nergiz.afatsun@siemens.com

***Abstract*—**Frontend framework migrations frequently disrupt UI test automation by introducing changes in the Document Object Model that invalidate existing locators and increase maintenance effort. This study investigates AI-assisted maintenance of Page Object Model based UI test automation after an industrial migration from Angular 13 to Angular 20, including a major PrimeNG upgrade. GitHub Copilot agents were used to analyze repository changes and update locator definitions, supported by a rule-based identification strategy that prioritizes stable attributes such as data-testid and id-based selectors. Experimental results on 272 locator definitions show that the proposed approach improves locator robustness by eliminating fragile XPath usage and shifting toward ID-based locator strategies. The quantitative evaluation reports a precision of 0.857, recall of 0.761, accuracy of 0.735, and an F1 score of 0.806 for locator change detection. In addition, the AI-assisted workflow reduced maintenance effort from 20 person-days to 6 person-days, corresponding to an effort reduction of approximately 70 percent. These findings indicate that the proposed approach provides a practical and scalable solution for maintaining UI test automation during large-scale Angular framework migrations.

Index Terms—UI test automation, test maintenance, Angular migration, GitHub Copilot, locator robustness, AI-assisted software engineering, software testing

BEAF: Blockchain-Enabled Accountability Framework for High-Assurance Clinical AI

Mersad Rahmati Tabrizi
Department of Computer Science and Digital Technologies University of East London, E16 2RD London, UK mrahmati@uel.ac.uk

Amin Karami
Department of Computer Science and Digital Technologies University of East London, E16 2RD London, UK a.karami@uel.ac.uk

Stevena Aleva
Department of Computer Science and Digital Technologies University of East London, E16 2RD London, UK stevena.aleva@outlook.com

***Abstract*—**Autonomous medical AI introduces significant accountability gaps, often rendering existing governance frameworks insufficient for runtime enforcement. We present the Blockchain-Enabled Accountability Framework (BEAF), an architecture designed to bridge normative regulations (EU AI Act) and technical execution. BEAF utilizes a Stakeholder-Risk Matrix and Hyperledger Fabric to enforce policy-as-code, while Zero-Knowledge Proofs (ZKPs) ensure auditability without compromising patient privacy. Validation across semi-autonomous and fully autonomous clinical scenarios confirms the framework satisfies 17 of 18 identified accountability requirements. Performance modeling predicts a p95 ledger commit latency of under 250 ms in high-volume hospital environments. By providing immutable, low-latency evidence logging, BEAF establishes a scalable infrastructure for computational accountability in timecritical clinical workflows.

Index Terms—Medical AI Governance, Computational Accountability, Blockchain, Zero-Knowledge Proofs, EU AI Act, Policy-as-Code, Risk Management

Stateful LLM Agents for Autonomous Capture-the-Flag Solving

Amir Amine
Department of Electrical and Computer Engineering Lebanese American University, Byblos, Lebanon amir.amine@lau.edu

Ali Zayat
Department of Electrical and Computer Engineering Lebanese American University, Byblos, Lebanon ali.zayat@lau.edu

Samer Saab Jr
Department of Electrical and Computer Engineering Lebanese American University, Byblos, Lebanon samer.saabjr@lau.edu.lb

***Abstract*—**We study end-to-end autonomy in tool-using large language model (LLM) agents for offensive-security under a strictly stateful execution contract. We implement an explicit state-machine-orchestrated agent that (i) maintains a persistent remote shell session, (ii) enforces a structured action interface that produces exactly one command or an explicit credential-extraction event, and (iii) logs and checkpoints the intermediate state for auditing and reproducibility. We evaluate the same workflow across API-based LLM backbones on two OverTheWire benchmarks with complementary profiles: Bandit (multi-step remote shell interaction) and Krypton (cryptanalytic reasoning). On Bandit, standalone (per-level) success substantially exceeds sequential (chained) success, revealing that longhorizon statefulness and closed-loop robustness are the primary bottlenecks. Among the mini models, sequential completion increases monotonically, while standalone completion reach more complex levels. Instantiating our stateful harness with GPT-4o matches a prior stateless GPT-4o standalone baseline (20/33), but exposes a large sequential drop (16/33) that is invisible without chaining. In contrast, Krypton is dominated by reasoning- and interface-limited failures: models reliably solve early substitution/encoding levels but fail on higher levels requiring multi-step statistical cryptanalysis and, in several cases, interactive stdindriven workflows not supported by a single-command execution interface. Together, these results motivate sequential evaluation as a necessary metric for autonomous penetration-testing pipelines and clarify where current agentic systems fail: interaction robustness in long horizons versus procedural competence in multi-step reasoning.

Index Terms—Autonomous agents, Large language models (LLMs), Penetration testing, Capture-the-Flag (CTF)

Revenue Forecasting Models from Point-of-Sale Data for Electronic Payment and Money Institutions

Zehra Sude Sarı
Department of R&D Center, Moka United, Istanbul, Turkey, zehra.sari@mokaunited.com

Ali Can Kunt
Department of R&D Center, Moka United, Istanbul, Turkey, alican.kunt@mokaunited.com

Ali Çelik
Department of R&D Center, Moka United, Istanbul, Turkey, ali.celik@mokaunited.com

Feyyaz Kayar
Department of R&D Center, Moka United, Istanbul, Turkey, feyyaz.kayar@mokaunited.com

Ceren Ulus
Department of Data Management, Moka United EFA Innovation Consultancy, Adana, Turkey, f.cerenulus@gmail.com

M. Fatih Akay
Department of Computer Engineering, Çukurova University, Adana, Turkey, mfakay@cu.edu.tr

***Abstract*—**Electronic payment and money institutions offer innovative solutions in the financial services sector by digitizing financial transactions. These institutions generate revenue through various products and services. Point of Sale (POS) is one of these products. Revenue forecasting for POS is a critical process that directly affects financial efficiency and market competitiveness. In this study, POS revenue forecasting models have been developed using Convolutional Long-Short Term Memory (ConvLSTM), Convolutional Neural Network (CNNLSTM), Seasonal Auto Regressive Integrated Moving Average (SARIMA), Categorical Boosting (CatBoost), Support Vector Machine (SVM) and ensemble learning. The dataset has been created using data obtained from Moka United. Monthly and weekly forecasting models have been developed for the months of September and December 2024. The effects of F-Regression feature selection and sequential/periodic lookback integration on the performance of the forecasting models have been analyzed. The performance of the developed forecasting models has been evaluated using Mean Absolute Percentage Error (MAPE). As a result, the CNN–LSTM model achieved the lowest MAPE value.

Keywords— Electronic Payment and Money Institutions, Revenue Forecasting, Machine Learning

Machine Learning–Based Classification and Symptom Forecasting Across the Menopausal Transition Using Longitudinal Self-Reported Data

Aadyaa Vijay
Mastermind Global School, Pune, India, aadyaa.vijay25@gmail.com

Anu Prabha
Department of Biosciences and Bioengineering, Indian Institute of Technology Bombay, Powai, Mumbai, India, anuprabh.mandal@gmail.com

Abstract –
Background: Menopause is a universal and natural biologically driven life transition that is highly heterogeneous in terms of symptom variability, its manifestation timing and extent of severity. Scalable and deployable models that utilize self-reported data to predict menopausal stage and short-term occurrence of symptoms could potentially enable earlier medical intervention and personalized treatment.

Objective: In this study we have utilized publicly available data from the Study of Women's Health Across the Nation (SWAN); created and validated a scalable machine learning pipeline that does the following: (a) predicts menopausal stage (pre, peri, post) from self-reportable longitudinal variables and (b) generates probabilistic short-term symptom forecasts for hot flashes and mood changes based on self-reported last menstrual period (LMP) timing.

Methods: Rule-based feature selection (regular expression heuristics) was used to extract self-report variables from the SWAN dataset. Thirty-eight interpretable features were selected for this study that are self-reportable covering demographics, lifestyle, menstrual timing, vasomotor symptoms, mood symptoms, pain and general health indicators. Median imputation and one-hot encoding were implemented in reusable scikit-learn pipelines. Numerical features were standardized as needed. Two classifiers were used: Multinomial Logistic Regression and Random Forest (200 trees). These were trained on a stratified 80/20 split of the dataset and a five-fold cross validation was performed. Symptom forecasting is conducted via a rule-based Symptom CycleForecaster model that calculates cycle day from LMP and returns symptom probabilities.

Keywords – Biology; Machine learning; Menopausal transition; Women's health analytics, Health informatics

Architecture-Aware Threat Modeling and Deployment-Time Attack Surface Analysis for LLM-Integrated Applications

Selin Şaşal
Department of Computer Engineering Graduate School of Natural and Applied Sciences Ege University Izmir, Türkiye, sasalselins@gmail.com

Özgü Can
Department of Computer Engineering Faculty of Computer and Informatics Sciences Ege University Izmir, Türkiye, ozgu.can@ege.edu.tr

***Abstract*—** Large Language Models (LLMs) are increasingly deployed as operational components within software applications that integrate external knowledge retrieval mechanisms, orchestration frameworks, and execution interfaces. In these deployments, the model interacts with user inputs, retrieves contextual data, and downstream tools, thereby extending the functional capabilities of application systems. However, this integration also introduces multiple interaction boundaries across architectural components that may serve as potential attack entry surfaces beyond prompt-level vulnerabilities. This study presents an architectural analysis of threat actors and attack surfaces in LLM-integrated applications by examining potential adversarial entry points across prompt interfaces, retrieval channels, and execution interfaces. For this purpose, a hierarchical categorization of vulnerability classes is introduced to capture how security risks may emerge from cross-component interactions within deployed application pipelines. The findings highlight that adversarial influence introduced at one interaction boundary may affect downstream system behavior through intermediary architectural components, emphasizing the importance of deployment-aware threat modeling for identifying system-level security risks in LLM-enabled applications.

Keywords— Large Language Models (LLMs), attack surface analysis, threat modeling, deployment security, LLM-integrated applications

When Transformers Fail to Generalize: A CrossDataset Study of Acute and Chronic Stroke Lesion Segmentation

Nasim Ahmadzadeh Nobari Azar
Computer Information Systems, Near East University, Cyprus, Nicosia nasim.ahmadzadeh@neu.edu.tr

Emine Atalay
Computer Information Systems, Near East University, Cyprus, Nicosia 20254074@std.neu.edu.tr

***Abstract*—**We explore transformer-based deep learning models for segmenting stroke lesions in MRI. In recent years, transformer-based models such as JHNet have achieved significant success in medical image analysis tasks by modeling global spatial and temporal relationships that are difficult to capture for conventional CNN-based methods. This is critically important, for example, in stroke lesion segmentation, since lesions on MR images have highly irregular shapes, complex signal characteristics, and can be widely distributed in the brain. In this paper, we conduct a comparative study of four representative transformer-based segmentation models across two publicly available stroke MRI datasets with distinct clinical conditions: the ISLES 2022 dataset (acute ischemic stroke) and the ATLAS v1.2 dataset (chronic stroke). We thoroughly investigate how these architectures handle multi-modal MRI — DWI, ADC, FLAIR, and T1-weighted images — and evaluate their segmentation performance in a benchmark framework. We show that although transformer-based models work well for segmenting acute stroke images, their performance deteriorates significantly when the same models are applied to chronic stroke datasets, where most models fail to extract useful lesion patterns and generate mainly background predictions. This performance gap indicates the negative effects of dataset shift, extreme class imbalance, and an unadapted training strategy in stroke lesion segmentation. Rather than proposing a novel architecture, this paper conducts an empirical study to understand the intrinsic limitations of Transformer-based models and highlights domain-aware training schemes for enhanced robustness and clinical relevance.

Keywords—stroke lesion segmentation, vision transformer, domain shift, medical image analysis, generalization

Compress to Generalize: Kernel Density–Based Information Bottleneck Regularization in Deep Reinforcement Learning

Pedro Mendes Odilon
Department of Electrical and Computer Engineering University of Campinas, Campinas, Brazil p204708@dac.unicamp.br

Denis G. Fantinato
Department of Electrical and Computer Engineering University of Campinas, Campinas, Brazil denisf@unicamp.br

***Abstract*—**Deep reinforcement learning has demonstrated great performance on complex control and game problems, yet it often relies on learned representations that overfit to irrelevant details of the training environment. The Information Bottleneck principle provides a way to control the information flow, forcing the neural network to trade off between reward-relevant information retention and representation compression. Recent methods of this principle typically implement the regularizer through variational bounds, as the Kullback-Leibler Divergent. Although it solves the problem, it also introduces persistent approximation error where both policy and data distribution evolve throughout the training. In this work, we propose an alternative IB regularization strategy for deep RL that directly estimates the MI term using a non-parametric Kernel Density Estimator. We evaluate the proposed approach in the Advantage Actor-Critic framework on two different environments: the MiniGrid maze and the CartPole control task. And, we compare KDE-based IB against the standard variational IB in terms of learning speed, reward performance over the long run, algorithm stability, and robustness to environment changes designed to probe generalization.

Index Terms—Information Theory, Deep Reinforcement Learning, Kernel Density Estimator, Regularization, Mutual Information, Information Bottleneck

Automating Identity and Corporate Authorization in Retail Channels: An AI-Driven Approach for Heterogeneous Document Intelligence

Vedat COSKUN
Professor & IEEE Member, Dept. of Software Engineering, Istanbul Atlas University, Istanbul, Türkiye, vedat.coskun@atlas.edu.tr

Busra OZDENIZCI KOSE
Associate Professor, Dept. of Management Information Systems, Gebze Technical University, Kocaeli, Türkiye, busraozdenizci@gtu.edu.tr

Reyhan GOGER
Dept. of Customer and Document Solutions, Turkcell Technology, Istanbul, Türkiye, reyhan.goger@turkcell.com.tr

Ozgur COSKUN
Dept. of Electrical and Computer Engineering, Virginia Commonwealth University, Richmond VA, USA, coskuno@vcu.edu

***Abstract*—**This paper presents an end-to-end intelligent framework designed to automate identity and authorization verification within telecommunications retail channels. Current processes for individual and corporate transactions often rely on manual document inspection, leading to increased operational costs, prolonged transaction times, and potential human error in verifying wet signatures and legal authorities. The proposed system, AI-IDAS (AI-based Identity & Authorization System), utilizes a multi-stage approach: first, it employs Convolutional Neural Networks (CNN) and heuristic methods to localize and extract signatures from diverse, multi-lingual, and non-standard documents while filtering non-distinctive marks. Second, it performs a risk-based similarity analysis, comparing extracted signatures against multiple reference points, including national ID cards (via MRZ/NFC), notary specimens, and live-captured biometric signatures. Finally, for corporate transactions, the framework integrates Natural Language Processing (NLP) and real-time database connectivity to automate the mapping of representative authorities from complex documents such as notary signature circulars and tax certificates. By transitioning from manual review centers to an automated, context-aware decision support system, the framework significantly reduces operational bottlenecks, minimizes false acceptance/rejection rates, and ensures regulatory compliance in high-volume retail environments.

Keywords— automated signature verification; corporate authorization; document intelligence; computer vision; natural language processing; telecommunications retail.

AI-Driven Bioinformatics for Deciphering Circular RNA (circRNA) Mechanisms in Qingre Huayu Recipe for Cerebral Infarction Therapy

Xianjing Zeng
Dr.,General Practice department, Affiliated Hosptial of Jinggangshan University, Ji'an city, Jiangxi Province, China, 343000,
18979610161@163.com

Jingfeng Zhou
Dr., Department of Anesthesiology, Affiliated Hosptial of Jinggangshan University, Ji'an city, Jiangxi Province, China, 343000,
645006811@qq.com

Jinghua Yuan
Dr., General Practice department, Affiliated Hosptial of Jinggangshan University, Ji'an city, Jiangxi Province, China, 343000,
yjh13407069867@sina.com

Abstract—
Background: Qingre Huayu Recipe, a traditional Chinese medicine formulation, has shown potential neuroprotective effects in ischemic stroke; however, its molecular mechanisms remain poorly understood.

Objective: To investigate the role of circular RNA (circRNA)-mediated regulatory networks in Qingre Huayu Recipe–induced neuroprotection using experimental and bioinformatics approaches.

Methods: A middle cerebral artery occlusion (MCAO) rat model was established and divided into Sham, MCAO, and treatment groups. Neurological and behavioral assessments were conducted. High-throughput circRNA sequencing was performed, followed by differential expression analysis using DESeq2 (FDR-adjusted $p < 0.05$). circRNA–miRNA–mRNA interaction networks were constructed using established bioinformatics tools. Machine learning models (Random Forest and Support Vector Machine) were applied for feature prioritization. Selected circRNAs were validated by qRT-PCR.

Results: Qingre Huayu treatment significantly improved neurological scores ($p < 0.05$). Differential expression analysis identified multiple circRNAs, with circRNA_012 significantly upregulated. Network analysis suggested a potential circRNA_012–miR-124–Bcl-2 regulatory axis. Machine learning–based feature selection demonstrated improved classification performance compared to traditional correlation-based methods. qRT-PCR results were consistent with sequencing findings.

Conclusion: Qingre Huayu Recipe may exert neuroprotective effects through circRNA-mediated regulatory mechanisms. These findings provide candidate molecular targets for further functional validation.

Keywords: Circular RNA (circRNA), Qingre Huayu, Cerebral Infarction, AI-Driven Bioinformatics

Using Cloud Computing and Distributed Systems to Improve Accessibility and Scalability of Online Education Platforms

Peiyan Liu
Tianjin Hexi District Workers University, Tianjin,China, pigxia7622@163.com

Fei Yang
Tianjin Hexi District Workers University, Tianjin,China, 86822234@qq.com

Zhexuan Ao
Tianjin Hexi District Workers University, Tianjin,China

Abstract-- Cloud computing and distributed systems are becoming the new trends and are redesigning the educational platforms to be more efficient, flexible, and democratic. These systems culminating in the cloud can execute large concurrent user cases as high availability and almost zero downtime to the user even in case the network experiences a failure. It is better to play with cloud computing whereby resources are scaled up to cater peak load conditions by adding up to the amount required. In this manner an unbroken learning process can be achieved. They are also applicable to propagate messages across various computers and simultaneously cut data retrieval time and consequently make it run faster. Scalability and flexibility assist in spreading the platform to the far corners in order to provide more inclusive and accessible education to a wider audience across the world. Cloud computing helps provide a far more efficient, sustainable, and cost-effective model of online learning in that educational resources can be easily accessed and expanded to meet the needs of a number of users. Compared to the legacy on-premise server architecture deployed prior to the system upgrade, the implementation of cloud computing increased user access by 45%, supporting over 10,000 simultaneous users during peak periods. Additionally, benchmarking against the previous year's performance baseline, distributed systems reduced downtime by 30% and cut resource costs by 25%, demonstrating the scalability and cost-effectiveness of cloud solutions in online education platforms. This paper is important for underlining how such technologies affect the future direction of education through making it responsive and accessible for the learner.

Keywords: Cloud Computing, Distributed Systems, Online Education, Scalability, Accessibility, Performance Optimization, Educational Platforms

Optimizing Enterprise Information Management through LINUX Operating System Integration in Intelligent Communication Networks

Xueyan Zhong
Lecturer, School of Computer, Science and Engineering, Guangzhou Institute of Science and Technology, Guangzhou, China,
zxy202600@163.com

Xiao Xiao
Associate Professor, School of Business Administration, Guangzhou Institute of Science and Technology, Guangzhou, China,
22153215@qq.com

Abstract-In contemporary business scenarios, effective and secure information management is very important for the processing of bulk-scale dynamic data. This article presents an AI-boosted LINUX-based enterprise information management system that incorporates Deep Echo State Networks (DESN) for the real-time processing of data and the Artificial Satellite Search Algorithm (ASSA) for dynamic resource allocation, routing of data, and workload allocation. Based on satellite orbital dynamics, ASSA provides fast convergence in multi-dimensional search spaces, which improves real-time decision-making and minimizes network latency. Experimental results show that the designed system has 40% less latency, 45% greater security efficiency and 50% improved management of computational resources compared to conventional enterprise solutions. Next, a comparative analysis with proprietary OS-based enterprise management solutions demonstrates the higher scalability, flexibility and cost-effectiveness of AI-LINUX integration. The approach presented in this study improves the resilience of systems, minimises the overhead associated with system operation, and enables the communication of the enterprise in dynamically changing environments. The study introduces a novel intelligent enterprise information management paradigm that provides a scalable, efficient, and AI-based intelligent response to the increasing complexities of the contemporary business network with greater security and performance.

Keywords—Enterprise Information Management, AI-Enhanced LINUX, Deep Echo State Network (DESN), Artificial Satellite Search Algorithm (ASSA), Resource Optimization

Mathematical Foundations of Hybrid Models: Using Logistic Regression and K-Means Clustering to Detect Anomalies

Mengqi Jin
College of Software, Northeastern University, Shenyang, China, 110819, 1365212258@qq.com

Wang Shuang
College of Software, Northeastern University, Shenyang, China, 110819,156622419@qq.com

***Abstract*--**In this set of algorithms, we investigated a hybrid model based on Logistics Regression and K-means Clustering methods for anomaly detection. The points classified into supervised learning with Logistic Regression are either normal or classified as anomalies, since K-means Clustering infers hidden patterns in the form of such clustering of similar data points in the unsupervised domain to give a natural structure to the examined dataset. This combination endows the model with the high interpretability and precision of logistic regression, while offering K-Means clustering more flexibility in pattern discovery. The blend produces a sound mechanism for outlier and rare event detection, even those of a complex, subtle nature, which hold good for a peculiar tradition. It is proved by experimenting based on a number of datasets regarding standard detection accuracy, adaptability, and generalizability in domains including cyber-security, fraud detection, and industrial systems monitoring that the efficiency of the hybrid model is achieved. The work displays how this hybrid approach is well-suited enough to solve most of the problems related to anomaly detection by giving reliable real-time insight into the behavioral patterns of systems.

Keywords: Anomaly Detection, Logistic Regression, K-Means Clustering, Hybrid Model Machine Learning, Outlier Detection

User-Centered Obstacle-Avoidance-based Shared Control Algorithm for an Active Assistive Walker

Muhammad Ishaq
DIEEI University of Catania, Catania, Italy muhammad.ishaq@unict.it

Dario C. Guastella
DIEEI University of Catania, Catania, Italy dario.guastella@unict.it

Giuseppe Sutera
DIEEI University of Catania, Catania, Italy giuseppe.sutera@unict.it

Giovanni Muscato
DIEEI University of Catania, Catania, Italy giovanni.muscato@unict.it

***Abstract*—**Smart walkers (SWs) have emerged as vital assistive technologies for enhancing mobility and independence among the elderly and individuals with gait impairments. However, effectively interpreting user intent without relying on expensive, fragile force sensors remains a significant challenge. This paper proposes a novel control framework for a SW that integrates a Sensorless Force Estimation (SFE) observer with a sector-based shared control strategy. The SFE algorithm utilizes intrinsic motor currents and kinematic data to estimate user interaction forces. It compensates for system dynamics and ground inclination to provide a natural admittance interface. To ensure safety without compromising user agency, a discrete finite state machine controls obstacle negotiation is performed. When an obstacle is detected within a safety threshold, the system halts motion and enters a safety interlock state, requiring a deliberate backward unlock gesture from the user to resume movement. Once unlocked, the shared controller evaluates environmental clearance using LiDAR sectors and modulates the turning gain, amplifying user intent toward clear paths while providing haptic resistance against obstacles. Experimental validation demonstrates that the proposed system is able to prevent collisions, interpret user intent, and provide intuitive guidance, offering a cost-effective and robust solution for assistive mobility.

Index Terms—Shared Control, Obstacle Detection, Smart Walker, Assistive Robotics, Force Estimation

Integration of IOT Technologies in Marketing, Logistics and Customer Service Management: A Comparative Analysis Between Bulgaria and EU (2021–2024)

Prof. Svetlana Dimitrakieva
Department "Industrial Management" Technical University of Varna, Varna, Bulgaria, s_dimitrakieva@tu-varna.bg

Prof. Siyka Demirova
Department "Industrial Management" Technical University of Varna, Varna, Bulgaria, s_demirova@tu-varna.bg

PhD Student Dobromira Ivanova
Department "Industrial Management" Technical University of Varna, Varna, Bulgaria, doromira.s.ivanova@tu-varna.bg

***Abstract* —** The purpose of report is to examine the impact of IoT technologies on marketing, logistics and customer relationship management in Bulgaria and the European Union for the period 2021–2024. An integrated digital maturity index IoTMSI is developed, including marketing, logistics and infrastructure components. By applying correlation and comparative analysis, the role of logistics as a connecting link between marketing promises and customer satisfaction CSAT is assessed.

Keywords—marketing, logistics, digital transformation, customer management

Systematic Evaluation of Data Augmentation Strategies for CNN-Based Image Classification

Rifat Kurban
Dept. of Computer Engineering, Abdullah Gul University, Kayseri, Turkey rifat.kurban@agu.edu.tr

Fatma Çakıroğlu
Vocational School of Information Technologies, Kayseri University, Kayseri, Turkey fatmacakiroglu@kayseri.edu.tr

Ali Durmuş
Dept. of Electrical & Electronics Eng. Kayseri University, Kayseri, Turkey alidurmus@kayseri.edu.tr

Ercan Karaköse
Dept. of Basic Sciences, Kayseri University, Kayseri, Turkey ekarakose@kayseri.edu.tr

***Abstract*—**Convolutional Neural Networks (CNNs) have achieved remarkable results in image classification studies. However, their performance is significantly dependent on training strategies and architectural choices, in particular data augmentation and regularization choices. This paper presents a systematic grid search study of augmentation hyperparameters across three CNN architectures with increasing capacity (Compact V1, Standard V2, and Advanced V3) on CIFAR-10. We evaluate commonly used geometric and photometric transformations, including rotation, vertical/horizontal flipping, scaling, contrast adjustment, and translation. The findings reveal that architecture-specific data augmentation policies meaningfully and measurably improve the model's generalization ability. The most effective Standard V2 configuration achieved an accuracy rate of 90.41%, providing a 3.16% performance increase compared to the baseline model without augmentation. Furthermore, the effects of interactions between augmentation density and parameters on model performance were examined in detail, providing a practical guide for selecting effective data augmentation policies under different model capacities.

Index Terms—CNN, CIFAR-10, data augmentation, grid search, deep learning

Acknowledgment
This study is supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) under the 2224-A program.

Plant Leaf Disease Segmentation Using U-Net++: A Comparative Evaluation with Classical Baselines

Vedat Ayaz
Department of Computer Engineering, Abdullah Gul University, Kayseri, Turkey vedat.ayaz@agu.edu.tr

Huseyin Cahid Donmez
Department of Computer Engineering, Abdullah Gul University, Kayseri, Turkey huseyincahid.donmez@agu.edu.tr

Burak Samet Varel
Department of Computer Engineering, Abdullah Gul University, Kayseri, Turkey buraksamet.varel@agu.edu.tr

Rifat Kurban
Department of Computer Engineering, Abdullah Gul University, Kayseri, Turkey rifat.kurban@agu.edu.tr

***Abstract*—**Accurate segmentation of diseased regions on plant leaves is a prerequisite for reliable autonomous crop monitoring systems. The image processing algorithms used in this area are generally simple from a computational perspective; however, many of these classical algorithms are sensitive to complex background noise and variations in lighting. A comparative evaluation study of three segmentation methods, including Otsu's Thresholding Methodology, K-Means Clustering in the L*a*b* color space, and a Deep Learning architecture (U-Net++) based upon a ResNet50 encoder, is presented in this paper. To account for lesions that are poorly defined at their boundaries, we developed a hybrid loss function which combines Binary CrossEntropy Loss, Dice Loss, and a custom Edge Loss with a warmup schedule. We employed Test-Time Augmentation (TTA), as well, to improve inference robustness. The experimental results using the Leaf Disease Segmentation Dataset demonstrated that the proposed deep learning system outperformed all classical segmentation methods in terms of both IoU and Dice metrics. In addition, we provided an explanation of how the proposed segmentation methodology functions by utilizing Grad-CAM visualizations to demonstrate that the proposed method learned to focus on pathologic features instead of background correlation noise.

Index Terms—Plant Disease Detection, Image Segmentation, Otsu's Thresholding, K-Means Clustering, U-Net++, Digital Image Processing, Comparative Study

Acknowledgment
This study is supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) under the 2224-A program.

Direction-Optimized Ridge Stacked Deep Learning Ensemble For Financial Market Prediction

RAGHAVENDRA RA, PRAJWAL B, VANAMALA HR
Department of Electronics and Communications Engineering, PES University, Bengaluru 560085, India
ragha11122003@gmail.com, praejwael@gmail.com, vanamalahr@pes.edu

***Abstract*—** Stock market prediction is a challenging task due to the dynamics, volatility, and temporal dependencies over the financial time-series data. Deep learning classifiers like LSTM and GRU have the capability to learn sequential patterns, however, single-model approaches for generating single-stock behavior underperform, as there can be differences in characteristics of the market among stocks. In the following paper, we present the unified stock price forecasting framework using ridge regression and combine several deep learning architectures using a stacked ensemble approach. The framework adopts recurrent, convolutional, and attentionbased neural models trained with historical open, high, low, close, and volume datasets. It proposes a new loss formulation for guiding the learning process when training. To make use of their complementary strengths and enhance generalization, the predictions of individual models are combined using ridge regression. Using standard regression metrics, the proposed approach is experimented on several Indian stocks and a benchmark market index. Experimental results reveal a superior or near-optimal stacked ensemble than a single model, confirming the robustness and reliability of the proposed framework, across a multitude of market conditions.

Keywords—Stock Market Prediction, Deep Learning, TimeSeries Forecasting, Ensemble Learning, Ridge Regression

Similarity-Based Bike Station Expansion via Hybrid Denoising Autoencoders

Oluwaleke Yusuf
Department of Engineering Cybernetics Norwegian University of Science and Technology (NTNU), NO-7491 Trondheim, Norway

M. Tsaqif Wismadi
Department of Architecture and Planning Norwegian University of Science and Technology (NTNU), NO-7491 Trondheim, Norway

Adil Rasheed
Department of Engineering Cybernetics Norwegian University of Science and Technology (NTNU), NO-7491 Trondheim, Norway

***Abstract*—**Urban bike-sharing systems require strategic station expansion to meet growing demand. Traditional allocation approaches rely on explicit demand modelling that may not capture the urban characteristics distinguishing successful stations. This study addresses the need to exploit patterns from existing stations to inform expansion decisions, particularly in data-constrained environments. We present a data-driven framework leveraging existing stations deemed desirable by operational metrics. A hybrid denoising autoencoder (HDAE) learns compressed latent representations from multi-source grid-level features (socio-demographic, built environment, and transport network), with a supervised classification head regularising the embedding space structure. Expansion candidates are selected via greedy allocation with spatial constraints based on latentspace similarity to existing stations. Evaluation on Trondheim's bike-sharing network demonstrates that HDAE embeddings yield more spatially coherent clusters and allocation patterns than raw features. Sensitivity analyses across similarity methods and distance metrics confirm robustness. A consensus-based procedure across multiple parametrisations distils 32 high-confidence extension zones where all parametrisations agree. The results demonstrate how representation learning captures complex patterns that raw features miss, enabling evidence-based expansion planning without explicit demand modelling. The consensus procedure strengthens recommendations by requiring agreement across parametrisations, while framework configurability allows planners to incorporate operational knowledge. The methodology generalises to any location-allocation problem where existing desirable instances inform the selection of new candidates.

Index Terms—Bike Sharing Systems, Location-Allocation, Denoising Autoencoders, Representation Learning, Spatial Analysis

Latency-Aware Speaker Identification in Browser Environments: A Comparative Study of Lightweight vs. Deep Architectures

Burak Samet Varel
Department of Computer Engineering Abdullah Gul University, Kayseri, Turkey buraksamet.varel@agu.edu.tr

Huseyin Cahid Donmez
Department of Computer Engineering Abdullah Gul University, Kayseri, Turkey huseyincahid.donmez@agu.edu.tr

Vedat Ayaz
Department of Computer Engineering Abdullah Gul University, Kayseri, Turkey vedat.ayaz@agu.edu.tr

Rifat Kurban
Department of Computer Engineering Abdullah Gul University, Kayseri, Turkey rifat.kurban@agu.edu.tr

***Abstract*—**Speaker recognition using machine learning that is accessed through a web-based user interface (UI) utilizing server-side inference faces strict limitations on both latency and usability; Users expect feedback in nearly real-time and do not want to have to download or install anything, while there are still limits to how much computing power and memory can be used. We examine how classical and deep learning techniques can be utilized to achieve low-latency speaker recognition within a browser-accessed application utilizing server-side inference where training data is limited. To accomplish this we implemented 5 different models utilizing the same audio preprocessing pipeline and train/test split, and also implemented a common timing harness: A Multilayer Perceptron (Neural Network), a Support Vector Machine (SVM), a Random Forest Classifier, An AdaBoost Classifier, and an X-Vector-inspired embedding network. All of the latencies stated were determined at the server-side Python inference only; End-to-End Latency will require the additional latency associated with a network round-trip, serialization, and client-side JavaScript runtime. Our results indicate that classical models provide the best speed – accuracy trade-off: The SVM achieved a 95.0% test accuracy with an 8 ms server-side inference time, and a 120 KB model size, While the Random Forest Classifier achieved an 85.0% test accuracy with high cross-validation performance (CV Mean = 90.5%). Our results indicate that the embedding network underperformed many of the classical baselines and had longer inference times and larger model sizes than many of the classical baselines. These results suggest that lightweight classical models are competitive with, and may be preferable to, deep learning based models for responsive, browser-accessed speaker recognition systems where the amount of enrollment data is limited.

Index Terms—Speaker Recognition, Browser Based Machine Learning, Low Latency Server-Side Inference, Lightweight Models, Web Edge Deployments, SVM, Random Forest, X-Vector, MFCC

Acknowledgment
This study is supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) under the 2224-A program.

Enactive Social Development: How Children Co-Create Stories in Pretend Play with a Robot

Hideki Kozima
Graduate School of Education Tohoku University, Sendai, Japan xkozima@tohoku.ac.jp

***Abstract*—**This study explores the enactive process of social development through analyzing kindergarten children's pretend play with a teleoperated robot. Through participant observation of 3- to 4-year-olds, we found that children project their individual fantasies onto the play "stage" as concrete words and actions. The children's words and actions are overlaid on the "stage," forming a holistic meaning in a self-organizing manner. This enactive phenomenon entails a circular relationship between individual cognition and the emerging collective stories. This sensemaking process requires not only autonomous integration at the collective level but also grounding in embodied experience at the individual level, enabled by intercorporeality. Based on these observations, we propose a semiotic model of communication development. In this model, words and actions constitute a middle layer that functions as a semiotic system that mediates between two qualitatively different sense-making realms: collective use within a shared story and subjective, embodied experience at the individual level. Finally, this study suggests that communication is not simply information transmission, but a generative process of co-constructing a meaningful world with others. In the AI era, returning to actual, enactive interactions with flesh-andblood others—rooted in physical and emotional experiences—is indispensable for promoting children's sociality and preventing the runaway of disembodied narratives.**

Index Terms—cognitive development, communication, embodiment, semiotics

The Reinforcing Cycle of AI Disadvantages: A Systematic Review of Job Displacement, Algorithmic Bias, Privacy Erosion, and Global Inequality

Sunil Deupala
Dept. of Information Technology University of the Cumberlands Williamsburg, Kentucky, USA sdeupala05905@ucumberlands.edu

Samjhana Shakya
Dept. of Mathematics and Statistics South Dakota State University Brookings, South Dakota, USA samjhana.shakya@jacks.sdstate.edu

Sulav Dahal
Dept. of Information Systems & Operations Management The University of Texas at Arlington Arlington, Texas, USA sulav.dahal@mavs.uta.edu

Rama Khadka
Dept. of Mathematics and Statistics South Dakota State University Brookings, South Dakota, USA Rama.khadka@jacks.sdstate.edu

***Abstract*—**This review synthesizes 59 studies published between 2014 and 2025 to examine four recurring AI harm dimensions: job displacement, algorithmic bias, privacy erosion, and global inequality. Using a PRISMA 2020-aligned workflow, we combined evidence from five academic databases with selected policy sources. Our main contribution is a reinforcing-cycle model that connects these harms: displacement increases economic precarity, precarity increases exposure to biased systems, biased systems normalize surveillance, surveillance consolidates institutional power, and concentrated power accelerates further displacement. Each step is supported in the literature, but the entire chain has not yet been tested end-to-end; we therefore present the model as an integrative hypothesis. Quality assessment further shows concentration of evidence in North America (26/59), limited coverage of the Global South (4/59), and persistent disagreement on net employment and regulatory effects. Overall, the findings suggest that single-issue interventions are insufficient and that governance must address interdependent harms.

Index Terms—Artificial Intelligence, Systematic Review, Job Displacement, Algorithmic Bias, Privacy, Surveillance, Digital Divide, PRISMA

A Multimodal Framework for Blink Detection: Audio-Anchored Synchronization and Comparative Analysis of EOG and Video Signals

Semanur Pak
Electrical and Electronics Engineering, Kahramanmaras Sutcu Imam University, Kahramanmaras, Türkiye semanur_pak@hotmail.com

Esma Cetinkaya*
Electrical and Electronics Engineering, Kahramanmaras Sutcu Imam University, Kahramanmaras, Türkiye esma.ctnky@icloud.com

Mahmut Nedim Ekersular
Electrical and Electronics Engineering, Kahramanmaras Sutcu Imam University, Kahramanmaras, Türkiye mahmutnedimekersular@ksu.edu.tr

Ahmet Alkan
Electrical and Electronics Engineering, Kahramanmaras Sutcu Imam University, Kahramanmaras, Türkiye aalkan@ksu.edu.tr

***Abstract*—**Accurate blink detection is important for cognitive, neurological, and brain–computer interface studies, yet the comparative reliability of electrophysiological and videobased approaches remains an open question. In this study, we developed a synchronized multimodal framework integrating bipolar electrooculography (EOG) and two-camera video recordings (front and side) for blink analysis. A shared acoustic beep signal was used as a temporal anchor to align EOG recordings stored in MAT format with video streams, enabling precise cross-modal delay estimation and event comparison. Beep detection was independently performed on audio-leakage components observed in the EOG channel and on the extracted video-audio waveform. Synchronization quality control demonstrated a stable temporal offset between modalities. Blink-related activity was quantified using an EOG-derived blinkness representation and region-of-interest (ROI) intensity signals from video frames. Detection coverage was comparable across modalities, while EOG exhibited lower latency variance, suggesting relatively greater temporal stability. For blink classification, epoch-based features were extracted and evaluated using logistic regression with a 70/30 holdout split. EOG-based features achieved the highest overall classification accuracy and a more balanced precision–recall trade-off. Videobased models showed high recall but low precision, reflecting increased false-positive detections. Feature-level fusion did not yield additional performance gains, likely due to limited dataset size. The proposed pipeline provides a reproducible, transparent, and multimodal framework for blink analysis, from synchronization and delay estimation to feature extraction and classification. The study presents a methodological pilot validation. Results highlight the temporal reliability of EOG while demonstrating the feasibility of video-based alternatives for non-contact blink detection.

Keywords—electrooculography (EOG), blink detection, multimodal synchronization, audio-based alignment, video ROI analysis, delay estimation, logistic regression, confusion matrix, analysis, processing, brain–computer interface, physiological signal

Dynamic analysis of a robot that refuses to tip over

Carmen-Silvia
OPRINA Doctoral School "Defense and Security Systems Engineering" Military Technical Academy "Ferdinand I", Bucharest, Romania
carmenoprina@yahoo.com
Ciprian RĂCUCIU
Doctoral School "Defense and Security Systems Engineering" Military Technical Academy "Ferdinand I", Bucharest, Romania
ciprian.racuciu@gmail.com
Lucian-Ștefăniță GRIGORE
CERAS – Center of Excellence in Robotics and Autonomous Systems Military Technical Academy "Ferdinand I", Bucharest, Romania
lucian.grigore@mta.ro

Radu MOINESCU
Doctoral School "Defense and Security Systems Engineering" Military Technical Academy "Ferdinand I", Bucharest, Romania
radu.moinescu@gmail.com

Marius-Nicolae NEBANCEA
Doctoral School "Defense and Security Systems Engineering", Military Technical Academy "Ferdinand I", Bucharest, Romania
marius.nebancea@gmail.com

***Abstract* —** This study introduces a validated analyticaldynamic model for a 6×6 mobile platform designed for hazardous environments. Findings demonstrate that center-ofmass positioning dictates a trade-off between obstacle negotiation and dynamic stability. Increased tire contact area is shown to optimize maneuverability and energy efficiency on deformable soils by reducing ground pressure and subsidence. Experimental results confirm the platform's efficacy on lowbearing terrains. While identifying needs for optimized mass distribution and adaptive torque control, the study validates the model's reliability for autonomous, safety-critical applications.

Keywords — Wheeled robot, vehicle dynamics, terrain mechanics, motion control, autonomous system

Extending and Operationalizing Biomedical Principlism for Medical AI Governance

Kassem Saleh
Department of Information Science, College of Life Sciences, Kuwait University, Sabah Al Salem University City, P.O. Box 5969, Safat 13060,
Shadadiya.kassem.saleh@ku.edu.kw

***Abstract*—** Artificial intelligence (AI) systems are increasingly integrated into healthcare environments, including diagnostic imaging, predictive clinical modeling, AI assisted triage, and clinical decision support. While these systems offer potential improvements in efficiency and diagnostic performance, they introduce ethical and governance challenges that extend beyond traditional clinical decision making. Risks such as algorithmic bias, automation bias, opaque decision making, safety failures, and accountability gaps require structured ethical oversight, particularly as medical AI systems are classified as high risk under emerging regulatory frameworks.

Biomedical principlism, grounded in the principles of respect for autonomy, beneficence, non maleficence, and justice, has long provided a foundational ethical framework for clinical practice. However, classical principlism does not directly address the socio technical characteristics, risks and challenges of AI systems, including data governance, model opacity, continuous learning, and distributed responsibility. At the same time, AI governance frameworks such as ISO/IEC 42001 and regulatory initiatives such as the European Union AI Act define lifecycle management and compliance requirements but do not offer a clinically grounded ethical interpretation model.

This paper bridges these perspectives by proposing an extension of biomedical principlism for medical AI systems, referred to as Principlism+, and by introducing a structured Medical AI Impact Assessment (MAIA) framework. Principlism+ preserves the four classical biomedical principles while incorporating AI specific governance dimensions including transparency, explainability, privacy, accountability, and safety and oversight. Together, these dimensions provide an integrated ethical foundation for evaluating AI powered healthcare systems.

To operationalize this ethical foundation, the MAIA framework connects three analytical layers: AI functional patterns such as recognition and predictive systems, associated ethical risk categories such as misdiagnosis risk and algorithmic bias, and principlism based evaluation criteria. MAIA is structured as a multi stage assessment process that includes system identification, AI pattern classification, ethical risk identification, principlism based checklist evaluation, and ethical maturity scoring. The scoring model enables organizations to assess ethical readiness and identify governance gaps across dimensions such as safety validation, fairness auditing, and human oversight.

An illustrative application involving an AI assisted diagnostic imaging system demonstrates how MAIA can be used in practice. The example shows how recognition based AI systems may exhibit strong safety validation controls while revealing comparatively weaker fairness evaluation mechanisms, thereby illustrating the framework's ability to highlight dimension specific ethical maturity differences. This application demonstrates traceability from AI system behavior to ethical principles and governance actions.

The proposed framework is evaluated conceptually along four dimensions: completeness of ethical coverage, alignment with AI governance standards, practical usability in healthcare organizations, and traceability from AI patterns to principlism based assessment criteria. The analysis shows that MAIA provides comprehensive coverage of core medical AI risk domains, aligns with lifecycle and risk management requirements reflected in ISO/IEC 42001, and supports compliance oriented processes relevant to high risk AI systems under the EU AI Act.

By integrating biomedical ethics, AI system risk assessment, and AI governance requirements, this work contributes an operational approach to ethical oversight of medical AI systems. Rather than treating ethics as a separate advisory activity, the MAIA framework embeds extended principlism based evaluation within AI management and governance workflows. Future work will involve empirical validation in healthcare settings, refinement of scoring criteria through expert engagement, and integration into AI management system implementations.

AI-Driven Security Operations Centers: A Research Landscape Analysis

Aysu İrem Adem
Department of Software Engineering, Atılım University, Ankara, Türkiye aysu.adem@atilim.edu.tr

Mahmut Furkan Bakal
Department of Computer Engineering, Atılım University, Ankara, Türkiye furkan.bakal@atilim.edu.tr

Arda Sezen
Department of Computer Engineering, Atılım University, Ankara, Türkiye arda.sezen@atilim.edu.tr

***Abstract*—**Security Operations Centers (SOCs) are leveraging AI, large language models and agent-based approaches as the alert volume and operational complexity grows. This research systematically maps and analyzes AI enable SOC research in terms of its application area, level of automation, models and architecture deployed, evaluation practice, security risk, and human – AI interaction design. The findings indicated that most of the applications of artificial intelligence systems are in log analysis, alert triage, threat intelligence processing, incident response and analyst decision support. The SOC workflows are evolving toward semiautonomous architectures supported by AI and integrated with SOAR, but most implementations remain human in the loop or human on the loop, while fully autonomous SOCs are mostly conceptual. Performance evaluations are primarily based on operational and technical metrics, such as MTTD, MTTR, precision, recall and false positives. The literature also identifies challenges such as explainability limitations, hallucination risks, integration complexity and excessive reliance on automation. Overall, this study offers orderly perspectives on current AIenabled SOCs. Furthermore, it also highlights the need for human-centered, explainable and trustworthy AI designs for future SOC architectures.

Keywords—Security Operations Center (SOC), Artificial Intelligence, Large Language Models (LLMs), Agent Based Systems, Security Automation, Human in the Loop

Digital Transformation of Industrial Logistics and Its Impact on Marketing Strategy Development: An Integrated Value-Driven Framework

Prof. Siyka Demirova
Department "Industrial Management" Technical University of Varna, Varna, Bulgaria, s_demirova@tu-varna.bg

Prof. Svetlana Dimitrakieva
Department "Industrial Management" Technical University of Varna, Varna, Bulgaria, s_dimitrakieva@tu-varna.bg

Nikolay Sharaliev, PhD Student
Department "Industrial Management" Technical University of Varna, Varna, Bulgaria, nikolay.a.sharaliev@tu-vara.bg

***Abstract*—**The rapid development of Industry 4.0 technologies is transforming logistics from an operational function into a strategic driver of competitive advantage. This study examines how digital logistics capabilities affect marketing strategy development, customer value creation, and competitive positioning in industrial enterprises. It proposes a conceptual framework that describes the relationship among logistics digitalization, supply chain visibility, logistics flexibility, and marketing agility. A mixedmethod approach was applied by conducting a survey of N=124 industrial enterprises and semi-structured interviews with logistics and marketing managers. Structural Equation Modeling (SEM) confirmed significant positive effects of digital logistics capabilities on marketing agility, partially mediated by logistics flexibility. The results suggest that logistics digitalization is a strategic marketing asset that helps enterprises in increasing responsiveness, personalization, and competitive positioning. Implications in terms of theory and managerial practice are considered.

Keywords— Digital logistics, Industry 4.0, Marketing agility, Supply chain visibility, Structural Equation Modeling, Industrial enterprises

Community-Aware Graph Learning for Enhanced GNN-Based Recommendation

Jhansi Lakshmi Vigrahala
Department of Computer Science and Engineering, SRM University-AP, Andhra Pradesh, jhansilakshmi vigrahala@srmap.edu.in

Abinash Pujahari
Department of Computer Science and Engineering Mahindra University, Telangana, abinashpujahari@ieee.org

Rama Ranjan Panda
Department of Computer Science and Engineering SRM University-AP, Andhra Pradesh, ramaranjan.p@srmap.edu.in

***Abstract*—**Graph Neural Networks (GNNs) have performed well in collaborative filtering by capturing complex user-item interactions. Still, most graph-based recommender systems rely solely on interaction data and overlook valuable information such as item attributes, relationships, and hidden community structures. In this study, we introduce a new community-aware recommendation approach that leverages behavioral and semantic item relationships to enhance graph-based recommendations. We start by building a combined item graph that merges global item transition patterns with content-based semantic similarities. To find meaningful item communities, we use modularity-guided Louvain community detection on this graph. We then add the discovered community structure to a community-aware LightGCN model to improve how items and users are represented. Tests on two benchmark datasets, Yelp and MovieLens-1M, show that our method consistently beats several leading baselines in Recall and NDCG. Further analysis shows that modularityguided pruning makes the graph better and directly leads to more accurate recommendations. These findings show that adding item community knowledge can make graph neural recommendation models more effective.

Index Terms—Collaborative Filtering, Graph Neural Networks, Recommender System

A Metric-Based Comparative Evaluation of Unit Test Quality Generated by AI Agents Under Different Prompting Schemes

Kemal Aktaş
Siemens Foundational Technologies, Istanbul, Turkey, kemal.aktas@siemens.com

Oğuzhan İşleyen
Siemens Foundational Technologies, Istanbul, Turkey, oguzhan.isleyen@siemens.com

***Abstract*—**In recent years, advances in artificial intelligence have led companies to adopt AI agents to address challenges in software services such as uninterrupted and sustainable operation, rapid response times, and data management. These agents are used across a wide range of tasks, including code generation, error analysis, automation, and integration. However, their success largely depends on how they are guided. In other words, an AI agent produces outputs in line with the quality and specificity of the prompt it receives: well-designed prompts tend to yield more consistent and reliable results, whereas poorly designed prompts may lead to erroneous or inconsistent outputs. Since this effect is especially visible in software engineering artifacts that must be executable and correct, unit test generation provides a concrete and quantifiable setting to examine prompt impact. This study systematically evaluates the quality of unit tests generated by six state-of-the-art AI agents under five different prompting schemes. We assess test quality using three complementary metrics: code coverage, mutation testing and code maintainability. Our results indicate that structured prompting generally improves unit test quality, but the magnitude and consistency of these gains vary significantly by agent and metric, with occasional regressions under certain prompt settings. These findings provide actionable guidance for practitioners selecting AI agents and crafting prompts for automated unit test generation.

Index Terms—unit test quality, test effectiveness, test adequacy, test coverage

Severity-Aware Dysgraphia Classification via Fusion of Online and Offline Handwriting Features

Khadija Khedr, Moutaz Saleh, Jayakanth Kunhoth, Sumaya Al-Maadeed
Computer Science and Engineering Department Qatar University, Doha, Qatar
khadija.khedr@qu.edu.qa, moutaz.saleh@qu.edu.qa, j.kunhoth@qu.edu.qa, s alali@qu.edu.qa

***Abstract*—**This study proposes a multimodal framework for multiclass dysgraphia severity grading by integrating online and offline handwriting modalities using an early-fusion strategy. Unlike most existing work that addresses only binary classification (dysgraphic vs. typically developing), the proposed approach categorizes severity into three levels: Typically Developing, Grade 1, and Grade 2. A dataset of 113 children performing eight handwriting tasks was used, from which 133 online kinematic and spatiotemporal features and 1,024 offline visual deep embeddings were extracted per task. The modalities were combined through feature-level concatenation per task to capture complementary cross-modal information, such as the relationship between abnormal writing dynamics and irregular stroke geometry.

Performance was evaluated using Support Vector Machines (SVM) and Extreme Gradient Boosting (XGBoost) within a nested stratified group 10-fold cross-validation protocol to ensure reliable generalization. The best results were achieved by the SVM classifier on the sentence-writing task, obtaining a Macro Recall of 58.73% and an F1-score of 0.57, outperforming previously reported online-only approaches. To the best of our knowledge, this is the first study to investigate early multimodal fusion for fine-grained dysgraphia severity grading.

Index Terms—Learning disabilities, dysgraphia, handwriting analysis, severity grading, multimodal fusion, machine learning

HERMES: A Lower Limb Exoskeleton for Walking Assistance

Despoina Markoglou
School of Engineering and Materials Science Queen Mary University of London, London, United Kingdom, d.markoglou@se25.qmul.ac.uk

Konstantinos Ampountolas
Automatic Control & Autonomous Systems Lab Department of Mechanical Engineering, University of Thessaly, Volos, Greece, k.ampountolas@uth.gr

***Abstract*—**Paraplegia is a common outcome of spinal cord injury (SCI), with serious impacts on human health and wellbeing. Powered exoskeletons can be used for rehabilitation or assistance of human movement, while increasing independence and enhance quality of life for people with mobility impairments. Typical exoskeleton models rely on crutches to provide stability and balance during walking. However, such aids compromise upper limb freedom. Devices that do not require crutches are heavier, slower and do not offer significant advantage in terms of mobility compared to a wheelchair. This paper introduces HERMES, an exoskeleton which designed according to the specifications of the Cybathlon competition, which is an international championship for "pilots" with disabilities who compete using advanced assistive technologies. HERMES was designed by taking into consideration parameters such as structural reliability, reduced weight, simplicity of design and ease of use. To ensure gait pattern training and walking balance with no need for crutches of the HERMES exoskeleton, we employ a Deep Reinforcement Learning (DRL) approach by adopting the Deep Deterministic Policy Gradient (DDPG) and the Twin Delayed Deep Deterministic Policy Gradient (TD3). The evaluation of the two DRL approaches through gait analysis for physiological movement has revealed that TD3 outperforms DDPG and it can be safely implemented in the HERMES exoskeleton.

Index Terms—Lower Limb Exoskeletons; Exoskeleton Control; Gait Analysis; Deep Reinforcement Learning

Comparative Evaluation of Large Language Models on Agile Story Point Estimation

Özgen ERBAKAN
Grid Simulation, SIEMENS Foundational Technologies, Ankara, Turkey ozgen.erbakan@siemens.com

***Abstract*—**Agile effort estimation is a necessary but chaotic part of the modern software development lifecycle. The popular human estimation method Planning Poker is disrupted by cognitive biases such as anchoring and over-optimism. This results in a large documentation debt and frequently missing the mark on deliveries. This paper presents the first comparative study of state-of-the-art Large Language Models (LLMs) Claude Opus 4.6, Gemini 2.5 Pro, GPT-5.2, and GPT-5.3 Codex in the area of automatic Agile-relevant story point estimation. The introduction of a new "Uncertainty-Based Step-Up Heuristic" method is designed to reverse the perennial underestimating of technical difficulty in natural language specifications. To validate the method, I utilized a real business dataset consisting of data from several agile sprints, processed through a customized Model Context Protocol (MCP) server template. The result reveals that although general-purpose reasoning LLMs like Claude Opus 4.6 can achieve a 60.7% exact match accuracy after calibration, domain-specific high code models like Codex indicate an "OverCorrection Paradox" as technical uncertainty scales. The study also uncovers a "Small Task Blindspot" and presents a simple to understand counterexample of why majority-vote ensemble techniques should mostly not be used in the complex verification logic. This research is the foundation of the closed-loop AI led agile orchestration that raises the bar above the real-time demands of autonomous verification and artifact synchronization.

Index Terms—Agile Estimation, Large Language Models, Story Points, Uncertainty Calibration, Model Context Protocol, Cognitive Bias, Software Effort Estimation.

End-to-End Framework for Real-Time Drone Detection and Alerting Using Lightweight Deep Learning

Orwa Aladaileh
Department of Computing and Informatics AlHussein Technical University, Amman, Jordan

Izz AlDrrass
Department of Computer Science Tafila Technical University, Tafila, Jordan

Reem Shtaiwi
Department of Computing and Informatics AlHussein Technical University, Amman, Jordan

Mona Obaisat
Department of Computer Science Mutah University, Karak, Jordan

Mallak Albarari
Department of Computing and Informatics AlHussein Technical University, Amman

***Abstract*—**Real-time drone detection is a significant issue in airspace security and privacy because of the increasing use of UAVs, this issue affects airport security directly as it results in various inclusions such as airport incursions and unauthorized surveillance. We proposed end-to-end framework for real time drone detection and alerting integrating multiple YOLO architectures, our system trained on a large scale composite dataset of over 77,000 labeled images for drones, expanded to approximately 90,000 through targeted data augmentation. The Yolo models first trained and evaluated independently, then combined using ensemble learning strategies to reduce false detections while preserving real-time performance. The final ensemble of (YOLOv8, YOLOv11, and YOLOv12) achieves 96.1% accuracy and 93.9% mAP@0.5.

Index Terms—Drone Detection, YOLO, Ensemble Learning, Real-Time Alert Systems, Unmanned Aerial Vehicles (UAVs), Lightweight DL Architecture

Deep Reinforcement Learning-Based Autonomous Control Architecture for Renewable Energy-Integrated Smart Grids

Koksal Erenturk
Department of Computer Engineeing Atatürk University, College of Eng., Erzurum, Türkiye, erenturk@yahoo.com

***Abstract*—** The rapid proliferation of renewable energy sources such as solar and wind power has introduced significant variability and operational uncertainty into modern power systems. Conventional grid control strategies, largely based on predefined rules or deterministic optimization, struggle to maintain stability and efficiency under highly dynamic renewable generation conditions. In this study, a novel deep reinforcement learning-based autonomous control architecture is proposed for renewable energy-integrated smart grids. The framework enables real-time, self-adaptive decision-making for energy dispatch, storage coordination, and grid interaction without relying on fixed control policies. The proposed architecture integrates a deep reinforcement learning agent with a grid-aware state representation that incorporates load demand, renewable generation, battery state-of-charge, and frequency deviation indicators. A multi-objective reward formulation is designed to simultaneously minimize operational cost, mitigate frequency instability, and preserve battery health. Unlike traditional approaches that treat forecasting and control separately, the presented method establishes an end-to-end adaptive control mechanism capable of learning optimal strategies directly from stochastic system behavior. The performance of the proposed system is evaluated within a simulated renewable-integrated microgrid environment under varying solar irradiance and load fluctuation scenarios. Comparative analyses against rule-based and model predictive control strategies demonstrate improved operational efficiency, enhanced grid stability, and reduced renewable curtailment. The results indicate that deep reinforcement learning can provide a scalable and robust foundation for next-generation autonomous smart grid control systems.

Keywords— Deep Reinforcement Learning, Smart Grids, Renewable Energy Integration, Autonomous Energy Management, Adaptive Control Systems

Hybrid-Rule and LLM-Based Feature Test Coverage Detection in Industrial SAFe Environments

Merve Nergiz Afatsun
Grid Simulation, SIEMENS Foundational Technologies, Ankara, Turkey, nergiz.afatsun@siemens.com

Aysu Gokkaya Karabulut
Grid Simulation, SIEMENS Foundational Technologies, Ankara, Turkey, aysu.gokkaya@siemens.com

Canberk Unluer
Grid Simulation, SIEMENS Foundational Technologies, Ankara, Turkey, canberk.unluer@siemens.com

***Abstract*—**Feature validation in vast SAFe ecosystems is usually assumed to be based on the traceability links among features, stories, and test artifacts. Despite the presence of trace links, acceptance criteria may not be behaviorally validated. The coverage of the feature test across different enterprise lifecycle tools is still time-consuming, subjective, and difficult to automate, making it mostly manual.

The integration of deterministic traceability analysis with large language model (LLM)-assisted semantic reasoning and rulebased assertion-quality evaluation is laid out in this paper. The MCP-based integration has been set up to ensure the complete structured retrieval of the relevant artifacts from Jira, Xray, and Confluence. The acceptance criteria are split into smaller units and then tested against the linked test steps and the expected results in order to assess the coverage at the level of FeatureStory.
The method has been tested in an actual SAFe program increment which had 27 features and 79 stories (83 analysis units). The results revealed that 59% of the units were without test linkage, 22% of the units were partially validated and 19% of the units were semantically aligned strongly. The data unveils that the manifestation of traceability is not enough to be considered a coverage meter and the application of the hybrid semantic analysis opens the way towards logical governance.

The proposed method offers a scalable and reusable mechanism for systematic feature-level coverage assessment in enterprise agile environments.

Index Terms—Feature-level test coverage, Requirements traceability, Large language models, SAFe, Semantic analysis, AIassisted software engineering

Benchmarking Reinforcement Learning for Goal-Conditioned Robotic Pushing: Tiered-Difficulty Protocols

Filip Matas
Faculty of Mechanical Engineering, Technical University of Kosice, Kosice, Slovakia, filip.matas@student.tuke.sk

Darius Rusinak
Faculty of Mechanical Engineering, Technical University of Kosice, Kosice, Slovakia darius.rusinak@tuke.sk

Ivan Virgala
Faculty of Mechanical Engineering, Technical University of Kosice, Kosice, Slovakia ivan.virgala@tuke.sk

***Abstract*—**Goal-conditioned robotic pushing is a contact-rich control problem where small changes in task definition can strongly affect reported performance. This paper presents a reproducible benchmark for planar pushing with a Franka Panda in PyBullet and a standardized evaluation protocol for goalconditioned policies trained with off-policy reinforcement learning. We introduce a Gymnasium-compatible environment with explicit success definitions based on an (ε, H) criterion (tolerance and hold/stability), and we propose tiered difficulty settings that vary goal sampling range, success tolerance, and stability requirements to enable protocol-aware comparisons. Using SAC with Hindsight Experience Replay (HER) as a strong baseline, we log training-time learning signals during optimization, but emphasize fixed-protocol evaluation metrics for comparisons. The results show high success under an Easy protocol and solid performance under stricter Medium and Hard protocols, while stable success remains more demanding than transient goal reaching. These findings highlight that goal-conditioned pushing performance is sensitive to protocol design, motivating explicit reporting of success criteria and tiered benchmark settings for fair, reproducible evaluation.

Index Terms—reinforcement learning, robotic manipulation, goal-conditioned control, Hindsight Experience Replay (HER), Soft Actor-Critic (SAC), benchmarking

A Multimodal Emotion-Aware Product Recommendation System Integrating Real-Time Facial Expression Recognition and Sentiment Analysis

M. Shanuga
Department of Computing and Information Systems, Faculty of Computing, Sabaragamuwa University of Sri Lanka, BelihulOya, Sri Lanka, mshanuga2000@gmail.com

J. D. T. Erandi
Department of Data Science Faculty of Computing, Sabaragamuwa University of Sri Lanka, BelihulOya, Sri Lanka, tenushi@foc.ac.lk

A. S. S. Amath
Department of Computing and Information Systems, Faculty of Computing, Sabaragamuwa University of Sri Lanka, BelihulOya, Sri Lanka alan@foc.ac.lk

***Abstract*—**Traditional recommendation systems primarily rely on historical interactions and textual reviews, often ignoring users' real-time emotional states. This limitation can result in recommendations that are not in line with the' immediate context of the users. This paper presents a multimodal emotion-aware product recommendation system that integrates real-time Facial Expression Recognition (FER) and transformer-based sentiment analysis to enhance personalization. Facial emotions are detected across seven emotion categories —happy, sad, angry, fear, disgust, surprise, and neutral—using a fine-tuned EfficientNetB0 model trained on benchmark datasets (JAFFE, CK+, and FER2013) and self-collected webcam images, achieving an overall accuracy of 88%under real-time conditions. Textual sentiment is analyzed using a fine-tuned DistilBERT model, which classifies inputs into positive, neutral, and negative sentiments with an accuracy exceeding 90%. A rule-based multimodal fusion strategy combines visual and textual emotional cues, resolving conflicting signals and improving emotional inference accuracy by approximately 10– 12% compared to unimodal approaches. The inferred emotional state is mapped to a structured recommendation database, generating personalized product suggestions. Experimental results demonstrate that the proposed multimodal approach produces more contextually relevant recommendations than single-modality systems, highlighting its applicability in realworld emotion-aware recommendation scenarios.

Keywords—Affective Computing, Emotion-Aware Recognition, Recommendation Systems, Facial Emotion, Multimodal Fusion, Sentiment Analysis

Development of a Geometric Model of Symmetric Binary Fractal Trees and Application in Furniture Design

Anarova Shahzoda Amanbayevna
Department of Digital Technologies Convergence, Tashkent University of Information Technologies, Tashkent, Uzbekistan, anorova@tuit.uz

Ismoilova Maftuna Ilxom kizi
Department of Digital Technologies Convergence, Tashkent University of Information Technologies, Tashkent, Uzbekistan, ismoilovamaftuna140@gmail.com

Ismailova Saodat Nazarboy kizi
Department of Television and Media Technologies, Tashkent University of Information Technologies, Tashkent, Uzbekistan, ismailovasaodat3006@gmail.com

Malikova Nodira Turgunovna
Department of Digital Technologies Convergence, Tashkent University of Information Technologies, Tashkent, Uzbekistan, malikova.nodira2024@mail.com

Saidkulov Elyor Abdullayevich
Department of Information Technologies, Samarkand Branch of Tashkent University of Information Technologies, Samarkand, Uzbekistan elyorsamtiut9977@gmail.com

***Abstract*—** This study is dedicated to the development of a symmetric binary fractal tree model based on fractal geometry and the analysis of its potential applications in furniture design. The primary objective of the research is to formulate a parametrically controlled fractal tree structure using an Iterated Function System (IFS) and to determine its aesthetic, structural, and functional properties. The model was constructed based on a scaling coefficient (λ) and a branching angle ( ) θ . Interconnected symmetric binary tree configurations, based on the golden ratio (ϕ)condition, were analyzed, and new models with angles of θ = 45° and θ = 90° were proposed. The fractal dimension value (D ≈1.44) was determined, and the model's degree of geometric complexity was assessed. The results demonstrated that fractal structures provide recursive stability, proportional harmony, and structural adaptability. The proposed approach allows for the application of fractal geometry not merely as a decorative element, but as a generative structural mechanism. The research substantiates the theoretical and practical significance of fractal modeling in parametric design, digital fabrication, and the creation of innovative furniture structures.

Keywords— fractal, fractal tree, geometric modeling, furniture, interior, iterative function system, model, golden ratio

ECSNet: Efficient Cross-Attentive Swin Network for Magnification-Independent Multiclass Breast Cancer Histopathology Classification

Zahra Golrizkhatami
Dept. of Computer Engineering, Antalya Bilim University, Antalya, Türkiye z.golrizkhatami@antalya.edu.tr

Shahram Taheri
Dept. of Computer Engineering, Antalya Bilim University, Antalya, Türkiye shahram.taheri@antalya.edu.tr

***Abstract*—**Automated classification of breast cancer histopathology images remains challenging due to magnification variability, class imbalance, and domain shifts across acquisition settings. We propose ECSNet, a lightweight hybrid CNN–Transformer architecture integrating EfficientNet-based local feature extraction, cross-attention fusion, and hierarchical Swin Transformer modeling. The model is designed for magnification-independent eight-class classification on BreakHis and evaluated using strict train/validation/test separation. External validation is conducted on the Camelyon16 dataset to assess cross-domain generalization. ECSNet achieves 93.7% accuracy and 0.948 macro-F1 on BreakHis while maintaining strong cross-dataset robustness. Compared with representative CNN and Transformer baselines, ECSNet delivers improved performance with substantially fewer parameters and lower computational cost. Grad-CAM++ visualizations demonstrate alignment with diagnostically relevant tissue regions. These findings suggest ECSNet as an efficient and interpretable framework for digital pathology applications.

Keywords— Breast Cancer, Histopathology Classification, Hybrid CNN–Transformer, Cross-Attention, Swin Transformer, Digital Pathology

Energy-Aware Model Training for Green AI: An Empirical Analysis of Architectural Topologies and CPU-GPU Trade-offs

Zainab Al-zanbouri
Electrical Engineering & Computing Sciences RIT Dubai, Dubai, United Arab Emirates, zxacad@rit.edu

Ayman Ibrahim
Smart Cities & Data Analytics RIT Dubai, Dubai, United Arab Emirates ayman.ibrahim@rit.edu

***Abstract*—** The design of energy-conscious machine learning models has become essential for advancing Green AI objectives, particularly as contemporary systems emphasize prediction accuracy at the expense of computational energy requirements during training. This study examines the relationship between neural network architectural characteristics-including parameter count, network depth, and layer configuration topology-and their corresponding energy demands throughout the training process. We conduct a comparative analysis of energy consumption patterns across CPU and GPU hardware platforms under controlled experimental conditions. Empirical evidence from the BUTTER-E dataset reveals that layer topology exerts measurable influence on energy efficiency; specifically, tapered (trapezoidal) architectures demonstrate elevated energy requirements compared to uniform (rectangular) configurations, independent of total parameter count. Furthermore, our analysis quantifies the temporal efficiency advantage of GPU-based training, demonstrating that accelerated execution times yield approximately 59% reduction in aggregate energy consumption despite elevated instantaneous power draw. These hardware-cognizant findings inform architectural selection strategies that balance predictive performance with energy sustainability in machine learning development.

Keywords— Green AI, Energy-Aware AI, Neural Network Architecture, Model Training, CPU-GPU Comparison, Sustain-able Computing, Race-to-Idle

AIoT Driven User-Centered Privacy Protection From Smart Home Assistant Devices

MD Nashid Anjum
*Department of Computer Science, Algoma University, Brampton, Ontario, Canada,*nashid.anjum@algomau.ca

Nagarani Gopalakrishnan
Department of Computer Science, Algoma University, Brampton, Ontario, Canada, ngopalakrishnan@algomau.ca

Abstract – Smart Home Assistant Devices (SHADs) always listen for wake words such as "Alexa", "Okay Google," or "Hey Siri." As a result, these devices continuously listen even when they are not being used, which can compromise users' privacy. Existing solutions largely focus on modifying network protocols or enforcing policy changes, but implementation of these approaches depends on authorities and therefore remains inaccessible to users. Other solutions rely on mechanical switches or tactile interfaces, which reduce usability since the main advantage of SHADs lies in their natural audio-based interface. This paper presents an AIoT (Artificial Intelligence and Internet of Things) driven user-centered approach to this privacy issue, named LampGuard, which outperforms existing solutions through two user-centered benefits: (i) its implementation does not depend on authorities, giving full control to the user, and (ii) it uses an audio user interface that aligns with the default interaction model of SHADs. LampGuard incorporates an ultrasonic interference system in the form of a desk lamp that provides localized privacy protection in shared living spaces by confining ultrasonic interference specifically to the home assistant device's microphone area rather than the entire room. Thus, LampGuard blocks only the SHAD's microphone and does not interfere with other microphones in the living space, such as cellphone microphones or TV remote microphones. LampGuard uses a separate microphone placed apart from the SHAD to detect wake words like "Hey Google." Once detected, it briefly disables its interference so the SHAD can wake and operate normally. LampGuard was evaluated using 30 spoken commands at close range (≤20 cm) and extended range (25–50 cm). At close range, the Word Error Rate (WER) increased from 7.64% to 96.56% ($p < 0.001$), demonstrating effective blocking of the SHAD's microphone. At longer distances, the WER decreased significantly, confirming that LampGuard does not interfere with other microphones in the room.

Keywords – Ultrasonic Jamming; Physical-Layer Security; Smart Home Privacy; MEMS Microphones; Distance-Dependent Protection; Voice Assistant Security; Nonlinear Signal Distortion, AIoT

Research on GPU-accelerated L2 Regularization Optimization Techniques in Deep Learning and a Comprehensive Analysis of their Impact on Model Generalization Error

Tong Zhao
Center for Data Science, New York University, New York, United States, 17801068210@163.com

Abstract-With the increasing popularity of GPU acceleration, it has become more feasible to apply regularization techniques to deep learning models. Thus, the purpose of this study is to assess GPU-based L2 regularization optimization methods within deep learning and demonstrate insights into their implications for decision generalization errors to optimize overfitting and on overall efficiency in various neural network structures and datasets. In this work, we examine deep learning L2 regularization optimization with GPU and the impact of its occurrence on the generalization error of the model. CNNs along with LSTMs and MLPs deep learning models were trained on the datasets such as CIFAR- 10, ImageNet, MNIST, IMDB with different L2 regularization of model parameters to measure its affect on overfitting and generalization. \. In our experiment on ImageNet, the same regularization helped to boost the validation accuracy to 73.5%. Of all the optimizers investigated, Adam optimizer was the best with the highest validation accuracy of 90.3% and lowest cross-entropy loss on CIFAR-10 data set. RTX 3080 for GPU acceleration resulted to a mere fraction gain of training time more than that of Tesla V100 but at close to or at par in validation accuracy with Adam and RMSProp. This work proves that by employing the optimization methods of L2 regularization by using the GPU, the generalization performance of the Deep Learning models increases

Keywords-GPU-accelerated, L2 regularization, deep learning, model generalization error, Deep Learning, GPU-accelerated L2 Regularization

On-Device AI for Mold Detection: Supporting Food Safety for the Visually Impaired People

Josef Chaloupka
Institute of Information Technology and Electronics, Technical University of Liberec, Liberec, Czech Republic, josef.chaloupka@tul.cz

Karel Palecek
Institute of Information Technology and Electronics, Technical University of Liberec, Liberec, Czech Republic, karel.palecek@tul.cz

***Abstract*—**This article presents the design and implementation of a mold detection module integrated into the bMyVision mobile application for visually impaired iPhone users. The system extends assistive technologies by focusing on everyday food safety. Unlike many cloud-based solutions, it operates entirely ondevice, ensuring privacy, independence, and offline functionality. A dedicated dataset of 1,300 food images was created, covering fruits, vegetables, cheeses, meat, and bakery products. Two approaches were evaluated: a classifier trained with Create ML and an object detection model based on YOLOv11. The Create ML pipeline, combining Apple's Vision Feature Print embedding with a generalized linear model classifier, achieved solid precision but lower recall due to more false negatives. In contrast, YOLOv11 demonstrated higher recall, F1-score, and overall accuracy, while also enabling mold localization. Although localization is not essential for people with visual impairment, its superior performance led to the deployment of YOLOv11 in the application. The results confirm that fully on-device AI can reliably support food safety assessment for visually impaired individuals.

Index Terms—assistive technology, visual impairment, mold detection, on-device artificial intelligence, computer vision.

Intelligent Industrial Power Demand Forecasting Using Bidirectional LSTM Networks

Reza Hassanian
School of Engineering and Natural Sciences (SENS), University of Iceland, Reykjavik, Iceland
seh@hi.is

Ingolfur Hjorleifsson
School of Engineering and Natural Sciences (SENS), University of Iceland, Reykjavik, Iceland
Juelich Supercomputing Centre, Germany
ingolfuh@hi.is

Morris Riedel
School of Engineering and Natural Sciences (SENS), University of Iceland, Reykjavik, Iceland
Juelich Supercomputing Centre, Germany
morris@hi.is

***Abstract*—**The electricity consumption of large industrial plants exerts a substantial influence on national power generation as well as on both residential and non-residential electricity supply networks, particularly when such facilities lack independent power generation and rely entirely on the national grid. These industrial plants comprise numerous machines whose energy use is affected by operating conditions and by various environmental and technical factors. Forecasting power demand is therefore a valuable approach for maintaining grid reliability and supporting efficient energy management. Estimating industrial electricity demand from historical consumption data offers two key advantages: (1) it enables utilities to anticipate short- and long-term demand requirements, and (2) it allows industrial consumers to enhance financial planning and operational efficiency based on anticipated energy needs. In this study, a Bidirectional Long Short-Term Memory (BiLSTM) network—an advanced sequential deep learning (DL) architecture based on Recurrent Neural Networks (RNNs)—was trained on historical power demand data from the business sector (Erhverv) located in the Syddanmark region in Denmark to forecast future, unseen demand periods. The model's forecasting performance was evaluated using several standard statistical metrics: the Symmetric Mean Absolute Error Percentage (sMAEP), Mean Absolute Error (MAE), and the Coefficient of Determination (R2). The results demonstrate that the BiLSTM model produced accurate forecasts using only one year of data, achieving an sMAEP of 3%, an MAE almost 0.026, and R2 values ranging from 0.91 to 0.93. These findings confirm the strong predictive capability of the BiLSTM model and suggest that its performance could be further enhanced through hyperparameter optimization, extended training, and the inclusion of multi-year historical datasets.

Index Terms—Deep Learning, Sustainable Energy, High-performance computing, Energy Demand

Intelligent Context-Aware Visual Assistance with Real-Time Object Detection Using Deep Learning

Hinostroza M. Farid Rolando
Software Engineering, Universidad Peruana de Ciencias Aplicadas, Lima, Peru, u202014468@upc.edu.pe

Ventura R. Raul Jersson
Software Engineering, Universidad Peruana de Ciencias Aplicadas, Lima, Peru, u201714049@upc.edu.pe

Deisy L. Acosta Ticse
Software Engineering, Universidad Peruana de Ciencias Aplicadas, Lima, Peru, pcgddaco@upc.edu.pe

***Abstract*—**The integration of deep learning technologies into assistive systems has opened new pathways to enhance accessibility for visually impaired individuals. This paper presents a mobile application leveraging MobileNetV2 and TensorFlow Lite to perform real-time object detection and environment description, designed specifically for visually impaired users in Lima, Peru. The system provides audio feedback to describe detected objects and their spatial locations, enabling greater independence and safety in daily activities. The methodology employs customized datasets for urban and domestic scenarios, achieving 85.3% precision, 82.7% recall, and real-time processing at 30 FPS. A dedicated Peruvian banknote recognition module further extends system capabilities toward financial autonomy. User validation conducted at CERCIL using the Technology Acceptance Model (TAM) yielded mean scores above 4.6 out of 5.0, confirming strong acceptance and practical usability.

Keywords—Assistive Technology, Human-Centered AI, RealTime Object Detection, MobileNetV2, Edge Computing, Accessibility, Currency Recognition

A Unified Prognostic Data Architecture for Risk Stratification in Pediatric Acute Lymphoblastic Leukemia

Utku Kose
Department of Computer Engineering, Artificial Intelligence Application and Research Center, Suleyman Demirel University, Isparta, Turkey, utkukose@sdu.edu.tr

Osman Ceylan
Department of Database, Network Design and Management, Isparta Applied Sciences University, Isparta, Turkey osmanceylan@isparta.edu.tr

Emine Betul Surucu
Department of Computer Engineering Suleyman Demirel University Isparta, Turkey betulsen@sdu.edu.tr

***Abstract*—**Risk stratification for childhood acute lymphoblastic leukemia (childhood-ALL) forms the basis of modern risk-based treatment regimens. Large international consortia, such as the Children's Oncology Group (COG), the Berlin–Frankfurt–Münster (BFM) group, and the National Cancer Institute (NCI) working groups, have defined current standards for risk-appropriate treatment. These groups determine treatment intensity using various variables such as age, baseline white blood cell count (WBC), genetic characteristics, and minimal residual disease (MRD) levels. However, there are differences in threshold values and categorical definitions among the criteria established by these groups. This heterogeneity creates difficulties in data processing, multicenter analyses, and data-driven modeling studies. This study proposes a unified prognostic data architecture integrating parameters at the time of diagnosis and early treatment response indicators. The NCI, COG, and BFM risk systems are matched under a common data representation and harmonized with different risk categories. In addition, the approximate 5-year event-independent survival (EFS) and overall survival (OS) ranges reported in the literature have also been correlated with risk levels. The proposed structure provides a scalable basis for data standardization and decision support systems while maintaining clinical validity.

Keywords—childhood leukemia, acute lymphoblastic leukemia (ALL), risk classification, prognostic modeling, data architecture, children's oncology group (COG), berlin–□rankfurt– münster (BFM), national cancer institute (NCI)

From Waste Tracking to Circular Intelligence: A Digital Platform for Healthcare Waste Management

Faisal Issa
Rochester Institute of Technology – Dubai, Dubai - UAE fmi8750@rit.edu

Abdulla Adawi
Rochester Institute of Technology – Dubai, Dubai - UAE ara3255@rit.edu

Anas Nazzal
Rochester Institute of Technology – Dubai, Dubai - UAE amn2923@rit.edu

Ahmed Hyari
Rochester Institute of Technology – Dubai, Dubai - UAE aaa9664@rit.edu

Muhammed Humais
Rochester Institute of Technology – Dubai, Dubai - UAE mj3207@rit.edu

Husain Rupawalla
Rochester Institute of Technology – Dubai, Dubai - UAE hsr2198@rit.edu

Dr. Dua Weraikat
Rochester Institute of Technology – Dubai, Dubai - UAE dxwcad@rit.edu

Abstract—This paper presents the Smart Circular Economy Platform for Healthcare Waste Management, a modular digital decision-support system developed to enhance traceability, regulatory compliance, and circular economy performance within hospital waste operations. The platform integrates structured Key Performance Indicators, compliance logic, and interactive dashboards within a web-based architecture. Due to limitations in accessing hospital data, a synthetic dataset was generated using Monte Carlo simulation calibrated to industry aggregates, enabling full validation of data pipelines and analytical modules. The system was implemented using a layered Flask-based architecture with Pandas data processing and Chart.js visualization. Structured validation confirmed analytical accuracy, traceability reconstruction, and compliance routing enforcement. The validated prototype demonstrates readiness for integration with real hospital datasets.

Keywords—Healthcare waste management, circular economy, KPI dashboard, traceability, compliance, synthetic data, Optimization

Modeling the Influence of Socio-Economic Development Factors on the Higher Education System

Olena Rayevnyeva
DSc in Economics, professor of statistics and economic forecasting dept. Simon Kuznets Kharkiv National University of Economics, Ukraine, olena.raev@gmail.com

Kostyantyn Stryzhychenko
DSc in Economics, professor of statistics and economic forecasting dept. Simon Kuznets Kharkiv National University of Economics, Ukraine, ukf.kendo@gmail.com

Olha Brovko
PhD in Economics, associated professor of statistics and economic forecasting dept. Simon Kuznets Kharkiv National University of Economics, Ukraine, ol.iv.brovko@gmail.com

Abstract - The paper is devoted to the assessment of the state and prospects for the development of Ukraine's higher education system, based on an intellectual analysis of the influence of the dominant factors in the country's social and economic development. The functioning of the HES is considered a process of dual interaction between the factors of the country's social and economic development and the system's structural characteristics. Hypotheses regarding the dependence of the attractiveness and effectiveness of HES on the level of social protection of the population, economic development, state financial support, and safety conditions have been formed and proven. A generalized portrait of Ukraine's social and economic development has been constructed, and structural changes in the functioning of the HES have been identified. The empirical basis of the research comprises models of intellectual data analysis, which enable the identification of structural and logical relationships between key indicators, as well as Granger causality testing, impulse analysis, and variance decomposition. As a result, the short-, medium-, and long-term effects of the dominant factors on the dynamics of HES development were determined, and the key transmission channels of the socio-economic environment's influence on its transformation were substantiated.

Keywords-- HES, impact, interaction, econometric model, ADF-test, VAR-model, variation analysis

Sample-Efficient Multi-Objective Optimization of Induction Motors using Bayesian Optimization

Nico Schmauch
Department of Mechatronics with a focus on vehicles, University of Kassel, Kassel, Germany nico.schmauch@uni-kassel.de

Nikita Vernergold
Former M.Sc. Student at the Department of Mechatronics with a focus on vehicles, University of Kassel, Kassel, Germany
nikita.vernergold@gmail.com

Michael Fister
Department of Mechatronics with a focus on vehicles, University of Kassel, Kassel, Germany, michael.fister@uni-kassel.de

Christian Spieker
Department of Mechatronics with a focus on vehicles, University of Kassel, Kassel, Germany christian.spieker@uni-kassel.de

***Abstract*—**The design and optimization of electrical machines is an extremely time-consuming and computationally intensive process, as it requires a large number of simulations and multiobjective optimization. Common metamodel-based approaches used to reduce the number of expensive simulations often employ sample-inefficient space-filling sampling methods for data generation. Induction motors, as a rare-earth-free alternative for vehicle traction drives, remain particularly under-explored in this regard. In this paper, we address the issue of sample-inefficient metamodel-based multi-objective optimization in induction motor design. We present an end-to-end multi-objective Bayesian optimization framework for the electromagnetic-thermal design of induction motors with squirrel-cage rotors and hairpin windings, which couples analytical sizing, coupled electromagnetic-thermal analytical and finite-element simulation, and Bayesian optimization. On an induction motor design task (12 design variables, 5 objectives including thermal and cooling objectives) our approach using 7× fewer expensive simulations, matches the hypervolume of a neural-network-based metamodel approach with NSGA-II, achieves a higher final hypervolume, and ultimately dominates 38.4% of the baseline's Pareto-optimal solutions while none of its own are dominated. The results demonstrate that Bayesian optimization enables practical multi-objective induction motor design under severely limited computational budgets.

Index Terms—Multi-Objective Bayesian Optimization (MOBO), Gaussian Process Regression (GPR), Metamodeling, Neural Networks, Induction Motor Design, Electric Vehicle Drives

Visual Task Modeling and Automated Planning for Humanoid Robots in Education of Individuals with Autism Spectrum Disorder

Lada Kudlackova
Department of Theoretical Computer Science and Mathematical Logic, Charles University, Faculty of Mathematics and Physics
Prague, Czech Republic kudlackova@ktiml.mff.cuni.cz

***Abstract*—**In robot-assisted education, a robot must understand how to complete a task in order to effectively guide a student through it. We present a novel method that enables a semi-autonomous, camera-equipped robot to recognise the task goal and plan actions to achieve it. Our work focuses on Shoebox Tasks, an activity commonly used in the education of individuals with Autism Spectrum Disorder (ASD). These tasks are designed so that the goal can be inferred directly from their visual structure. We have developed a solver that uses a vision-based Large Language Model to convert photos of a Shoebox Task into a Planning Domain Definition Language (PDDL) representation and generate action plans for solving it. We have also implemented a robotic interface that enables a Nao robot to autonomously execute various Shoebox Tasks and assist a student by suggesting next steps or signalling detected failures through action demonstrations, voice commands, or gestures. With an adapted robotic interface, the solver can be integrated into a variety of educational robots. No programming expertise is required from teachers, and the solver operates exclusively on captured images as input. Research in special educational needs indicates that students with ASD can benefit substantially from robot-assisted teaching, and our system aims to strengthen these learning opportunities while also fostering interest in robotics among individuals with ASD.

Index Terms—visual task modeling, PDDL, Large Language and Vision Models, humanoid robots, robot-assisted education, Autism Spectrum Disorder

High-Frequency-Link Assisted 11-Level Packed UCell Inverter with Dynamic Switched Rectifier

Hasan HATAŞ
Department of Electrical and Electronics Engineering Faculty of Engineering Van Yuzuncu Yil University, Van, Türkiye hasanhatas@yyu.edu.tr

Kenan GÜRÇAM
Vocational School of Technical Sciences, Department of Electricity and Energy Iğdır University, Iğdır, Türkiye kenan.gurcam@igdir.edu.tr

Erdoğan ÖZEL
Department of Electrical and Electronics Engineering Faculty of Engineering Van Yuzuncu Yil University, Van, Türkiye
erdoganozel@yyu.edu.tr

***Abstract*——**This paper proposes a hybrid methodology for an asymmetric Packed U-Cell (PUC) multi-level inverter (MLI) supporting voltage collection. Integration of two additional switches into the High Frequency Coupling (HFL) circuit enables modulation of the output between half and full amplitudes. This modification allows for adjustment of the DC bus voltages, enabling the conventional 7-level configuration to produce an 11-level output. Simulation analysis was performed using MATLAB/Simulink software. The operational stability of the introduced topology was verified under heavy inductive loading conditions (5Ω + 100mH) across an extended frequency band (25–200 Hz). For control purposes, the Nearest Level Control (NLC) strategy was implemented. This technique provides high-quality sinusoidal waveforms and achieves an efficiency of 95.02% while minimizing switching losses. Overall, this technique successfully expands voltage levels in MLI designs and increases their capacity to drive inductive loads. These features make it an economical option for application in renewable energy grids and industrial drive systems.

Keywords—MLI, Dynamic Switched Rectifier, Sensorless Control, HFL, Single DC Source

Estimating Damage Caused by Natural Disasters using Deep Learning Methods on the xBD Dataset

Md. Rifat Ahmed, Rezwan-Ul-Alam, Mohammed Rakibul Hasan, Shahnewaz Siddique
Department of ECE North South University, Dhaka, Bangladesh
rifat.ahmed10@northsouth.edu, rezwan.alam1@northsouth.edu, *mohammed.hasan02@northsouth.edu, shahnewaz.siddique@northsouth.edu*

***Abstract*—**Accurate object detection and segmentation remain central challenges in computer vision, particularly when balancing accuracy with computational efficiency. In this study, we present a comprehensive evaluation of modern detection–segmentation frameworks, including YOLOv8–YOLOv12, YOLOv10 with SAM-based segmentation, RT-DETR, Detectron2, and SegFormer. Native YOLO variants demonstrated a strong boundary fidelity in segmentation. The SAM-based hybrids enhanced the semantic purity of masks. Transformer-based RTDETR proved effective in detecting small and occluded objects, though with lower overall mAP compared to advanced YOLO models. To overcome these trade-offs, we present a hybrid integration of YOLOv8 with RT-DETR, which combines the spatial accuracy of YOLO with the fine-grained detection robustness of a transformer decoder. Experimental results on the refined dataset show that YOLOv8+RT-DETR consistently achieved superior balance across detection and segmentation metrics. It ensured higher reliability on challenging cases while also maintaining a moderate training time. This work highlights the strengths and limitations of state-of-the-art architectures. It also establishes YOLOv8+RT-DETR as a practical and highperforming framework for robust detection and segmentation during damage estimation of natural disasters.

Index Terms—deep learning, YOLOv12, Mask R-CNN, RTDETR, SegFormer, natural disasters, damage estimation

Stability-Aware Aggregation for Binary Federated Learning in the Presence of Noisy Client Data

Ayse Serbetci
Department of Computer Engineering Istanbul Commerce University, Istanbul, Turkey asturan@ticaret.edu.tr

***Abstract*—**Binary Neural Networks (BNNs) enable efficient edge deep learning, yet their sensitivity makes them vulnerable to noisy client data in Federated Learning (FL). In scenarios where clients have corrupted labels or noisy features, standard aggregation methods such as FedAvg struggle to mitigate the negative effects of erroneous updates, leading to severe global model instability. This paper proposes a robust aggregation method specifically designed to handle noisy client data by leveraging the local loss stability of BNNs. In our approach, the global model monitors the stability of each client's training process to assess their reliability and adjust their participation accordingly. Experimental results demonstrate that BNNs are highly sensitive to label noise, and the proposed model mitigates the negative effects of noisy clients while maintaining reasonable accuracy under aggressive noise conditions.

Index Terms—Binary Federated Learning, Noisy Client Data, Robust Aggregation, Loss Stability, Edge AI Security

Analysis of the Robustness and Sensitivity of Deep Learning Models for Automatic Target Recognition

Wael Bouchaala
Department of Computer Science and Engineering University of Louisville, Louisville, KY, USA wael.bouchaala@louisville.edu

Hichem Frigui
Department of Computer Science and Engineering University of Louisville, Louisville, KY, USA hichem.frigui@louisville.edu

***Abstract*—**This paper aims to provide a comprehensive evaluation of several state-of-the-art models used in Automatic Target Recognition (ATR) using two benchmark infrared (IR) data sets. We compare six deep learning models. Two models, VGG16 and ResNet50, are based on CNNs. Another two models are based on vision Transformers. These are the baseline Vision Transformer (ViT) and Swin Transformer. The last two models are variations of the ViT that we propose to make it more suitable for relatively small input images. We compare the robustness and sensitivity of the six models to critical factors that influence the recognition performance, including occlusion, noise, scaling, and suboptimal target localization. Our results show that the six models have comparable results when the test image patches capture the location and scale of the targets correctly. However, the transformer-based methods are more robust when the targets are occluded, corrupted by noise, or the image patch does not localize the target correctly.

Index Terms—Automatic Target Recognition, Infrared Images, Target Localization, Vision Transformers

Prediction of Feelings in Individuals with Eating Disorders Using Physiological Signals

Mahdi Hammami
Department of Computer Science and Engineering University of Louisville, Louisville, KY, USA mahdi.hammami@louisville.edu

Hichem Frigui
Department of Computer Science and Engineering University of Louisville, Louisville, KY, USA h.frigui@louisville.edu

Andrew Karem
Department of Computer Science Bellarmine University, Louisville, KY, USA adkare01@gmail.com

Christina Ralph-Nearman
Louisville, KY, USA, christinaralphnearman@gmail.com

***Abstract*—**Eating disorders are severe psychiatric conditions associated with high morbidity and mortality, often driven by an overwhelming fear of weight gain that can lead to extreme behaviors such as food restriction. Traditional treatment methods do not provide continuous, real-time support, highlighting the need for innovative monitoring solutions. In this longitudinal study, Empatica E4 wearable sensors were used to collect multimodal physiological signals, including heart rate, electrodermal activity, skin temperature, blood volume pulse, and movement data (3- axis acceleration). Data were collected from multiple participants in naturalistic daily settings over a 30-day monitoring period, yielding over 67 hours of high-resolution physiological recordings. Ecological momentary assessments were delivered through semirandom prompts every four hours, enabling repeated capture of subjective emotional states throughout the day. Participants rated their ”Tiredness”, ”Fear of weight gain”, and ”Anxiety” on a validated 0–100 scale. Physiological recordings were synchronized with self-reports within a one-hour window, cleaned, baselinenormalized, and augmented using multisampling techniques to address the sparsity of real-world clinical datasets. Two machine learning models were then developed: a gradient-boosting regressor and a Long Short-Term Memory (LSTM) network to predict symptom intensities. The gradient boosting model achieved a mean absolute error (MAE) of 0.118, while the initial LSTM model was hampered by overfitting (MAE = 0.159). After optimization through dropout regularization, complexity reduction, and further data augmentation, the LSTM model improved to an MAE of 0.108. Participant-specific fine-tuning further reduced the weighted global MAE to 0.0989 across all validation samples. These results suggest that integrating wearable sensor data with machine learning can enable real-time, personalized monitoring, and intervention for eating disorders.

Index Terms—Eating Disorders, Fear of Weight Gain, Wearable Sensors, Machine Learning, XGBoost, LSTM, Ecological Momentary Assessment

Rethinking Generalization in Cognitive AI: Neural Networks Evidence from Social Subgroups

Corina Ilinca
Faculty of Sociology and Social Work, University of Bucharest, Softbinator Technologies, Bucharest, Romania, corina.ilinca@unibuc.ro

Abstract. Creating machine learning algorithms for prediction purposes that successfully achieve high levels of performance depends on the data, its features and the cognitive models behind them. How the data looks like can influence the results, as well as differences between social subgroups of the same sample. Bias based on social aspects may exist, as well as different profiles depending on how people behave in different situations, at different life stages, or by being part of a certain social group with action resources in terms of digital skills and within the cognitive AI domain. If an outcome is predicted, does a general list of features as predictors have a better performance than training and testing the model on subgroups on which we theoretically know that act as differentiators with respect to the outcome? If a general model is compared with models trained and tested on subgroups based on education level, age or sex different for performance evaluation, is the general model better or subgroups models, as well as their interaction (i.e. subgroups of education and age, age and sex, and education and sex) working better? Based on training and testing neural networks on data from 1229 ChatGPT users from Germany, with a scale conjugate gradient as an optimization algorithm, the results show that several models trained on cognitive subgroups perform better than the general model. The generalizability of the cognitive models is questioned based on these results, underlining the importance of testing models that target specific groups of people in order to account for their profiles, possible group differences for the entire prediction model, and keep into account how the characteristics are connected theoretically.

Keywords: Cognitive Models, Group-specific, Neural Networks, Predictive Performance, ChatGPT User Data

Explainable Image Classifiers for Automating the Organ-on-a-Chip Pipeline

Ilze Ivanova
Faculty of Science and Technology University of Latvia, Riga, Latvia, ackergaul2013@gmail.com

Maksims Ivanovs
Faculty of Science and Technology University of Latvia, Riga, Latvia, m.ivanovs@lu.lv

***Abstract*—**Organ-on-a-Chip (OOC) technology enables physiologically relevant in-vitro tissue modelling but requires continuous monitoring to ensure sample quality and experimental reliability. This study investigates automated OOC image classification using a recently published microscopy dataset. A structured architecture search based on a MobileNetV3 backbone is conducted by varying classifier depth and backbone finetuning across 52 configurations. Statistical analysis indicates that performance improvements are primarily driven by unfreezing deeper backbone blocks, whereas increasing the number of fully connected layers in the classification head does not produce consistent gains. To analyze model behavior, twelve explainability methods are evaluated using Insertion, Deletion, and MuFidelity metrics across the five best-performing models. The comparison reveals substantial disagreement between evaluation metrics and no method consistently dominating across all criteria. Overall, the results emphasize the importance of backbone adaptation and highlight the need for cautious, multi-metric evaluation of explainability methods in texture-dominated biomedical imagery.

Index Terms—Organ-on-a-chip, computer vision, deep learning, explainable AI

Utilizing AI-Powered Channel Coding Techniques to Enhance the Delivery of Lingnan Cultural Content in Communication System

Deran Jin
College of Art and Media, Guangzhou Xinhua University, Dongguan, Guangdong, China, gs63023@student.upm.edu.my

Dong Wu
College of Art and Media, Guangzhou, Xinhua University, Guangzhou, Guangdong, China, wudong@xhsysu.edu.cn

***Abstract*--**Bandwidth capacity, signal attenuation, and noise distortion are some of the impairing factors that hinder the successful transmission of Lingnan cultural content across modern communication networks. This paper argues for AI-based channel coding methods in order to increase the reliability and efficiency of transmitting cultural content. Tests use a recent Transformer-based Neural Decoding Network (TNDN), which provides self-attention operations to adapt to the dynamic channel conditions to enhance error-correcting ability compared to traditional convolutional and recurrent neural decoders. Furthermore, we present a Quantum-inspired Particle Swarm Optimization (QPSO) algorithm that can optimize channel code parameters in real-time by incurring a minimal latency and reducing the number of bit errors to preserve culture. The technology acquires a vast library of Lingnan media content from the past and present to optimize encoding tools to preserve culture. The results of the simulation show a tremendous enhancement in signal integrity, spectral, and decoding accuracy compared to the standard LDPC and Turbo codes. Specifically, the proposed model achieves a 30% bit error rate, a 44% spectral efficiency, and a 34% latency reduction, and hence Lingnan heritage high fidelity may be delivered in digital media. This paper develops an effective AI-driven model that will make Lingnan heritage trickle down to the new generations to sustain its valuable heritage and propel the communication infrastructures of the new generation.

Keywords: Lingnan Culture, AI-Powered Channel Coding, Transformer-Based Neural Decoding Network (TNDN), Self-Attention Mechanism, Quantum-Inspired Particle Swarm Optimization (QPSO)

Explainable Tabular Deep Learning for Network Anomaly Detection: A Comparative Study of AutoInt and DANet Architectures

Burçak Asal
Institute of Informatics Hacettepe University, Ankara, Turkiye ¨ burcakasal@hacettepe.edu.tr

***Abstract*—**This study addresses network anomaly detection as a supervised binary classification problem by using bandwidthbased telemetry features. Specifically, inbound and outbound traffic rates and bandwidth utilization percentages are utilized to identify abnormal network behavior. Two advanced deep learning architectures developed for tabular data, which are—AutoInt and DANet, are comprehensively tested and analyzed. Experimental results demonstrate that both models achieve strong classification performance, with DANet consistently outperforming AutoInt in terms of accuracy, F1-score, and Matthews Correlation Coefficient metrics. To further enhance transparency and interpretability, SHAP-based analysis is conducted, which reveals that bandwidth utilization features have the most significant influence on anomaly estimations, while raw traffic rates play a secondary role. Overall, the findings points out the effectiveness of deep tabular architectures for network anomaly detection and show the importance of explainable model behavior in security-critical applications.

Index Terms—explainable artificial intelligence (XAI), AutoInt, DANet, network anomaly detection, SHAP

Health Status Prediction Supported by Explainable Machine Learning: A Voting Regression Analysis with SHAP and LIME

Burçak Asal
Institute of Informatics Hacettepe University, Ankara, Turkiye ¨ burcakasal@hacettepe.edu.tr

***Abstract*—**In the scope of recent advancements in the healthcare sector, various health based analyses can be performed for individuals based on different factors. Within the scope of these analyses, accurately determining an individual's health status holds critical importance. In this study, a regression problem aimed at predicting individuals' health status is addressed and a Voting Regression model is proposed as the solution. Additionally, this model is composed of an ensemble of three different individual regression models, which are Kernel Ridge Regression, Gradient Boosting Regression, and Support Vector Regression. In the study, both the individual models and the voting model are compared quantitatively and visually in terms of performance. Furthermore, for enhancing the transparency of the voting model's decision making process, feature contribution analysis is conducted by utilizing explainable artificial intelligence (XAI) techniques, SHAP and LIME.

Index Terms—health status prediction, machine learning, voting regression, kernel ridge regression, gradient boosting regression, support vector regression, explainable artificial intelligence (XAI), SHAP, LIME

Subject-Independent Attention State Decoding from Ear-EEG Using Multivariate Spectral Dynamics

Mehmet Akif Cenber
Electrical and Electronics Engineering Kahramanmaras Sutcu Imam University Kahramanmaras, Türkiye, cenbermehmetakif@gmail.com

Esma Cetinkaya
Electrical and Electronics Engineering Kahramanmaras Sutcu Imam University Kahramanmaras, Türkiye, esma.ctnky@icloud.com

Ahmet Alkan
Electrical and Electronics Engineering Kahramanmaras Sutcu Imam University, Kahramanmaras, Türkiye aalkan@ksu.edu.tr

***Abstract*—** Sustained visual attention is commonly studied through controlled laboratory paradigms; however, reliable subject-independent decoding from wearable neural signals remains challenging. In this study, we investigate whether attentional state during Troxler fading can be decoded from earEEG using multivariate spectral dynamics. In this preliminary proof-of-concept study, five participants performed a baseline condition and a sustained fixation task that induced Troxler fading, while ear-EEG was recorded. Signals were resampled to 200 Hz, band-limited to 1–45 Hz, segmented into 5 s epochs with 50% overlap, and transformed into spectral features including relative band powers (theta, alpha, beta) and log10(theta/beta ratio). Group-level statistical analysis revealed no consistent single-band shifts across subjects (n=5), indicating high intersubject variability. However, when multivariate spectral summaries were combined with temporal descriptors (median, interquartile range, and slope across time), subject-independent classification under leave-one-subject-out (LOSO) validation achieved 0.77 balanced accuracy (AUC = 0.85) at the epoch level and 0.90 balanced accuracy (AUC = 0.80) at the subject level. These findings suggest that attentional state during Troxler fading is not characterized by uniform changes in band power but by structured multivariate spectral dynamics. The results demonstrate the feasibility of subject-independent attention state decoding from ear-EEG, highlighting the importance of temporal modeling in wearable AI-based neuro-monitoring systems.

Keywords—Ear-EEG, Attention State Classification, SubjectIndependent Learning, Multivariate Spectral Analysis, Temporal Feature Modeling, Troxler Fading

Metaheuristic Weight Optimization of DGKC-A* for Performance-Driven Autonomous Vehicle Planning

Huseyin Can Azmanoğlu
Otokar Automotive and Defense Ind., Autonomous Vehicle Development Team, Sakarya, Turkey, hazmanoglu@otokar.com.tr

Oğuzhan Karahan
Kocaeli University, Department of Electronics and Communication Engineering, Kocaeli, Turkiye, oguzhan.karahan@kocaeli.edu.tr

***Abstract*—**Autonomous vehicle path planning relies on carefully tuned cost functions to balance efficiency, safety, and comfort. In practice, these weights are often selected manually, leading to suboptimal and inconsistent performance under varying traffic conditions, especially for large-scale vehicles with strict kinematic constraints.

This study proposes automated cost-weight optimization for Direction-Guided Kinematic Constrained A* (DGKC-A*). The weight selection problem is formulated as a continuous optimization task and solved using Particle Swarm Optimization (PSO) and Grey Wolf Optimization (GWO). Additionally, a context-aware modulation strategy adapts weights online according to driving modes such as cruise, overtaking, and narrow-road navigation.

The framework is validated in simulation and through real-world experiments using OTOKAR's E-CENTRO Autonomous Bus. Results demonstrate that swarm-based tuning combined with context-aware adaptation improves efficiency and trajectory smoothness while maintaining safety constraints under diverse driving scenarios.

Index Terms—cost optimization, swarm intelligence, A algorithm, context-aware planning, trajectory planning, autonomous vehicles, real-world validation*

Facial Emotion Recognition using Action Unitsbased Machine Learning

Manuel Amir Freer Valdez
School of Computing National College of Ireland Dublin, Ireland x22120921@student.ncirl.ie

Ioana Ghergulescu
Adaptemy, Dublin, Ireland ioana.ghergulescu@adaptemy.com

Arghir-Nicolae Moldovan
School of Computing National College of Ireland Dublin, Ireland arghir.moldovan@ncirl.ie

***Abstract*—**Facial emotion recognition (FER) has been extensively studied through the lens of deep neural networks, yet the predictive capacity of anatomically grounded features, specifically Action Units (AUs) defined within the Facial Action Coding System (FACS), remains underexplored in the context of classical machine learning. This paper investigates the performance of traditional ML algorithms trained on AU features extracted with the OpenFace tool across four benchmark datasets: CK+, FER+ / FER2013, SFEW and ExpW. Two experiments are conducted. The first experiment evaluates four classifiers — Random Forest (RF), K-Nearest Neighbours (KNN), Naïve Bayes and Support Vector Machine (SVM), trained on AU features. The second experiment evaluates the influence of 255 OpenFace feature set combinations on the classification performance using RF. The results indicate that Random Forest with a combination AU and other facial features achieves 95.1% accuracy on the CK+ dataset. Moreover, the proposed approach outperformed directly comparable AUs + CML based methods from past works on the controlled benchmarks CK+ and SFEW, whilst the lower performance on unconstrained datasets reflects the intrinsic difficulty of in-the wild FER and the need for more complex DNN-based methods.

Keywords—Facial Emotion Recognition (FER), Action Units (AUs), OpenFace, Machine Learning, Image Classification

A Hybrid CNN–LSTM Framework for Crowd Density Estimation and Anomaly Detection in Surveillance Systems

Madhav Theeng Tamang
Intelligent Technologies Research Group, School of Architecture, Computing and Engineering, UEL, London, United Kingdom,
m.tamang@uel.ac.uk

Michael Ademola Anthony
Intelligent Technologies Research Group, School of Architecture, Computing and Engineering, UEL, London, United Kingdom,
u2828814@uel.ac.uk

Mhd Saeed Sharif
Intelligent Technologies Research Group, School of Architecture, Computing and Engineering, UEL, London, United Kingdom,
s.sharif@uel.ac.uk

***Abstract*—**As cities grow and public events become larger, there is a greater need for smart surveillance systems that can monitor crowds in real time. Traditional CCTV systems rely on people monitoring screens and applying fixed rules, which do not work well in crowded places. In this study, we introduce a hybrid deep learning system that simultaneously estimates crowd density and detects unusual events. Our approach combines a Convolutional Neural Network (CNN) for estimating how crowded an area is with a Long Short-Term Memory (LSTM) autoencoder for detecting unusual patterns over time. The CNN creates heatmaps showing where crowds are, while the LSTM learns what normal crowd behaviour looks like and flags events such as stampedes, sudden breakups, or violent actions. We trained and tested our models on public surveillance datasets, using standard data preparation methods. Our results show that the combined CNN-LSTM system performs better than either model alone. It achieved lower counting errors and an F1-score above 0.90 for anomaly detection, with an ROC-AUC above 0.93. The system runs almost in real time and can be scaled up, making it a good fit for smart surveillance and public safety uses.

Keywords—crowd density estimation, anomaly detection, intelligent surveillance, deep learning, convolutional neural networks, computer vision

Explaining Individual Unfairness with Surrogate Decision Trees

Saso Karakatic
Intelligent Systems Laboratory, University of Maribor, Maribor, Slovenia

Nejc Mlinaric
FERI, University of Maribor, Maribor, Slovenia

Ivona Colakovic
Eurecat - Technology Centre, Barcelona, Spain

***Abstract*—**Group fairness metrics aggregate prediction outcomes over demographic subgroups and cannot identify which individuals are unfairly treated or why. We present IBEX, a model-agnostic, post-hoc pipeline that scores individual unfairness via cross-group k-nearest-neighbor comparisons and extracts interpretable explanations through a decision tree surrogate. On synthetic data, we find that different types of group fairness violations produce fundamentally different individual-level signals: Equal Opportunity is the only condition that creates detectable, group-concentrated unfairness, whereas Demographic Parity and Equal Quality violations produce substantially weaker individual-level signals. On the Adult Income dataset, IBEX consistently detects sex as an unfairness driver, yet sex never appears among the most prominent surrogate rules because correlated proxy features dominate the top-level splits, revealing a proxy-substitution mechanism that standard group audits cannot detect. IBEX provides stable, interpretable explanations of who is unfairly treated and why, and can serve as a diagnostic complement to group fairness auditing.

Index Terms—fairness, fair ML, explanations, XAI

Sentry: Efficient Real-Time Weapon Detection on Edge-Mobile Platforms

Sandro Alarcón
Software Engineering Universidad Peruana de Ciencias Aplicadas, Lima 15023, Perú

Julio Elsner
Software Engineering, Universidad Peruana de Ciencias Aplicadas Lima 15023, Perú

Elio Navarrete
Software Engineering Universidad Peruana de Ciencias Aplicadas, Lima 15023, Perú

***Abstract*—**Urban public safety in Lima, Peru faces persistent challenges related to weapon enabled crime, where timely detection and rapid response are critical. This paper presents Sentry, an Edge IoT mobile platform for real time weapon detection that integrates on device computer vision, geolocation, and push notifications to support municipal patrol operations. The system follows a hybrid edge cloud architecture. Detection is executed locally on mobile devices to reduce latency and preserve privacy, while cloud services provide authentication, event logging, and notification delivery. To train and evaluate the detection model, we curated and annotated a dataset of 4100 images containing firearms, knives, and non weapon contexts. Images were resized to 640 by 640 and augmented using flipping, rotation, cropping, and zooming to improve robustness to real world variations in viewpoint, scale, and illumination. The dataset was split into 70 percent training, 20 percent validation, and 10 percent test subsets. On the held out test set, the proposed YOLOv8 based detector achieved mean average precision at intersection over union 0.50 of 0.909 and mean average precision averaged from 0.50 to 0.95 of 0.655, with precision 0.928, recall 0.878, and F1 score 0.902. The proposed design supports real time alerting under resource constraints and offers a practical, privacy aware alternative to fully centralized surveillance pipelines in urban environments.

Keywords—Weapon detection, YOLOv8, edge AI, mobile application, IoT, public safety

Acoustic Feature-Based Laryngeal Voice Disorder Classification Using Machine Learning and Statistical Comparison

Safa Enes Türkoğlu
Computer Engineering, Tokat Gaziosmapaşa University, Tokat, Turkey safaenes.turkoglu@gop.edu.tr

Turgut Özseven
Computer Engineering, Tokat Gaziosmapaşa University, Tokat, Turkey, turgut.ozseven@gop.edu.tr

***Abstract*—** The early and accurate diagnosis of laryngeal pathologies is of great importance in clinical practice. In this study, an automatic multi-class classification system covering the most commonly encountered classes 'healthy', 'rekurrensparese', and 'stimmlippenpolyp' was proposed using the Saarbrücken Voice Database. Acoustic features were extracted from the feature groups MFCC, LPCC, CPP, ZCR, HNR, jitter, and shimmer; patient-based training-test separation was applied to prevent data leakage. SMOTE was applied to the training set to address class imbalance, and SVM, LightGBM, k-NN, and MLP models were evaluated using fivefold cross-validation. While LightGBM demonstrated the highest performance, the Friedman test revealed statistically significant differences between the models. SHAP analysis indicated that shimmer, jitter, and MFCC coefficients were the most decisive features in the classification decision. The results obtained demonstrate that acoustic-based vocal pathology detection offers a promising approach for clinical support systems.

Keywords— Laryngeal Voice Disorders, Acoustic Feature Extraction, Machine Learning, Multi-Classification, Saarbruecken Voice Database