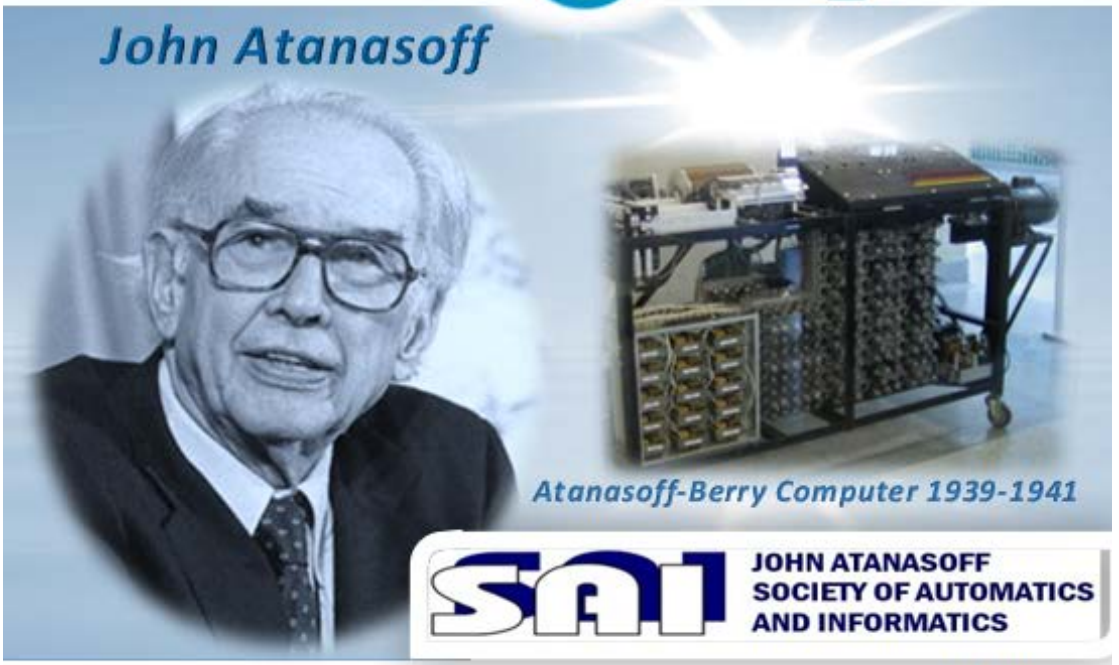
IEEE

TECHNICAL UNIVERSITY OF VARNA



JOHN ATANASOFF SOCIETY OF AUTOMATICS AND INFORMATICS

OCTOBER 4th - PROFESSIONAL DAY OF BULGARIAN SPECIALISTS ON COMPUTERS, INFORMATION TECHNOLOGIES AND AUTOMATICS

VARNA STU

ABSTRACT BOOK

INTERNATIONAL CONFERENCE AUTOMATICS AND INFORMATICS 2025,

VARNA, BULGARIA

Welcome to ICAI'2025

Dear participants,

It is a great honor and pleasure to welcome you to the International Conference Automatics and Informatics`2025 in the campus of the Technical University in the beautiful city of Varna, Bulgaria.

The International Conference Automatics and Informatics (ICAI) traditionally is held under the patronage of the President of the Republic of Bulgaria during the John Atanasoff days in October every year. The conference has over 55 years of history and has significantly contributed to the development of automation and computer technology in Bulgaria.

The purpose of the conference is to bring together international researchers and industrial practitioners interested in the development and implementation of modern technologies for automation, information, computer science, artificial intelligence and others.

First of all, the congratulations go to the participants who contributed with their papers. Without your high quality articles, we would not be here today.

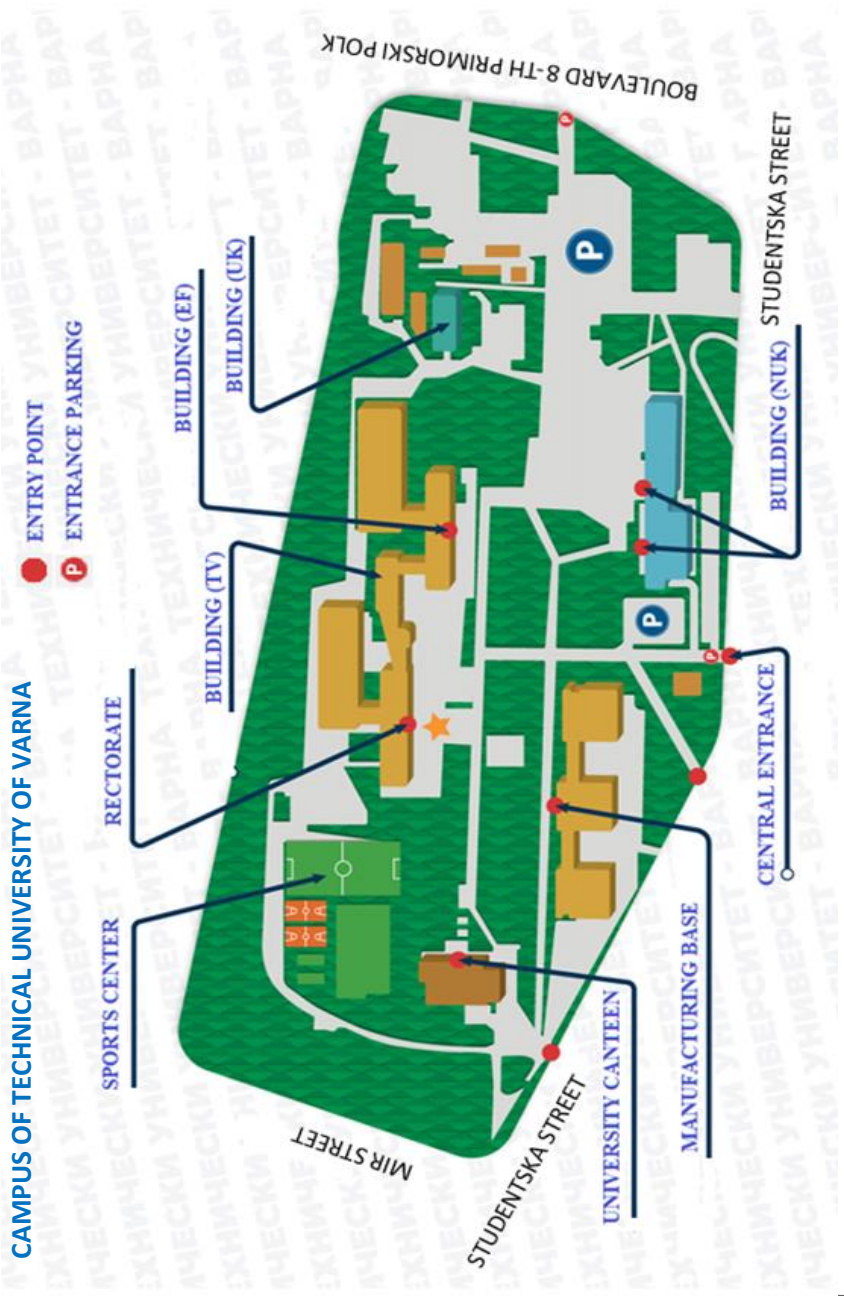
We would like to express our deepest gratitude to hard working reviewers whose effort contributed for high quality of the paper selection process.

Please, have a look at the conference program to find the most important topics for you.

We wish you a productive meetings and hope you enjoy your stay in Varna!

Through our conference, we want to build bridges between scientists around the world.

The Committees and Chairs of ICAI'2025


CAMPUS OF TECHNICAL UNIVERSITY OF VARNA
ENTRY POINT
ENTRANCE PARKING
BOULEVARD 8-TH PRIMORSKI POLK
STUDENTSKA STREET
BUILDING (NUK)
BUILDING (UK)
BUILDING (EF)
BUILDING (TV)
RECTORATE
SPORTS CENTER
CENTRAL ENTRANCE
MANUFACTURING BASE
UNIVERSITY CANTEEN
STUDENTSKA STREET
MIR STREET

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IEEE INTERNATIONAL CONFERENCE AUTOMATICS AND INFORMATICS'2025 (ICAI'25),

09 - 11 October 2025, VARNA (Technical University – Varna) (Hybrid)

http://icai-conf.org

CONFERENCE PROGRAM

THE GIVEN TIME IS ACCORDING TO THE BULGARIAN TIME ZONE - SOFIA UTC+3 HOURS

Thursday, October 9th

In the NUK gallery
08:00 – 09:00 REGISTRATION OF PARTICIPANTS

Stream 1 (Conference Hall NUK)
09:00 – 09:20 WELCOME AND OPENING CEREMONY

09:20 – 10.00 30 YEARS OF THE BULGARIAN SECTION OF IEEE
Chairman: Todor Ganchev

Stream 1 (Conference Hall NUK)

10:00 - 10:50 PLENARY SESSION 1 (PS1)
Chairman: Kosta Boshnakov

Neural Computation for Socioeconomic Forecasting in Turbulent Times

George Mengov
Sofia University St. Kliment Ohridski

10:50 - 11:00 DISCUSSION

Stream 1 In attendance (In-person) (Room A – Hall 109TV)	Stream 2 Online (Virtual) (Room B)	Stream 3 Online (Virtual) (Room C)
11:00 - 12:30 SESSION A11 **"Control And Optimization"** **Chairman: Kamen Perev**	**11:00 - 12:30 SESSION B11** **"Control Theory and PWM Systems"** **Chairman: Alexandar Ichtev**	**11:00 - 12:30 SESSION C11** **"Search Algorithms and Optimization"** **Chairman: Valentina Markova**
1. Feedback Control Structure for Nonlinear Plants, Kamen Perev (9492) **2. Algorithm for adaptive smoothing of contour curves in a Voronoi**	**1. Robust Control of PWM Inverter in Robotic System**, Georgi Stefanov (3902)	**1. Algorithmic Efficiency in Rubik's Cube Solving: A Study of Timeout Rates, Solution Quality, and Heuristic Limitations,** Miguel Angel Garcia

diagram, Ognyan Zhelezov and Valentina Petrova (8741) **3. Parameter Optimization Using Experimental Design and Statistical Modeling for Injection Molding,** Todor Todorov, Georgi Todorov and Borislav Romanov (5581) **4. Testing the Case of Knapsack-like Portfolio Optimization Using Various Evolutionary Algorithms,** Nikolay Penchev and Angel Marchev (0625)	**2. Robust LMI based Model Predictive Control for discrete-time singular systems,** Andrey Yonchev (9263) **3. Network Flows with Potentials at the Network Vertices,** Vassil Sgurev and Lyubka Doukovska (9213) **4. Computational Fluid Dynamics usage for development of Digital Twin for Chemical Reactor with Periodical Action,** Plamen Vasilev and Nedko Perchemliev (7516)	Higuita, Loubna Ali, Shan Faiz, Rand Koutaly and Meerah Karunanithi (0556) **2. A Comparative Analysis of Informed and Uninformed Search Algorithms for the 8-Puzzle Problem with a Novel Hybrid Approach,** Petar Mileski, Dijana Capeska Bogatinoska and Aleksandar Karadimche (1633) **3. Visualizing Search Algorithms: A Practical Approach Using the Rubik's Cube,** Eslam Aly, Loubna Ali, Syed Arslan Abbas Rizvi, Ahmed Hassan and Pratik Rughe (9105) **4. N-Queens using Genetic Algorithm: a comparative study,** Mehul Jain, Syed Arslan Abbas Rizvi, Somesh Rewadkar, Rand Kouatly, Ahmed Hassan and Muhmmad Saqib (6650)
12:30 – 13:30 LUNCH in the UNIVERSITY CANTEEN		
13:30 - 15:00 SESSION A12 **"Machine Learning and Data Analysis"** **Chairman: George Mengov**	**13:30 - 15:00 SESSION B12** **"Robotics and Control Systems"** **Chairman: Vladimir Hristov**	**13:30 - 15:00 SESSION C12** **"Optimization and Metaheuristics"** **Chairman: Alexandra Grancharova**
1. Predictive Limits, Imposed by Likert-type Data, George Mengov, Dimitar Gotchev, Irina Zinovieva and Iliyan Nenov (0299)	**1. Model-Free Super-Twisting Control for Rigid-Flexible Coupled Robotic Mechanisms with Time-Delay**	**1. Metaheuristic Algorithms for Transport Planning: Simulated Annealing and Ant Colony**

2. Predicting Student Placement Status Using Tree-Based Ensemble Classifiers, Ivo Vladimirov Rakitin, Evgeniya Vladimirova Rakitina-Qureshi, Neli Ananieva Arabadzhieva-Kalcheva, Maya Petrova Todorova, Ivaylo Plamenov Penev and Daniela Ivanova Petrova (1476) **3. Random Forest versus Logistic Regression for Student Placement Prediction in Complex Educational Data**, Evgeniya Vladimirova Rakitina-Qureshi, Ivo Vladimirov Rakitin, Neli Ananieva Arabadzhieva-Kalcheva, Hristo Bozhidarov Nenov, Stefka Popova and Velislav Kolesnichenko (2463) **4. Decision Trees, Random Forests, and Hybrid Ensembles for Ordinal Survey Data Analysis**, Evgeniya Vladimirova Rakitina-Qureshi, Ivo Vladimirov Rakitin, Neli Ananieva Arabadzhieva-Kalcheva, Maya Petrova Todorova, Donika Georgieva Stoyanova and Dimitrichka Zheleva Nikolaeva (4739)	**Estimation,** Yang Shen, Haoping Wang and Yang Tian (1551) **2. Adaptive Performance-Guaranteed Control with Safety Constraints for Continuum Robots: A 6-DoF Elephant Trunk Robot System,** Dong Zhang, Haoping Wang and Yang Tian (6724) **3. A framework for trajectory optimization of an industrial KUKA robot,** Georgi Georgiev (3459) **4. Mathematical Modeling of an Automated Assembling Machine for Door Locks**, Ilian Iliev, Reneta Parvanova and Desislava Mihaylova (9650)	**Optimization,** Adelina Petkova, Martin Vassilev and Alexander Penev (5998) **2. A derivative free algorithm for function minimization with application in economics,** Ilia Atanasov (4709) **3. Use of Neural Networks for the Modelling and Optimization of the Manganese Ions Adsorption from Aqueous Solutions,** Alexandra Grancharova and Silviya Lavrova (3479) **4. Minimizing Road Curvature Through Parallel Computing in Pathfinding Algorithms,** Filip Bosilkov and Vladimir Zdraveski (9186)

15:00 - 16:30 SESSION A13 **"Robotics and Control Systems I"** **Chairman: Javanshir Mammadov**	**15:00 - 16:30 SESSION B13** **"CNC Machining and Industrial Automation"** **Chairman: Mariyana Todorova**	**15:00 - 16:30 SESSION C13** **"Deep Learning and Reinforcement Learning"** **Chairman: Gancho Vachkov**
1. Diagnostics of İndustrial Robot Applied in Flexible Manufacturing System, Javanshir Mammadov, Aminaga Sadigov, Ulduz Agayev, Natig Talibov, Nadir Hajibalayev and Banovha Veliyeva (4565) **2. Modeling of the innovation construction mobile industrial robot applied in technology park,** Gulshan Orujova, Ulduz Agayev, Gulnara Genjeliyeva, Yusif Huseynov, Metanet Ahmadova and Ahmad Ahmadzada (4719) **3. Control of a two-joint planar robot through machine vision**, Elena Vasileva and Zhivko Zhekov (1540) **4. Modeling of Inverse Kinematics of a 3R Robotic Arm with Adaptive Neuro-Fuzzy Inference System**, Iliyan Iliev and Viktor Iliev (8773)	**1. Multi-Purpose Optimization of the Turning Process on CNC Machines with Robotic Loading,** Irina Aleksandrova, Hristo Metev and Nikolay Kolev (1237) **2. Determining the Number of Cutting Tools, Ensuring a Continuous Work Cycle in CNC Turning Machines with Robotic Loading,** Irina Aleksandrova, Hristo Metev and Nikolay Kolev (2218) **3. Automatic Controlled Liquid Filling System: Loadcell And Servo Motor Controlled Approach,** Hilmi Kuşçu and Kubilay Özyalçın (1494) **4. Synthesis of a MIMO Model of an Electro-Hydraulic System with Temperature Compensation,** Stanimir Yordanov, Georgi Mihalev, Krasimir Ormandzhiev and Hristina Stoycheva (2268)	**1. Integrating Deep Learning and Reinforcement Learning: A Case Study on the Chrome Dino Game,** Krish Anish Shah, Loubna Ali, Rand Kouatly, Meerah Karunanithi and Debopriya Das (1049) **2. MAARV: Multi-Agent Architecture for Runtime Verification,** Ajitava Deb, Arush Jauhari, Mridangam Goswami, Dr. Usha G and Dr.Vinoth N.A.S. (0342) **3. Improving Bullying Detection Through Feature Selection and Machine Learning Evaluation,** Dimitrios Galiatsatos (9283) **4. Enhancing Academic Performance Prediction Using Feature Transformation and Machine Learning Models,** Dimitrios Galiatsatos (9328)
16:30 – 17:00 COFFEE BREAK		

17:00 - 18:30 SESSION A14 **"Cybersecurity and System Security"** **Chairman: Xuejun Zong**	**17:00 - 18:30 SESSION B14** **"ERP and Business Systems"** **Chairman: Idilia Batchkova**	**17:00 - 18:30 SESSION C14** **"Virtual Reality and Simulation"** **Chairman: Kosta Boshnakov**
1. Analyzing Vulnerabilities in Desktop Operating Systems, Svetoslav Hadzhitodev and Valentina Petrova (0490) **2. Technical Evolution and Practice of Industrial Internet Security Protection in the Era of Large language Models**, Bowei Ning, Kan He, Xunjun Zong and Yifei Sun (5769) **3. Entropy-Aware AI-Powered Ransomware Detection Using IBM FlashCore Module 4 in SAN Environments**, Genka Slavova-Torres (6374) **4. Bibliometric API Integrations: Combining Research Networks and Institutional Repositories**, Boris Bankov and Olga Marinova (7577)	**1. ERP systems in the digital transformation era: A comparative study of leading solutions,** Dilyana Dimitrova (3843) **2. Modular Architecture For Financial Process Automation: From Excel/INI to API and ERP integrations,** Ivan Ignev (1161) **3. Implementation of E-logistics in Food Supply Chain Operations,** Firuza Aghazada and Lala Bekirova (3551) **4. Evaluation and Selection of Project Management Software for Secure Civil-Military Collaboration,** Milen Sotirov, Valentina Petrova and Miroslav Tsvetkov (5199)	**1. Virtual Reality Driving Simulation System for Critical Situations,** Elitsa Bakalova (1917) **2. Comparative Analysis of Traditional and VR-Based Learning in Schools: Results and Challenges,** Elitsa Bakalova (4634) **3. Conceptualization, modeling and simulation for 3D printed modular hand prosthesis,** Vasil Lozanov, Radoslav Vasilev, Maya Staikova and Nayden Chivarov (6285) **4. Simulation of large battery clusters based on multi-threaded programming using OpenMP and a hybrid-core CPU,** Martin Minkov (9326)

18:30 - 19:30 **"COMPANY PRESENTATIONS"** **Chairman: Hristo Valchanov**		
1.Siemens. Industrial Artificial Intelligence, Boyko Boykov **2. Honeywell Protonium – design, control and optimization of green hydrogen production,** Daniel Nikolov		
19:30 COCKTAIL in the NUK gallery		

Friday, October 10th

Stream 1 (Online)

09.00 - 09:45 PLENARY SESSION 2 (PS2)
Chairman: Hristo Valchanov

Interpretable Machine learning methods for management of 5G networks

Petia Georgieva
University of Aveiro, Portugal

09.45 - 10:00 DISCUSSION

Stream 1 In attendance (In-person) (Room A – Hall 109TV)	Stream 2 Online (Virtual) (Room B)	Stream 3 Online (Virtual) (Room C)
10:00 - 11:30 SESSION A21	**10:00 - 11:30 SESSION B21**	**10:00 - 11:30 SESSION C21**

"Power Electronics and Motor Control" **Chairman: Desislava Delicheva**	**"Software Development and Programming"** **Chairman: Ivaylo Penev**	**"Computer Vision and Image Processing"** **Chairman: Albena Taneva**
1. Research of a low-power single-phase induction motor, Zlatan Ganev (0799) **2. Robust Repetitive Control of a PWM Inverter in a Robotic System**, Nina Nikolova, Boris Grasiani and Vesela Karlova-Sergieva (1075) **3. Modeling of Synchronous Reluctance EV Propulsion Drive**, Nikolay Djagarov, Nikolay Yanev, Valery Goldshtein and Vladimir Romanov (4412 **4. Braking Mode Investigation of Synchronous Reluctance EV Propulsion Drive**, Nikolay Djagarov, Nikolay Yanev, Valery Goldshtein and Vladimir Romanov (7790)	**1. Common Dependency Injection Errors in C# for .NET: How to avoid them?,** Daniel Damyanov, Zlatko Varbanov and Atanas Hristov (4686) **2. Comparison of Object-Relational Mapping Frameworks on C#, Python, Go, and Node.js using MSSQL With A Case Study,** Rand Kouatly and Orkun Demirci (5360) **3. A Modular Teaching-Oriented Chess Engine with Validated Move Generation and Classical Search Enhancements,** Yulian Dashev, Martin Vassilev and Alexander Penev (4597) **4. Accelerating Spell Checking with Parallel Processing Techniques,** Nikola Petrushevski and Vladimir Zdraveski (6918)	**1. Computational Limits and Breakthroughs in Deep Learning-Based Image Restoration,** Debopriya Das, M. Kamran Asif, Moumita Mukherjee, Jose Luis Bueso Vega and Zeeshan Ali (3105) **2. Wild Animals' Recognition System Based on Optimized YOLO Model and Camera Traps in Bulgarian Mountains,** Petar Matov (6514) **3. Microscopic Image-Based Classification of Honey Pollen Types Using Convolutional Neural Networks,** Lyubomir Zaykov (8196) **4. Vision Quality Inspection in a Flexible Assembly System,** Ivanka Dimitrova, Albena Taneva, Michail Petrov and Yavor Boychev (9757)

11:30 - 13:00 SESSION A22 **"Signal Processing and Communications"** **Chairman: Aydan Haka**	**11:30 - 13:00 SESSION B22** **"Parallel Computing and Performance"** **Chairman: Todor Ganchev**	**11:30 - 13:00 SESSION C22** **"Energy Systems and Smart Grids"** **Chairman: Nikolay Djagarov**
1. A Method for Synthesis of Families of Orthogonal Matrix Signals, Processed by Mismatched Filters, Borislav Bedzhev and Dobri Stoyanov (5789) **2. Simulation Environment for Studying EnOcean Communication Processes**, Georgi Genev and Aydan Haka (5999) **3. A Method for Synthesis of Complementary Quads of Binary Signals, Processed by Mismatched Filters**, Borislav Bedzhev and Deyan Atanasov (6909) **4. Machine learning dataset assembly interface**, Georgi Enchev, Dimitar Tsvetanov and Nikolay Djagarov (8904)	**1. Prime Generation and Factorization Parallelization: A comparative Study of CPU and GPU Parallelization,** Sofija Tasevska, Viktor Kostadinoski and Vladimir Zdraveski (2362) **2. Social Dynamics in Distributed Free and Open-Source Software Development: A Case Study,** Gnanendra Bachu (8104) **3. Analysis of spam detection techniques using machine learning,** Ginka Marinova (2974) **4. BAP-Blockchain-Assisted Attribute-Based Public Auditing for Secure and Transparent Cloud Storage,** Vimala Manohara Ruth Padeti and Dr. Ujwala Rekha Jinugu (7244)	**1. Unified, ontology-based information model for smart energy management systems,** Tsvetelina Ivanova, Polina Kesova, Yordan Belev and Idilia Batchkova (0467) **2. Simulation Model of a Solar Water Heating System with Vacuum Tubes Based on Real Data,** Nikolay Komitov, Margarita Terziyska and Zhelyazko Terziyski (3756) **3. Lightweight CNN-Based Machine Learning Approach for Thermographic Anomaly Detection in Photovoltaic Panels,** Antonio Karaganov and Filip Batalov (4547) **4. Survey and analysis of different types of rechargeable batteries, applicable to EVs and hybrid EVs,** Raycho Ilarionov, Ivan Simeonov, Hristo Kilifarev, Egnar Özdikililer and Borislav Nedev (6129)
13:00 – 14:00 LUNCH in the UNIVERSITY CANTEEN		

14:00 - 15:30 SESSION A23 **"Educational Technology and AI in Education"** **Chairman: Valentina Markova**	14:00 - 15:30 SESSION B23 **"IoT and Surveillance Systems"** **Chairman: Delyan Genkov**	14:00 - 15:30 SESSION C23 **"Artificial Intelligence and Machine Learning Applications"** **Chairman: Veneta Aleksieva**
1. Constructive thinking of students in educational telematics: the potential of robotics, Nurassyl Kerimbayev, Arailym Meiran, Vladimir Jotsov and Aliya Akramova (2247) **2. The influence of Generative AI on the transfer of algorithmic skills in students**, Nurassyl Kerimbayev, Zhanbota Menlibay, Rustam Shadiev, Esenbek Mambetakunov, Sholpan Kolumbayeva, Ainar Nurymova and Karlygash Adamova (7651) **3. Enhancing Accessibility with AI Algorithms: Simulating and Evaluating Human Typing Behaviour**, Radka Nacheva (8751) **4. Explainability of Multi-Agent AI Systems in Decentralized Educational Environments**, Radka Nacheva and Otmane Azeroual (8878)	**1. IoT Night Vision Goggles as a Multifunctional Surveillance and Real-Time Streaming Tool: Dual-Camera System Combining FPV, WiFi Streaming, and YOLO AI for Enhanced Detection and Live Streaming Applications,** Paul Daniel Calimoso, Kyle Siegfred K. Sumicad and Joseph Bryan Ibarra (7277) **2. Compact wireless sensors for energy consumption analysis and cost optimization in small, medium, and large enterprises,** Petar Georgiev (1126) **3. Emerging Sensing Technologies in Crime Investigation: Applications and Innovations - A Comprehensive Review,** Dimitar Rangelov, Radoslav Miltchev and Jaap Knotter (2597) **4. Detection of Sunflower Oil in Olive Oil Using a Multisensor System of the Artificial Nose Type**, Stefan Ivanov, Todor Todorov, Toshko Nenov, Jacek	**1. Driving Disruptive LLM Adoption on Technology Markets with Bug Report-Enhanced Human-Value Alignment in RLHF,** Teodora Nikolova and Miglena Molhova-Vladova (1290) **2. LLM Implementation for Multi-Objective University Timetabling: Technical Description,** Vitali Atias and Emil Doychev (2738) **3. Integration of Large Language Model Agents with Robot Operating System for Human-Robot Interaction and Task Allocation in Complex Environments,** Kaloyan Yovchev (4218) **4. RAG augmented Large Language Models as a tool for Education,** Samuel Teixeira, Mustafa Sonkaya and Petia Georgieva (9028)

	Wilk-Jakubowski and Stanimir Yordanov (4314)	
15:30 – 17:00 SESSION A24 **"Industrial Instrumentation and Control"** **Chairman: Nikola Nikolov**	**15:30 - 17:00 SESSION B24** **"Network Architecture and Cloud Computing"** **Chairman: Ivaylo Penev**	**15:30 - 17:00 SESSION C24** **"Machine Learning in Healthcare and Biometrics"** **Chairman: Cvetelina Georgieva**
1. Accuracy Optimization of Electro-magnetic Flowmeter via Empty Pipe Diagnostic Calibration, Pavel Dimitrov (5202) **2. Performance enhancement of PID control of nonlinear industrial plants via online fuzzy logic auto-tuning and genetic algorithms optimisation**, Desislava Delicheva and Snejana Yordanova (5497) **3. Design of a DCS-Based Experimental Platform for Evaluation of Industrial Flowmeters**, Pavel Dimitrov, Reneta Parvanova and Ivan Grigorov (7765) **4. Model Predictive Control-based High-level Control of Active Car Seat Suspension System**, Ivan Ruškan, Branimir Škugor, Joško Deur and Ivan Cvok (2178)	**1. Architectural Transformations in Networking: The Journey From Traditional Systems to Cloud-Based,** Mohammad Al Rawajbeh, Evon Abu-Taieh and Issam Alhadid (1312) **2. Architecture of an Application for Software Defined Network,** Delyan Genkov, Tsvetan Raykov, Miroslav Slavov and Hristo Kilifarev (3705) **3. Optimizing Zscaler SASE Disaster Recovery: region-aware and latency optimized load balancing,** Tsvetomir Bogdanov and Prof. Nayden Chivarov (1047) **4. Deployment and Verification of an automated backup solution for Zscaler Private Access (ZPA),** Tsvetomir Bogdanov and Nayden Chivarov (9065)	**1. Using Deep Learning Applications to Predict Brain Tumor Presence,** Hafsa Allauddin Shaikh, M. Kamran Asif, Moumita Mukherjee, Pratik Rughe and Shaurrya Baheti (3176) **2. Automated COVID-19 Screening Using Convolutional Neural Networks: Performance and Interpretability Analysis,** Nazar Zhanabergenov, Hafsa Allauddin Shaikh, Moumita Mukherjee, Muhammad Saqib and Meerah Karunanithi (8705) **3. Deep-SimPPG: A GAN- Based Hybrid Framework for Realistic Photoplethysmographic Signal Synthesis,** Galya Georgieva-Tsaneva, Yoan-Aleksandar Tsanev and Krasimir Cheshmedzhiev (3249)

		4. A Privacy-Preserving Architecture for Biomedical Signal Acquisition and Transmission Using Hybrid Cryptography and Regulatory-Aware Protocols, Galya Georgieva-Tsaneva, Krasimir Cheshmedzhiev, Miroslav Dechev and Yoan-Aleksandar Tsanev (2122)
16:30 – 17:00 COFFEE BREAK		
17:30 - 19:00 SESSION A25 **"Advanced Manufacturing and Materials"** **Chairman: Nikolay Djagarov**	**17:30 - 19:00 SESSION B25** **"5G Networks and Telecommunications"** **Chairman: Ventsislav Nikolov**	**17:30 - 19:00 SESSION C25** **"Financial Technology and Machine Learning"** **Chairman: Idilia Batchkova**
1. Tensile Testing at Elevated Temperatures of Test Specimens Made of Polymer Materials Obtained by Fused Deposition Modeling, Miglena Paneva, Peter Panev and Veselin Tsonev (1103) **2. The Role of Additive Manufacturing in Advanced Cooling Channel Design**, Todor Todorov, Georgi Todorov and Borislav Romanov (1375) **3. Investigation of Optimal Parameters for PLA Printed Details**, Kliment Georgiev (8513)	**1. Performance Analysis of 5G Advanced Synchronization Techniques using GNSS-Referenced Timing Analyzers,** Teodor Iliev and Ivelin Penkov (2636) **2. AI-Driven Trust Score-Based Synchronization Control for Robust 5G and Beyond Networks,** Teodor Iliev and Ivelin Penkov (3807) **3. Digital disruptor of communication and navigation systems using phase manipulation,** Konstantin Nesterov, Nikolay Gueorguiev, Atanas Nachev,	**1. Comparative Evaluation of Machine Learning Models for Credit Scoring in FinTech Applications,** Sayyed Khawar Abbas (2318) **2. Leveraging Language Models and Technical Analysis for Real-Time Crypto Trading Signal Generation,** Muhammad Saqib, M. Kamran Asif, Ahmed Hassan, Somesh Rewadkar and Zeeshan Ali (3428) **3. Ensemble Methods for Predicting Continuous Cash Flow in Credit Risk**

4. Investigating the Hardness of Test Specimens Made of Fused Deposition Modeling Materials, Miglena Paneva, Peter Panev and Gabriela Kotseva (8569)	Ognyan Todorov and Yavor Boychev (3771) **4. System for emitting radio signals with a fictitious electromagnetic center,** Konstantin Nesterov, Nikolay Gueorguiev, Atanas Nachev, Yavor Boychev, Kamen Vasilev and Svetlana Yaneva (6965)	**Assessment,** Dimitre Tomov and Veta Grigorova (3472) **4. Comparison of Classification Algorithms for Notebook Fault Prediction System Using Machine Learning,** Ralitza Raynova (2812)
20:00 GALA DINNER in the BM City restaurant (it is located behind the Festival and Congress Center)		

Saturday, October 11th

Stream 1 In attendance (In-person) (Room A – Hall 109TV)	**Stream 2 Online (Virtual) (Room B)**	**Stream 3 Online (Virtual) (Room C)**
09:00 - 10:30 SESSION A31 **"Neural Networks and AI Applications"** **Chairman: Aydan Haka**	**09:00 - 10:30 SESSION B31** **"Cryptography and Security Systems"** **Chairman: Ventsislav Nikolov**	**09:00 - 10:30 SESSION C31** **"E-Learning and Educational Technology"** **Chairman: Galina Ivanova**
1. Camera calibration by a neural network with parallel sub-layers with different activation functions for robotic lab setup, Zhivko Zhekov, Elena Vasileva and Dian Dzhibarov (1119) **2. Impact Of Classifier Choice On Automa-ted Spam Detection: An Experimental Analysis**, Stefka Popova, Hristo Nenov and Velislav Kolesnichenko (2206) **3. Evaluating Neural Network Parameter Effects on Spam Classification Accuracy**, Stefka Popova, Hristo Nenov and Genoveva Dimitrova (5408) **4. Comparison of Artificial Neural Networks with Dictionary-Based Approach in Aspect-Based Sentiment**	**1. Simulation and evaluation of a quantum-aware chaotic OTP generator in MATLAB,** Dilyana Dimitrova (1199) **2. Design of a quantum-aware chaotic one-time password generator,** Dilyana Dimitrova (4243) **3. Secure communication scheme based on chaotic switching between non-identical systems,** Hristina Stoycheva (4330) **4. Comparative Analysis of Different Types of Chaotic Synchronization,** Hristina Stoycheva (9175)	**1. Development of an Information System for Accreditation and Assessment in Education,** Baktygul Akulova, Burul Tashtobaeva, Tzvetomir Vassilev and Bibigul Koshoeva (0225) **2. The Role of Intelligent Systems in E-Learning for Financial Education in the Digital Age,** Angel Popgeorgiev, Elitsa Ibryamova and Galina Ivanova (0617) **3. Assessment of the Use of E-learning Resources and Platforms in the Education of Students in General Education Schools,** Milena Velikova and Galina Ivanova (1736) **4. Gamification and AI: Rethinking E-Learning Experiences,** Aleksandra

Analysis, Harun Aksaya, Sevinc Gulsecen and Natalija Lepkova (8409)		Kovacheva, Neviana Krasteva and Tsvetan Davidkov (5040)
10:30 - 12:00 SESSION A32 **"Software Architecture and Development"** **Chairman: Hristo Valchanov**	**10:30 - 12:00 SESSION B32** **"Network Security and Encryption"** **Chairman: Delyan Genkov**	**10:30 - 12:00 SESSION C32** **"Educational Assessment and Quality"** **Chairman: Milena Karova**
1. Keeping Up When Disconnected: Applying Conflict-Free Replication to Digital Twin Architectures, Petar Chakalov and Svetoslav Enkov (2020) **2. SASet: A Unified Approach for Modeling and Interaction of Multiple Architectures in Large Software Applications**, Hristo Hristov (7180) **3. Supply Chain Logistics Marine Simulator with Smart AI Assistant**, Danail Dimitrov, Plamena Atanasova, Milena Karova, Gergana Spasova and Bozhidar Dyakov (9445) **4. Structural Analysis of a Smart Home System in Accomodation Residence**, Desislava Mihaylova and Miroslav Akbatirov (9716)	**1. An Approach to Network Key Encryption in the Zigbee Network for IoT**, Marieta Haka, Aydan Haka, Veneta Aleksieva and Hristo Valchanov (3471) **2. Enhancing the Security of Computer Systems Through the Use of Specialized Supplementary Modules,** Dako Dimov and Vladimir Sulov (2849) **3. Development of experimental device for data acquisition from accelerometric sensor,** Dimitar Dimitrov and Stefan Ivanov (8443) **4. Algorithm for Generation of Bent Functions using Wavelet Transform,** Alla Levina and Ilya Shibakin (8844)	**1. Aware Foreign Language Assessment with Integrated Speech-to-Speech Translation and Multimodal Learning Analytics**, George Pashev and Silvia Gaftandzhieva (1592) **2. Using Software Solutions for Quality Assessment in School Education,** Silvia Gaftandzhieva, Rositsa Doneva, Mariya Docheva, George Pashev and George Totkov (1705) **3. Automated Analysis Of Results Obtained From The Most Widely Used Online Testing Platform,** Monika Petrunova, Atanas Atanassov and Dimitar Pilev (2568) **4. A Study of Affordable Online Proctoring Solutions with AI and Moodle Integration,** Tzvetomir Vassilev and Hristo Beloev (8019)

12:00 - 13:30 SESSION A33 **"Healthcare Informatics and Medical Applications"** **Chairman: Nikola Shakev**	**12:00 - 13:30 SESSION B33** **"UAV and Radar Systems"** **Chairman: Ivan Garvanov**	**12:00 - 13:30 SESSION C33** **"E-Government and Public Services"** **Chairman: Tzvetomir Vassilev**
1. Comparative Analysis of Methods for ADHD Diagnosis Using EEG – systematic review, Elena Nikolova (1369) **2. Design and Evaluation of an Ergonomic Ultralight Face Shield for Enhanced Protection Against Aerosol Transmission in Children**, Todor Todorov, Georgi Todorov and Yavor Sofronov (4083) **3. Conveying respiratory care towards sub-symbolic models: Data-Centric Approaches to Mitigate VILI and Patient-Ventilator Asynchrony**, Ivelin Karageorgiev, Sevil Ahmed-Shieva, Nikola Shakev and Ivaylo Minev (4920) **4. Pre-processing and data analysis of Mechanical Ventilation parameters used in Mechanical Power**, Ralitsa Petrova, Sevil Ahmed-Shieva, Nikola Shakev and Ivaylo Minev (9207)	**1. Comparative Analysis of Algorithms for Detection and Classification of UAV in Video Surveillance,** Ivan Garvanov, Miroslav Tsintsarski and Magdalena Garvanova (2007) **2. Moving Object Detection with Doppler Radar,** Ivan Garvanov, Magdalena Garvanova, Georgi Tsonkov, Daniela Borissova, Gabriela Garvanova and Maria Mindova (2197) **3. Logical Data Corruption in UAV Storage: Forensic Analysis and Recovery Techniques, Logical Data Corruption in UAV Storage: Forensic Analysis and Recovery Techniques,** Azamat Baibussinov, Kaisarbek Yesbergenov and Gulnara Abitova (5647) **4. Advanced Non-Volatile Memory Technologies for Military Robotics: Architecture, Applications, and Future Trends,** Azamat Baibussinov, Kaisarbek Yesbergenov and Gulnara Abitova (3244)	**1. Leveraging Open Data for Transparency and Efficiency in Katarungang Pambarangay in Malabon City,** Ezekiel Borja and Rodolfo Jr Raga (2831) **2. Analysis of Learning Management System of Selected Private HEI: An Assessment,** Ezekiel Borja, Cristine Erica Untalan, Mark Anthony Gipit, Irish Delos Santos, Cheryl Lou Tinaan and Michael Carlo Carriedo (5621) **3. Information and Communication Technologies in Education: Challenges and Opportunities for the Classroom System,** Julia Doncheva and Tzvetomir Vassilev (6104) **4. Competency-Based Training in Artificial Intelligence - an Innovative Approach in E-Learning,** Silvia Parusheva, Petya Strashimirova and Bistra Vassileva (7932)

13:00 – 14:00 LUNCH		
14:30 - 16:00 SESSION A34 **"Supply Chain and Agricultural Informatics"** **Chairman: Milena Karova**	**14:30 - 16:00 SESSION B34** **"Digital Innovation in Technical and Environmental Applications"** **Chairman: Kosta Boshnakov**	**14:30 - 16:00 SESSION C34** **"Tourism and AI Applications"** **Chairman: Aldeniz Rashidov**
1. Intelligent supply chain management, emphasizing the public procurement requirements for supplying food to kindergartens, Laska Kostadinova-Tsankova, Stanimir Stoyanov, Veneta Tabakova-Komsalova, Ivan Stoyanov, Asya Stoyanova-Doycheva and Katharina Wassilew (3655) **2. Power Supply Units in Bee Behaviour Monitoring Systems**, Dimitar Avramov and Ivaylo Penev (5731) **3. Cross-Platform Integration of Ontologies and Information Extraction for Plant Genetic Resources for the Bulgarian National GeneBank**, Pencho Malinov, Sebiha Madanska, Emil Doychev, Laska Kostadinova-Tsankova, Ivan Stoyanov and Katharina Wassilew (6517) **4. Generative Adversarial Network for Cold Nuclear Fusion Data Set Generation**, Todor Malchev, Milena Lazarova, Yordan Paunov and Dimiter Alexandrov (0286)	**1. Democratizing IVDR Technology: Low-Cost Real-Time Driver Feedback Using Consumer Hardware**, David Trajkoski, Aleksandar Karadimche and Dijana Capeska Bogatinoska (0861) **2. Analysis and Validation of the Mechanical Ventilator performance**, Arbnor Pajaziti and Petrit Abdyli (6993) **3. Spatiotemporal Analysis of Forest Degradation and Avian Habitat Stress in the Varna Region Using Satellite Data**, Philipa Aleksandrova, Chavdar Alexandrov and Miroslav Tsvetkov (9164) **4. Stitch-agnostic, Technique-aware Data Model for Digital Embroidery Pattern Design,** Stefan Bozov and Elena Zaharieva-Stoyanova (8643)	**1. Contextual Sentiment Analysis for Tourism with Hybrid Models: Evidence from YouTube Reviews of Kazakhstan,** Arseniy Bapanov, Aslanbek Murzakhmetov, Nurbol Beisov and Maxatbek Satymbekov (6121 **2. Multilingual Semantic Analysis of Tourist Destinations with Transformer-Based Language Models,** Aslanbek Murzakhmetov, Nurbol Beisov, Arseniy Bapanov and Maxatbek Satymbekov (8811) **3. Industry 5.0 - the use of new business models and artificial intelligence in tourism in Bulgaria,** Neviana Krasteva (7758)

16:00 – 16:30 BREAK	
16:30 - 18:00 SESSION A35 **"Digital Society and Social Informatics"** **Chairman: Veneta Aleksieva**	**16:30 - 18:00 SESSION B35** **"Digital Systems and Interfaces: Applications Across Disciplines"** **Chairman: Nikola Nikolov**
1. Obfuscating online gambling and addiction behind progression in digital card games, Boris Bankov (1367) **2. E-Learning And Quality Of Life In Older Age**, Irina Todorova and Dimana Dilova-Vasileva (2798) **3. From Books to Screens: How Older Adults Use the Internet to Sustain Cognitive and Social Activity**, Irina Todorova and Dimana Dilova-Vasileva (5370) **4. Cyberbullying between children and adolescents: perceptions of caregivers**, Ivaylo Tsanov and Plamena Markova (5483)	**1. Digital Immortality — A Comprehensive Survey of Technologies, Ethics and Societal Impacts**, Svetlana Syarova, Elina Petkova-Gueorguieva, Victoria Angelova, Evelina Zdravkova, Yoana Hadzhiyska and Stefka Toleva-Stoimenova (5285) **2. Dot-based, Dual-view User Interface for Realistic Embroidery Simulation in Cross-stitch Software**, Stefan Bozov and Elena Zaharieva-Stoyanova (6356) **3. Exploring the potential of NDVI derivatives for monitoring in precision agriculture**, Asparuh Atanasov, Plamen Petrov and Radostina Yankova (7654)
18:00 – 18:15 CLOSING CEREMONY	

PLENARY SESSION 1	**Stream 1**
Chairman: Kosta Boshnakov	University of Chemical Technology and Metallurgy, BG
Thursday, October 09th 10:00 – 11:00	Conference Hall NUK

Neural Computation for Socioeconomic Forecasting in Turbulent Times

George Mengov *Sofia University St. Kliment Ohridski, BG*

Abstract: Most computer methods in the social sciences traditionally rely on linear models. That approach has been justified by limited amounts of data, and by a need to capture reliably the mainstream trends. Over the last decades, however, the advent of versatile big data, powerful computing capabilities, and machine learning algorithms created vast new opportunities for analysis and deeper understanding of the socioeconomic reality. Neural networks have been at the forefront of this progress. Their ability to deal with noisy and imprecise data, alongside their modelling flexibility, makes them indispensable in the attempts to forecast business, economic, and social processes.

This talk presents a set of neural models successfully used in problems of macroeconomics, international trade, economic choice predictability, decision making under uncertainty, and human work motivation. All of these models implement results from mathematical neuroscience and are closer to the actual brain mechanisms than some widely used deep neural networks. Thus, it becomes possible to arrive at discoveries such as these: (1) When people take economic decisions in a virtual social network, they become more predictable by a neural model; (2) Forecasting by neural computation under economic shocks becomes as good as the best state-of-the-art econometric models; (3) In turbulent times, human work characteristics, attitudes, and dispositions remain stable; All the same, employees rethink unpredictably their commitment, loyalty, and in general – their relationship with their organization. For some of these findings a new computationally efficient, explainable, and novelty detecting neural network is used for the first time.

PLENARY SESSION 2	**Stream 1**
Chairman: Hristo Valchanov	Technical University of Varna, BG
Friday, October 10th 09:00 – 10:00	Online

Interpretable Machine learning methods for management of 5G networks

Petia Georgieva *University of Aveiro - Portugal, PT*

Abstract: The goal of this talk is to introduce the Artificial Intelligence (AI) framework as a promising approach to deal with the next generation (5G+/6G) complex communication networks that are expected to embed a wide range of services and operations. In the first part of the talk the most relevant machine learning and deep learning methods will be presented, such as Artificial Neural Networks (ANN) architectures suitable for time series processing and short/long term predictions. The second part will summarise our experience in applying AI for 5G management in different scenarios. Long Short Time Memory (LSTM) versus Gated Recurrent Unit (GRU) will be exemplified to forecast Key Performance Indicators (KPI) for cellular network traffic. Graph Convolutional Networks will be illustrated for dynamic connectivity prediction.

SESSION A11 "CONTROL AND OPTIMIZATION"	**Stream 1**
Chairman: Kamen Perev	Technical University of Sofia, BG
Thursday, October 09th 11:00 – 12:30	Hall 109TV

Feedback Control Structure for Nonlinear Plants

Kamen Perev *Technical University of Sofia, BG*

Abstract: The paper considers the problem of nonlinear system control. The controller design procedure is based on local feedback linearization of the nonlinear plant and then by using linear techniques to derive the controller model. The linearization properties of the feedback structure are presented and it is shown that these properties depend on the nonlinear version of the sensitivity function. A special local feedback structure called conditional feedback is proposed and its sensitivity properties with respect to unmodeled dynamics are derived. The proposed method for nonlinear plant control based on local feedback linearization is demonstrated by a numerical example showing its advantage with respect to direct application of linear system control techniques.

Algorithm for adaptive smoothing of contour curves in a Voronoi diagram

Ognyan Zhelezov *Nikola Vaptsarov Naval Academy Varna, BG*

Valentina Petrova *Nikola Vaptsarov Naval Academy Varna, BG*

Abstract: The article proposes an algorithm for adaptive smoothing of the contours of graphic objects in a Voronoi diagram using digital filtering with an averaging filter. It is proven that the size of the averaging window when filtering the numerical series representing the contour curves can be obtained for the individual areas by setting a minimum length for the contours of the objects. As a practical result, an example is given of the application of adaptive smoothing of graphic objects in a Voronoi diagram obtained with a test program SFTessellation.

Parameter Optimization Using Experimental Design and Statistical Modeling for Injection Molding

Todor Todorov *Technical University of Sofia, BG*

Georgi Todorov *Technical University of Sofia, BG*

Borislav Romanov *Technical University of Sofia, BG*

Abstract: The study focuses on optimizing the injection molding process by applying experimental design methods. The main task is to develop a systematic approach for analyzing the structural and technological parameters that influence mold filling stages. The study consists an evaluation of the molded part, assessing its design and manufacturability. A key aspect of the analysis is the cooling channel system, which plays a crucial role in process efficiency and

part quality. By implementing statistical modeling, the research aims to predict the filling behavior of the injection mold, identifying the most significant parameters that impact the process. A statistical model of the mold filling phase is developed based on experimental data, enabling the selection of the most influential process parameters to achieve the desired final result. This model will provide a practical approach to process control and optimization. The optimization steps are detailed, emphasizing the minimum required number of analyses to achieve reliable results. By systematically refining the process with experimental design techniques, the study aims to enhance efficiency, reduce material waste, and improve product quality in injection molding.

Testing the Case of Knapsack-like Portfolio Optimization Using Various Evolutionary Algorithms

Nikolay Penchev *Sofia University "St. Kliment Ohridski", BG*

Angel Marchev *University of National and Wordl Economy, BG*

Abstract: This study examines the optimization of asset allocation within a portfolio to achieve a cost-efficient solution. Each asset is characterized by three properties: investment cost, expected return, and risk. However, during optimization, we consider only two properties, investment cost and the Sharpe ratio, which combines return and risk into a single metric. We compare several evolutionary algorithms, including genetic algorithms, evolution strategies, and memetic algorithms. A dynamic programming approach and a random chromosome strategy (BASE) are also used as baseline solutions. The performance of these algorithms is evaluated using datasets of varying sizes, consisting of 10, 100, 1,000, and 10,000 assets.

SESSION B11 “CONTROL THEORY AND PWM SYSTEMS”	**Stream 2**
Chairman: Alexandar Ichtev	Technical University of Sofia, BG
Thursday, October 09th 11:00 – 12:30	Online

Robust Control of PWM Inverter in Robotic System

Georgi Stefanov *Technical University of Sofia, BG*

Abstract: This study addresses the design and control of a PWM inverter used in the technological modules of a robotic system. The application of robust control with an internal model (IMC) and the free parameter method for controlling this class of systems is examined. The paper presents modeling and simulation results, along with analytical conclusions that demonstrate improved robustness and accuracy in the presence of various disturbances.

Robust LMI based Model Predictive Control for discrete-time singular systems

Andrey Yonchev *Technical University of Sofia, BG*

Abstract: This paper addresses the robust model predictive control (RMPC) for singular systems based on linear matrix inequalities (LMIs). The uncertain singular system is represented as a polytopic model, then a min-max approach is implemented to perform the RMPC design. In the proposed derivation procedure we theoretically replace the maximization of the considered cost function with a proper upper bound. The derived approach to perform RMPC in discrete-time case is valid under some conditions suitable for the singular systems. A theorem, involving LMIs and its proof is presented. Illustrative examples depicting the efficiency of the obtained approach are also included.

Network Flows with Potentials at the Network Vertices

Vassil Sgurev *Institute of Information and Communication Technologies BAS, BG*

Lyubka Doukovska *Institute of Information and Communication Technologies BAS, BG*

Abstract: A new class of network flows is proposed in which potentials are introduced – flows on the vertices of the network. It is called network flow with potentials (NFP). This leads to a qualitatively new structure with more possibilities than the classical interface flow. A strict definition of this new class of network flows is given. In it, the same vertex can be in one of three states – source, consumer, and flow storage vertex. The throughput of the potentials in the network vertices is defined. A method for flow optimization with simultaneous evaluations on the arcs and vertices of the network is proposed. An example of using the network flow with potentials to solve the practical problem is described. Directions for future research in the field of network flows with potentials are defined.

Computational Fluid Dynamics usage for development of Digital Twin for Chemical Reactor with Periodical Action

Plamen Vasilev *University of Chemical Technology and Metallurgy, BG*

Nedko Perchemliev *University of Chemical Technology and Metallurgy, BG*

Abstract: Batch reactors, commonly used in the chemical and pharmaceutical industries for small to medium-scale production, present unique challenges as control objects due to their inherent operational characteristics. They are most often used for syntheses in the pharmaceutical, microbiological, multi-assortment, and small-tonnage productions, polymerization processes, some processes in the pulp and paper industry, and the production of polyester fibers. The various application is why they are a subject of process modelling. Their dynamic behavior must be modeled and simulated in such a way that the results and obtained characteristics can be used in building a digital twin. This article describes the examination and modelling of processes in a periodic chemical reactor, using the software products of the Ansys platform.

SESSION C11 "SEARCH ALGORITHMS AND OPTIMIZATION"	**Stream 3**
Chairman: Valentina Markova	Technical University of Varna, BG
Thursday, October 09th 11:00 – 12:30	Online

Algorithmic Efficiency in Rubik's Cube Solving: A Study of Timeout Rates, Solution Quality, and Heuristic Limitations

Miguel Angel Garcia Higuita — *University of Europe for Applied Sciences, DE*
Shan Faiz — *University of Europe for Applied Sciences, DE*
Rand Koutaly — *University of Europe for Applied Sciences, DE*
Loubna Ali — *Berlin School of Business and Innovation, DE*
Meerah Karunanithi — *University of Europe for Applied Sciences, DE*

Abstract: Solving the Rubik's Cube represents a classical benchmark for evaluating search algorithms in artificial intelligence due to its well-defined state space and computational complexity. The application of search techniques to this problem offers insights into algorithmic efficiency and practical performance in constrained environments. Despite extensive research on heuristic search methods, comparative studies involving uninformed and informed search strategies applied to different cube sizes remain limited. This study addresses that gap by evaluating Depth-First Search (DFS), Breadth-First Search (BFS), and A* Search in solving the NxN Rubik's Cube. The experiment involves a facelet-based representation of the cube and simulates randomized scrambles of increasing complexity. Each algorithm is implemented in C++ and evaluated on performance metrics including solution length, execution time, and completeness under varied depth limits and cube sizes. Results show that A* Search consistently outperforms both DFS and BFS in terms of execution speed and reliability, achieving optimal or near-optimal solutions without timeouts. BFS demonstrates optimality but suffers from scalability, while DFS offers flexibility with higher time costs. This study provides a practical and measurable comparison of search strategies, highlighting A* as the most balanced approach for real-time puzzle solving within smart systems. Index Terms—Rubik's Cube, Search Algorithms, A* Algorithm, Depth-First Search, Breadth-First Search, Artificial Intelligence, Heuristic Search, State Space Exploration.

A Comparative Analysis of Informed and Uninformed Search Algorithms for the 8-Puzzle Problem with a Novel Hybrid Approach

Petar Mileski — *University of Information Science and Technology "St. Paul the Apostle"- Ohrid, MK*
Dijana Capeska Bogatinoska — *University of Information Science and Technology "St. Paul the Apostle"- Ohrid, MK*

Aleksandar Karadimche — *University of Information Science and Technology "St. Paul the Apostle"- Ohrid, MK*

Abstract: The 8-puzzle problem serves as a fundamental benchmark for evaluating search algorithm performance in artificial intelligence applications. This paper presents a comprehensive comparative analysis of informed and uninformed search algorithms for solving the 8-puzzle problem, including Breadth-First Search (BFS), Depth-First Search (DFS), Greedy Best-First Search, and A* Search. Additionally, we introduce a novel hybrid approach called Hybrid-ADFS (A-Driven Depth-First Search) that integrates the heuristic guidance of A* with the memory-efficient exploration of depth-limited DFS. The study evaluates algorithm performance across four critical dimensions: completeness, optimality, time complexity, and space complexity. Experimental results on ten carefully selected 8-puzzle instances demonstrate that while A* provides the most balanced performance with guaranteed optimal solutions, the proposed Hybrid-ADFS algorithm achieves competitive execution times with significantly reduced node expansion (9-75 nodes compared to 71-887 for A*) while maintaining complete problem-solving capability. BFS ensures optimality but suffers from prohibitive memory consumption (up to 49MB), while DFS offers excellent memory efficiency but lacks reliability, failing on 20% of test cases. Greedy Best-First Search achieves superior speed but produces severely suboptimal solutions with path lengths up to 346% longer than optimal. The Hybrid-ADFS algorithm demonstrates promising characteristics for resource-constrained environments, successfully solving all test instances with execution times ranging from 0.013 to 0.095 seconds and memory usage between 185-1,112 KB. These findings provide valuable insights for algorithm selection in practical AI applications and establish the potential of hybrid approaches for balancing optimality, efficiency, and resource management in search problems.

Visualizing Search Algorithms: A Practical Approach Using the Rubik's Cube

Eslam Aly — *University of Europe for Applied Sciences, DE*

Syed Arslan Abbas Rizvi — *Berlin School of Business and Innovation, DE*

Ahmed Hassan — *Arden University Berlin, DE*

Loubna Ali — *Berlin School of Business and Innovation, DE*

Pratik Rughe — *University of Europe for Applied Sciences, DE*

Abstract: The Rubik's Cube represents a canonical combinatorial search problem with an enormous discrete state space, making it a compelling testbed for evaluating algorithmic performance in artificial intelligence. Efficient cube-solving techniques have broader implications for robotics, automated planning, and optimization in resource-constrained environments. However, prior research has primarily focused on machine learning or phase-based solvers, with limited comparative analysis of classical search strategies. In particular, there exists no scalable benchmark contrasting uninformed methods such as Depth-First Search (DFS) and Breadth-First Search (BFS) with informed search like A* across varying cube complexities. To address this gap, we developed a modular Python simulator capable of handling cubes from 2×2×2 to 6×6×6 and generating randomized scramble sequences. We evaluated DFS, BFS, and A* under uniform depth and heuristic constraints, measuring solve time, memory usage, and solution length over 100 randomized trials per configuration. Results show that A* consistently achieves the best trade-off between speed and memory efficiency as cube complexity increases. BFS guarantees optimal solutions but exhibits prohibitive memory usage, while DFS maintains low memory consumption at the cost of longer, suboptimal paths. This work introduces a reproducible benchmarking framework for Rubik's Cube solvers and provides baseline performance metrics for future research on classical and heuristic-guided search methods.

N-Queens using Genetic Algorithm: a comparative study

Mehul Jain — *University of Europe for Applied Sciences, DE*
Ahmed Hassan — *Arden University Berlin, DE*
Muhmmad Saqib — *Arden University Berlin, DE*
Syed Arslan Abbas Rizvi — *Berlin School of Business and Innovation, DE*
Somesh Rewadkar — *University of Europe for Applied Sciences, DE*
Rand Kouatly — *University of Europe for Applied Sciences, DE*

Abstract: This paper aims to shed light on the use of genetic algorithm to solve for the N Queens problem on values of N that are too large to compute using the simple backtracking method. The N Queens problem is where Queens are to be placed on a N*N matrix that represents a chessboard such that no two queens are able to be in contact with each other. The textbook solution for the problem is to use backtracking, a problem-solving algorithmic technique that involves finding a solution incrementally and reverting to the previous state when one route is blocked. This approach can become computationally infeasible when the value of N is too large. By implementing the solution using a genetic algorithm we see a sharp drop in the complexity and the time taken for higher values of N. We

compare and contrast the approach with the backtracking method and conclude the superior efficiency of genetic algorithm for this particular problem.

SESSION A12 "MACHINE LEARNING AND DATA ANALYSIS"	**Stream 1**
Chairman: George Mengov	Sofia University St. Kliment Ohridski, BG
Thursday, October 09th 13:30 – 15:00	Hall 109TV

Predictive Limits, Imposed by Likert-type Data

George Mengov — *Sofia University St. Kliment Ohridski, BG*
Dimitar Gotchev — *Experian Bulgaria Ltd, BG*
Irina Zinovieva — *Sofia University St. Kliment Ohridski, BG*
Iliyan Nenov — *Sofia University St. Kliment Ohridski, BG*

Abstract: Likert-type data are indispensable in today's socio-economic research due to the efficient procedures for their practical application. However, theoretical deficiencies, issues of measurement imprecision, and instability impose limits on their use for forecasting. Here we present an extreme case by examining key variables from a study on work motivation during the turbulent 1990s in Bulgaria. The data properties are such that an advanced neural network and a lagged-panel regression model achieve equal results. Both hit a forecasting 'glass ceiling', showing how analytical methods cannot go beyond what the data would allow.

Predicting Student Placement Status Using Tree-Based Ensemble Classifiers

Ivo Rakitin — *Technical University of Varna, BG*
Evgeniya Rakitina-Qureshi — *Technical University of Varna, BG*
Neli Arabadzhieva-Kalcheva — *Technical University of Varna, BG*
Maya Todorova — *Technical University of Varna, BG*
Ivaylo Penev — *Technical University of Varna, BG*
Daniela Petrova — *Technical University of Varna, BG*

Abstract: This study compares Random Forest and Gradient Boosting for predicting student placement outcomes using age, GPA, failed courses, and attendance from a 2,000- record dataset (80/20 train/test split). Both models achieved ~87% test accuracy, with balanced precision, recall, and F1- scores (0.86–0.88). Attendance and GPA emerged as key predictors via feature importance analysis. Gradient Boosting slightly outperformed in reducing misclassifications for nonplaced students, while Random Forest showed better precisionrecall balance (AP: 0.93 vs. 0.77). These results endorse ensemble methods for enhancing educational analytics and targeted interventions.

Random Forest versus Logistic Regression for Student Placement Prediction in Complex Educational Data

Evgeniya Rakitina-Qureshi — *Technical University of Varna, BG*

Ivo Rakitin — *Technical University of Varna, BG*
Neli Arabadzhieva-Kalcheva — *Technical University of Varna, BG*
Hristo Nenov — *Technical University of Varna, BG*
Stefka Popova — *Technical University of Varna, BG*
Velislav Kolesnichenko — *Technical University of Varna, BG*

Abstract: This paper compares Random Forest and Logistic Regression for predicting student placement based on age, GPA, failed courses, and attendance. Data preprocessing included normalization, feature engineering, and an 80–20 stratified split. Logistic Regression used L2 regularization; Random Forest applied 200 trees with entropy splitting. Performance was evaluated using accuracy, precision, recall, F1-score, and AUC-ROC. Random Forest achieved 91.52% accuracy and 0.9743 AUC-ROC, outperforming Logistic Regression's 76.11% accuracy and 0.7241 AUC-ROC, due to better handling of non-linear feature interactions. Attendance and GPA were the most influential predictors. Results demonstrate the superiority of ensemble methods for complex educational data and support their use in early student risk detection.

Decision Trees, Random Forests, and Hybrid Ensembles for Ordinal Survey Data Analysis

Evgeniya Rakitina-Qureshi — *Technical University of Varna, BG*
Ivo Rakitin — *Technical University of Varna, BG*
Neli Arabadzhieva-Kalcheva — *Technical University of Varna, BG*
Maya Todorova — *Technical University of Varna, BG*
Donika Stoyanova — *Technical University of Varna, BG*
Dimitrichka Nikolaeva — *Technical University of Varna, BG*

Abstract: This study compares Decision Trees (DT), Random Forests (RF), and hybrid deep learning models on eight years of ordinal university survey data, predicting a key satisfaction question from related items. Using statistical and visual analyses, we evaluate accuracy, Mean Absolute Error (MAE), interpretability, and efficiency. DT provides transparent rules but lower accuracy and higher variance. RF improves performance with more balanced feature importance and greater stability. Hybrids further enhance accuracy and robustness through nonlinear modeling. Overall, DT is suitable for exploratory, interpretable analyses, while RF and hybrids offer superior predictive capability. Findings highlight that ensemble methods outperform DT, capturing multifaceted influences on student satisfaction and supporting targeted refinements in educational surveys and decision-making.

SESSION B12 "ROBOTICS AND CONTROL SYSTEMS"	**Stream 2**
Chairman: Vladimir Hristov	Technical University of Sofia, BG
Thursday, October 09th 13:30 – 15:00	Online

Model-Free Super-Twisting Control for Rigid-Flexible Coupled Robotic Mechanisms with Time-Delay Estimation

Yang Shen *Nanjing University of Science and Technology, CN*
Haoping Wang *Nanjing University of Science and Technology, CN*
Yang Tian *Nanjing University of Science and Technology, CN*

Abstract: To obtain high-accuracy trajectory tracking control under complicated and unknown uncertainties of rigidflexible coupled robotic mechanisms, a super-twisting nonsingular fast terminal sliding mode (ST-NFTSM) control system based on time-delay estimate (TDE) is presented. There are three main terms that make up the suggested TDE-based STNFTSM control approach. The TDE term estimates and compensates for the remaining system dynamics. The ST term is employed to ensure improved dynamic performance and resilience throughout the reaching phase. In order to guarantee quick convergence and accuracy throughout the sliding mode phase, the NFTSM term is used. The TDE system enables model-free control. Meanwhile, the ST and NFTSM terms may assure rapid convergence, strong robustness, and high precision. The stability of the system is assessed using the Lyapunov technique. At last, comparison simulations prove the effectiveness and superiority of the ST-NFTSM control system based on TDE that is newly proposed by this paper.

Adaptive Performance-Guaranteed Control with Safety Constraints for Continuum Robots: A 6-DoF Elephant Trunk Robot System

Dong Zhang *Nanjing University of Science and Technology, CN*
Haoping Wang *Nanjing University of Science and Technology, CN*
Yang Tian *Nanjing University of Science and Technology, CN*

Abstract: This paper presents an integrated adaptive control framework for continuum robots that ensures precise trajectory tracking while guaranteeing operational safety. This paper propose a synergistic approach combining Ultra-Local Model (ULM) formulation for model-free control, Adaptive Time-Delay Estimation (ATDE) for real-time disturbance compensation, Prescribed Performance Control (PPC) for bounded tracking errors, and Control Barrier Functions (CBFs) for safety constraint enforcement. The ULM eliminates dependence on complex dynamic models, while ATDE handles lumped uncertainties. PPC confines tracking errors within user-defined boundaries, and CBFs ensure satisfaction of joint limits and collision avoidance constraints. Lyapunov analysis establishes exponential convergence to a bounded residual

set with formal safety guarantees. Simulations on a 6-DOF continuum manipulator demonstrate superior tracking accuracy and constraint satisfaction, validating the framework's effectiveness for safety-critical applications requiring both precision and robustness.

A framework for trajectory optimization of an industrial KUKA robot

Georgi Georgiev *University of Chemical Technology and Metallurgy, BG*

Abstract: The paper presents a trajectory planning and execution framework for a 6-DOF KUKA robotic arm operating in environments with obstacles. The method combines trapezoidal velocity profiles and high-order polynomial trajectories to compute smooth, collision-free paths. Developed in MATLAB Simulink, the simulation framework supports modular, real-time analysis of robotic motion. Forward and inverse kinematics are used to ensure feasible joint and end-effector movements. Simulation results show that hybrid trajectory planning improves motion smoothness, reduces mechanical stress, and lowers collision risks compared to singular approaches. This contributes to more efficient and reliable automation, particularly in applications like precision assembly, automated manufacturing, and service robotics. The study highlights the advantages of integrating multiple planning techniques to optimize robot performance in cluttered or dynamic workspaces. By offering a flexible and executable planning system, the framework enhances robotic motion efficiency, safety, and adaptability in complex industrial environments.

Mathematical Modeling of an Automated Assembling Machine for Door Locks

Ilian Iliev *Technical University of Varna, BG*
Reneta Parvanova *Technical University of Varna, BG*
Desislava Mihaylova *Technical University of Varna, BG*

Abstract: The paper provides mathematical grounds supporting an updated production process. The subject of investigation is a door lock assembly machine, which has been renovated to correspond to the design requirements of a new production line distinguished with improved latching. Adequate modeling with contemporary engineering tools is examined in depth. Time, kinematic, logical and probabilistic models are covered, as well as methods for sustainable and adaptive control. An analytical approach referring robot control algorithms has been applied, along with simulations and reliability analysis.

SESSION C12 “OPTIMIZATION AND METAHEURISTICS”	**Stream 3**
Chairman: Alexandra Grancharova	University of Chemical Technology and Metallurgy, BG
Thursday, October 09th 13:30 – 15:00	Online

Metaheuristic Algorithms for Transport Planning: Simulated Annealing and Ant Colony Optimization

Adelina Petkova *University of Plovdiv "Paisii Hilendarski", BG*
Martin Vassilev *University of Plovdiv "Paisii Hilendarski", BG*
Alexander Penev *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: Urban transportation systems face increasing challenges related to efficiency, accessibility, and adaptability. This paper explores a methodology for optimizing public transport networks through the application of mathematical models and metaheuristic algorithms. By integrating techniques such as Simulated Annealing and Ant Colony Optimization (ACO), the approach aims to improve route planning, reduce travel time, and balance passenger loads. The proposed framework supports flexible adaptation to both small urban centers and large metropolitan areas, making it scalable across various contexts. The work emphasizes the potential of heuristic optimization as a practical tool for tackling the complexity of real-world transit planning. By shifting from static planning to algorithmically driven strategies, this approach contributes to the development of more responsive and efficient public transport systems. The study lays the groundwork for future exploration of broader optimization goals, such as infrastructure layout and service frequency, within an integrated, data-informed planning process..

A derivative free algorithm for function minimization with application in economics

Ilia Atanasov *Sofia University "St. Kliment Ohridski", BG*

Abstract: Minimizing non-differentiable functions presents an optimization challenge. To address this, we introduce a new parallelized derivative-free, grid based optimization algorithm. The method uses a two-stage approach: an exploration step, consisting of a coarse stochastic grid search with dynamic pruning, followed by a fine local refinement step, used for local exploitation. As an example, the algorithm is used for estimation of parameters in a recursive nonlinear economic model of job search.

Use of Neural Networks for the Modelling and Optimization of the Manganese Ions Adsorption from Aqueous Solutions

Alexandra Grancharova *University of Chemical Technology and Metallurgy, BG*
Silviya Lavrova *University of Chemical Technology and Metallurgy, BG*

Abstract: Wastewater treatment, handling and purification processes is critical for the environmental protection, while at the same time there is a need for innovative approaches to minimize and recover a variety of waste and waste products. A promising approach to develop a system for effective wastewater treatment of pollutants hazardous to the global ecosystem and human health is to utilize waste plant materials in order to use them as green adsorbents. In this

paper, a study on using walnut and cherry woody biomass as green adsorbents of manganese ions from aqueous solutions is described. Since there does not exist an analytical model of the influence of the various conditions of performing the adsorption process on its efficiency, here a machine learning approach based on neural networks is applied to obtain a black-box model of the process. Further, based on the obtained model, a mixed-integer nonlinear optimization problem for the adsorption process is formulated. The solution of this problem gives the optimal combinations of the factors for performing the manganese ions adsorption for both types of green adsorbents.

Minimizing Road Curvature Through Parallel Computing in Pathfinding Algorithms

Filip Bosilkov — *Ss. Cyril and Methodius University in Skopje, MK*
Vladimir Zdraveski — *Ss. Cyril and Methodius University in Skopje, MK*

Abstract: This paper proposes a curvature-constrained pathfinding approach that aims to minimize the total sum of the turning angles on road networks. We employ an A* search modified to account for turning-angle costs, rather than just distance. To complement this, we integrate parallelization techniques, by assigning path segments or waypoint pairs to different threads, which accelerates the search, especially in multi-waypoint scenarios. Experimental results show that while segmentation-based parallelization can reduce the total turning cost, overhead can counteract speed gains when only two waypoints are involved, at least on a small map. The findings emphasize the utility of curvature-focused routing and highlight the importance of balancing computational overhead with the practical benefits of parallel computing.

SESSION A13 "ROBOTICS AND CONTROL SYSTEMS I" **Stream 1**

Chairman: Javanshir Mammadov — Sumgayit State University, AZ

Thursday, October 09th 15:00 – 16:30 — Hall 109TV

Diagnostics of İndustrial Robot Applied in Flexible Manufacturing System

Aminaga Sadigov — *Sumgayit State University, AZ*
Javanshir Mammadov — *Sumgayit State University, AZ*
Ulduz Agayev — *Sumgayit State University, AZ*
Natig Talibov — *Sumgayit State University, AZ*
Nadir Hajibalayev — *Sumgayit State University, AZ*
Banovha Veliyeva — *Sumgayit State University, AZ*

Abstract: Abstract: The scientific work aim is to develop functional models and study through computer experiments on diagnostics of mechatronic parts, which ensure the improvement of the operational capacity and the increase of the service life of industrial robot (IR) based on technological processes of the flexible manufacturing system in many industrial area. To solve the problems

posed in the work, progressive modeling principes, artificial intelligence technology and the automated control methods were used. Based on some analysis of the research object, information provision of the information-measuring, control, monitoring and diagnostic elements of the robotic complex for device manufacturing and its industrial robots were created and their functions were determined. The models for the control of the working zone, structural analysis, and movement trajectories of the IR in the instrument-making robotics complex were proposed and verified by experiments. A functional model was proposed for the technical diagnostics of operations of IR operated at the robotics complex and a technical vision system for monitoring malfunctions of mechatronic parts was developed. An action algorithm of diagnostic for mechatron parts IR at the information-measuring flexible manufacturing module has been developed.

Modeling of the innovation construction mobile industrial robot applied in technology park

Gulshan Orujova — *Sumgayit State University, AZ*
Ulduz Agayev — *Sumgayit State University, AZ*
Gulnara Genjeliyeva — *Sumgayit State University, AZ*
Ahmad Ahmadzada — *Azerbaijan State Oil and Industry University, Baku, AZ*
Yusif Huseynov — *Azerbaijan Technological University, Ganja, AZ*
Metanet Ahmadova — *Azerbaijan Technological University, Ganja, AZ*

Abstract: The types of modern mobile industrial robots (MIR) that transport finished, defective products, and waste in the production process of a technopark, which is considered a complex technical system, were analyzed. The shortcomings of the designs and technological features of existing MIR were identified, and a project of a multifunctional mobile industrial robot with a new design was proposed, which provides automation of transport service functions in the production enterprise of the technopark. A 3D model of a newly designed MIR has been developed to automate the operations of transporting products manufactured at a mechanical engineering enterprise to the warehouse, transporting defective materials to special locations, and transporting waste to the secondary processing area. A new modeling algorithm has been developed to automate transportation along optimal routes in the production process of the technopark.

Control of a two-joint planar robot through machine vision

Elena Vasileva — *Technical University of Varna, BG*
Zhivko Zhekov — *Technical University of Varna, BG*

Abstract: This article presents an algorithm for controlling a two-joint planar robot through machine vision and the steps necessary to implement its control from

camera calibration to completion of the task it is tasked with. The goal is to investigate the possibility of fully neural control of a robot manipulator. A laboratory model has been created, necessary for the implementation and study of the task.

Modeling of Inverse Kinematics of a 3R Robotic Arm with Adaptive Neuro-Fuzzy Inference System

Iliyan Iliev *Nikola Vaptsarov Naval Academy Varna, BG*
Viktor Iliev *Wordspace Germany, DE*

Abstract: This article presents the modeling of the inverse kinematics of a three-joint robotic arm using an adaptive neuro-fuzzy inference system (ANFIS). Traditionally, inverse kinematics uses analytical and iterative models to solve this problem. For robotic arms with more than three joints operating in a threedimensional input space, iterative models are a possible option for finding a mathematical solution for inverse kinematics. An alternative to these models is to construct a fuzzy inference system (FIS) that derives the inverse kinematics if the direct kinematics of the problem is known, thus avoiding the need to develop an analytical solution. The advantage of the fuzzy approach to the solution is that it is easy to understand and does not require special knowledge to apply. In the report on the validation of the ANFIS method for inverse kinematics, the accuracy of the output data for positioning the 3R manipulator is compared with the accuracy of the analytical and iterative models. The selected iterative model uses the Broyden-FletcherGoldfarb-Shanno (BFGS) algorithm.

SESSION B13 "CNC MACHINING AND INDUSTRIAL AUTOMATION"	**Stream 2**
Chairman: Mariyana Todorova	Technical University of Varna, BG
Thursday, October 09th 15:00 – 16:30	Online

Multi-Purpose Optimization of the Turning Process on CNC Machines with Robotic Loading

Irina Aleksandrova *Technical University of Gabrovo, BG*
Hristo Metev *Technical University of Gabrovo, BG*
Nikolay Kolev *Technical University of Gabrovo, BG*

Abstract: The paper presents a methodology for multipurpose optimization of the turning process on CNC machines with robotic loading and its specific implementation for turning hardened steel 42CrMo4, using carbide inserts from various manufacturers. To optimize the process, models of the arithmetic mean utility function with weighting coefficients have been developed. The models are obtained as a result of a research and modelling of the main response variables (production rate, cutting tool life and surface roughness) of the CNC turning

process depending on the cutting conditions. The optimal conditions for implementing the process of CNC turning have been determined, under which the generalized utility function has a maximum for each of the cutting tools used. The determined optimal solutions guarantee the best combination of process production rate, cutting tool life and roughness of the machined surfaces.

Determining the Number of Cutting Tools, Ensuring a Continuous Work Cycle in CNC Turning Machines with Robotic Loading

Irina Aleksandrova — *Technical University-Gabrovo BG*
Hristo Metev — *Technical University-Gabrovo BG*
Nikolay Kolev — *Technical University-Gabrovo BG*

Abstract: The article proposes a methodology for determining the required number of cutting tools for operations, performed on CNC turning machines with robotic loading, taking into account the specified tool lifetime and the capacities of the workpiece loader and the tool magazine. The methodology guarantees a continuous machine operating cycle when processing a set number of workpieces without unplanned stops for tool changes. A fblock diagram of an algorithm for practical implementation of the methodology is proposed, creating conditions for controlling the operation of CNC turning machines with robotic loading.

Automatic Controlled Liquid Filling System: Loadcell and Servo Motor Controlled Approach

Hilmi Kuşçu — *Trakya University of Edirne, TR*
Kubilay Özyalçın — *Trakya University of Edirne, TR*

Abstract: This study aims to realize automatic and precise liquid filling processes widely used in industrial applications. In the designed system, the weight of the liquid is measured in realtime using a load cell, and a servo motor-controlled mechanism performs filling of the predetermined amount. Thus, the accuracy of the filling process is increased and manual interventions are minimized. The system is integrated with a microcontroller-based control structure, automating the filling process with precision and repeatability. Experimental tests demonstrated that the system operates with high accuracy and stability. This study contributes as a low-cost, user-friendly, and reliable solution for industrial liquid filling lines..

Synthesis of a MIMO Model of an Electro-Hydraulic System with Temperature Compensation

Stanimir Yordanov — *Technical University-Gabrovo, BG*
Georgi Mihalev — *Technical University-Gabrovo, BG*
Krasimir Ormandzhiev — *Technical University-Gabrovo, BG*
Hristina Stoycheva — *Technical University-Gabrovo, BG*

Abstract: The article discusses the synthesis and verification of a MIMO-type mathematical model of an electro-hydraulic system with temperature compensation. The aim is to describe the system's dynamic behavior and evaluate the influence of temperature variations on hydraulic parameters. The proposed model incorporates nonlinear dependencies related to the dynamics of the servo valve, the compressibility of the working fluid, and the inertial characteristics of the mechanical load. Temperature dependence of the oil's viscosity and bulk modulus is included in the model, enabling more accurate simulation of operating conditions. Simulations and experimental studies have been conducted, with a comparison made between the transient responses based on key performance indicators— settling time, overshoot, and steady-state error. The results show good agreement between the model and the actual system, with observed deviations remaining within acceptable engineering margins. The proposed model can be used for the synthesis and optimization of control algorithms, as well as for the predictive analysis of system behavior under various operational conditions.

SESSION C13 "DEEP LEARNING AND REINFORCEMENT LEARNING"	**Stream 3**
Chairman: Gancho Vachkov	BG
Thursday, October 09th 15:00 – 16:30	Online

Integrating Deep Learning and Reinforcement Learning: A Case Study on the Chrome Dino Game

Krish Anish Shah — *University of Europe for Applied Sciences, DE*
Loubna Ali — *Berlin School of Business and Innovation, DE*
Shan Faiz — *University of Europe for Applied Sciences, DE*
Meerah Karunanithi — *University of Europe for Applied Sciences, DE*
Debopriya Das — *University of Europe for Applied Sciences, DE*

Abstract: The intersection of deep learning and reinforcement learning has opened new avenues in real-time decisionmaking for interactive systems like games. In this context, the Chrome Dino game serves as a compelling platform to evaluate AI models' ability to perceive and act dynamically. Despite significant progress in AI gaming applications, there remains a gap in integrated approaches that simultaneously leverage visual recognition and adaptive decision-making in fast-paced environments. This study addresses the challenge by combining deep learning for action detection with reinforcement learning for policy optimization. A convolutional neural network (CNN) was trained to classify player actions—jump, duck, and idle—based on game images. The trained model was then integrated with a Deep Q-Network (DQN) reinforcement learning framework to enable adaptive gameplay based on trial-

and-error interaction. The combined model showed strong performance, with the CNN achieving high accuracy and low loss during classification, and the DQN demonstrating significant improvement in gameplay metrics such as episode length and cumulative rewards. Training graphs revealed a consistent reduction in loss and enhanced policy convergence over 1,000 episodes. Additionally, a custom simulation environment was developed to facilitate training and evaluation in real-time. This study demonstrates a successful integration of vision-based deep learning with decision-making reinforcement learning, offering a viable blueprint for AI agents in dynamic and unpredictable settings.

MAARV: Multi-Agent Architecture for Runtime Verification

Ajitava Deb — *Harman International, IN*
Dr. Usha G — *SRM Institute of Science & Technology, IN*
Mridangam Goswami — *SRM Institute of Science & Technology, IN*
Arush Jauhari — *SRM Institute of Science & Technology, IN*
Dr.N.A.S.Vinoth — *SRM Institute of Science & Technology, IN*

Abstract: The increasing adoption of AI agents for automated code analysis has exposed critical limitations in static evaluation methods, particularly when they fail to ensure runtime correctness. Traditional approaches, such as Agent as a Judge [15], often hallucinate successful execution by simulating dependency installation and script behavior without actual validation. In response, we propose MAARV, a multi-agent architecture that distributes responsibilities across specialized agents to enable verified runtime execution and iterative code refinement. The system includes Agent A, which generates scripts using large language models (LLMs); a Helper Agent, responsible for installing real dependencies on the local system; and the MAARV Judge, which integrates Meta AI's static code analysis with a dynamic execution engine to evaluate the script's performance against the original intent. A closed feedback loop between the Judge and Agent A facilitates error detection and code regeneration, improving accuracy over multiple iterations. By bridging the gap between theoretical analysis and practical execution, MAARV offers a reliable, autonomous framework for trustworthy agentic code validation.

Improving Bullying Detection Through Feature Selection and Machine Learning Evaluation

Dimitrios Galiatsatos — *Model Vocational Senior High School Alexandroupolis, GR*

Abstract: This study investigates the predictive effectiveness of various machine learning algorithms in classifying student responses related to incidents of school bullying. The analysis is based on data collected from 115 students attending the Model Vocational Senior High School of Alexandroupolis. Two distinct dimensionality reduction techniques were

applied and evaluated: Correlation-Based Feature Selection and Principal Component Analysis. These techniques were used to reduce the number of input variables while aiming to retain the most informative features. Eight different classification algorithms were examined using a data mining software environment: probabilistic, linear, nonlinear, tree-based, and ensemble methods. The algorithms included a bayesian classifier, a logistic regression model, a multilayer neural network, a support vector classifier, a nearest neighbor classifier, a bagging ensemble method, a decision tree, and a random forest model. The findings reveal that the feature subsets selected through correlation-based evaluation consistently led to better predictive performance compared to the principal component-based transformation. Among the algorithms tested, the bayesian classifier and the random forest model achieved the highest classification accuracy, exceeding 70 percent in several instances. These results highlight the value of targeted feature selection in educational data analysis and suggest that component-based transformations may be less effective when variable correlations are weak. The study includes visual comparisons of model performance and explained variance.

Enhancing Academic Performance Prediction Using Feature Transformation and Machine Learning Models

Dimitrios Galiatsatos *Model Vocational Senior High School Alexandroupolis, GR*

Abstract: Identifying students at academic risk is essential for effective intervention in education. Traditional predictive models often treat behavioral factors in isolation, overlooking their real-world interactions. This study examines whether transforming behavioral features into interaction terms enhances the accuracy and interpretability of machine learning models for predicting academic performance. Using a simulated dataset of 1,000 students, behavioral data such as study hours, sleep duration, social media use, and mental health status were collected. Eight interaction features were engineered to reflect combined effects. Data preprocessing in R included imputation, normalization, and encoding. Nine classification algorithms were tested in Weka, including probabilistic, linear, neural, instancebased, decision tree, and ensemble methods. The results indicate that interaction terms significantly improved prediction accuracy in instance-based methods, with accuracy increases exceeding 14 percentage points. Ensemble models also improved modestly, while linear and neural models showed minor declines. The engineered features revealed meaningful patterns linking academic performance with digital behavior and mental health. The study concludes that interaction-based feature transformation enhances performance and interpretability, supporting a balanced approach that integrates domain expertise and machine learning to address educational challenges.

SESSION A14 "CYBERSECURITY AND SYSTEM SECURITY"	**Stream 1**
Chairman: Xuejun Zong	Shenyang University of Chemical Technology, CN
Thursday, October 09th 17:00 – 18:30	Hall 109TV

Analyzing Vulnerabilities in Desktop Operating Systems

Svetoslav Hadzhitodev *Nikola Vaptsarov Naval Academy, BG*
Valentina Petrova *Nikola Vaptsarov Naval Academy, BG*

Abstract: Vulnerability scanning tools play a critical role in identifying security weaknesses in applications and networks by detecting issues such as improper data validation and outdated software. This study analyzes and compares the results of two vulnerability scanners – Tenable Nessus Essentials and Greenbone OpenVAS, across distinct environments, specifically Windows, macOS and Linux. The approach used in this research involves deploying scanners within an internal network and systematically analyzing detected vulnerabilities. The authors of this research include vulnerability scanning tools for identifying security weaknesses in desktop operating systems, by cross-referencing known vulnerabilities stored in a global database, known as Common Vulnerabilities and Exposures.

Technical Evolution and Practice of Industrial Internet Security Protection in the Era of Large language Models

Bowei Ning *Shenyang University of Chemical Technology, CN*
Kan He *Shenyang University of Chemical Technology, CN*
Xuejun Zong *Shenyang University of Chemical Technology, CN*
Yifei Sun *Shenyang University of Chemical Technology, CN*

Abstract: The convergence of industrial internet and artificial intelligence is reshaping the landscape of manufacturing and critical infrastructure, while simultaneously introducing significant security challenges. The proliferation of sophisticated cyber-attacks against Industrial Control Systems (ICS) necessitates a paradigm shift from traditional, rule-based security to more dynamic, intelligent defense mechanisms. This paper explores the transformative role of Large Language Models (LLMs) in this new era. We present a comprehensive analysis of the "double-edged sword" nature of LLMs—as a powerful tool for enhancing defensive capabilities or a technology that can be effectively leveraged by attackers. The paper systematically reviews the technical evolution of LLMpowered security applications, including automated threat intelligence, multi-modal intrusion detection, and AI-assisted security operations. We analyze practical case studies from industry leaders like Microsoft, Siemens, and NVIDIA, alongside cutting-edge academic research. Furthermore, the systemic challenges of deploying LLMs in resource-

constrained and high-stakes industrial environments are examined, including issues of model security, data privacy, and integration with legacy OT systems. Finally, we chart a future roadmap, highlighting key trends in lightweight edge models, federated and transfer Learning, and the critical need for robust standardization and ecosystem development. This paper provides a structured overview for researchers, practitioners, and policymakers navigating the complex intersection of AI and industrial cybersecurity.

Entropy-Aware AI-Powered Ransomware Detection Using IBM FlashCore Module 4 in SAN Environments

Genka Slavova-Torres — *Institute of Information and Communication Technologies - BAS, BG*

Abstract: Ransomware poses a critical risk to storage networks, demanding fast and accurate detection. This work presents an entropy-aware, AI-powered method for identifying ransomware in SAN environments using IBM FlashCore Module 4. By analyzing data entropy in real time, the system detects anomalous write patterns while leveraging FlashCore Module 4's high-speed processing for low-latency response. The study demonstrates the potential of combining computational storage and intelligent analytics to enhance enterprise-level ransomware defense.

Bibliometric API Integrations: Combining Research Networks and Institutional Repositories

Boris Bankov — *University of Economics - Varna, BG*

Olga Marinova — *University of Economics - Varna, BG*

Abstract: Bibliometric reporting for publications and citations is critical in all modern research universities and centers. Academic social networks help discover partnerships and showcase achievements in myriad of fields. Existing scientific databases like Scopus and Web of Science provide web interfaces for end users and developers to browse and perform searches on complex data metrics. Internal platforms need to catch up to speed with the expanding volume of opportunities for data collection. In this paper we present our system design for a retrieval and processing web solution in the University of Economics - Varna to improve bibliometric auditing and statistical analysis of research documents, written by the academic staff. Current institutional repository "Register Publications" relies on manual data submission for publications, citations and other scientific activities, which can be further digitalized and help verification processes via public Application Programming Interfaces (API). The practical study focuses on architecture, data flow and database implementation, as well as communication protocol analysis of Full JSON, Progressive JSON and gRPC approaches.

SESSION B14 "ERP AND BUSINESS SYSTEMS"	**Stream 2**
Chairman: Idilia Batchkova	University of Chemical Technology and Metallurgy, BG
Thursday, October 09th 17:00 – 18:30	Online

ERP systems in the digital transformation era: A comparative study of leading solutions

Dilyana Dimitrova *Nikola Vaptsarov Naval Academy, BG*

Abstract: Enterprise Resource Planning (ERP) systems are fundamental to digital transformation efforts, enabling the integration and automation of core business functions. This study provides a comparative analysis of three leading ERP platforms - SAP S/4HANA, Oracle Cloud ERP, and Microsoft Dynamics 365. While all three contribute to organizational digital transformation, SAP stands out for its enterprise-wide integration, financial capabilities, and human capital management. Oracle excels with its advanced cloud-native architecture and strong database integration, while Microsoft Dynamics 365 offers flexible and cost-efficient ERP solutions designed for small and medium-sized enterprises. Beyond these distinctions, this paper highlights the emerging role of artificial intelligence and generative technologies in transforming ERP systems.

Modular Architecture for Financial Process Automation: From Excel/Ini To Api and Erp Integrations

Ivan Ignev *Technical University of Varna, BG*

Abstract: This paper presents a modular architecture for automating payment and accounting processes, initially built on file-based formats (Excel/INI/CSV) and subsequently evolving toward API-driven integrations with banks and ERP systems. The approach decomposes the data life cycle into independent modules—ingest, validation, classification, mapping, and export —with clearly defined interfaces and configuration layers. We demonstrate how such an architecture facilitates portability across heterogeneous data sources and sinks and reduces the adaptation time when a bank or accounting system changes. An empirical evaluation on real bank statements is reported, covering automation rate, processing time, and the number of errors before and after deployment. The results show a significant reduction in manual effort and confirm the framework's flexibility for future extensions with ML components and microservice-based services.

Implementation of E-logistics in Food Supply Chain Operations

Firuza Aghazada *Azerbaijan State Oil and Industry University, Baku, AZ*

Lala Bekirova *Azerbaijan State Oil and Industry University, Baku, AZ*

Abstract: Logistics is essential in the food sector because of the distinct characteristics of food products and the intricacies of the distribution system.

Numerous companies in this industry encounter difficulties like ineffective inventory management, unreliable supply chain coordination, and imprecise production predictions. Moreover, markets are extremely competitive, driven by increasing customer expectations and stringent food safety regulations. This paper explores the impact of ecommerce on the food supply chain's logistics structure. While managing information flow has always been important in supply chain management, web-based data exchange has greatly increased its significance. Integrating IT with logistics management is essential for efficient operations. E-commerce platforms can act as marketing channels, either by collaborating with intermediaries or directly reaching customers, facilitating disintermediation and offering greater flexibility. Adopting elogistics is crucial for success, particularly in global business. Case studies highlight how e-logistics improves transparency, efficiency, and customer satisfaction through advanced technologies like real-time tracking and data analytics.

CEvaluation and Selection of Project Management Software for Secure Civil-Military Collaboration

Milen Sotirov — *Nikola Vaptsarov Naval Academy, BG*
Valentina Petrova — *Nikola Vaptsarov Naval Academy, BG*
Miroslav Tsvetkov — *Nikola Vaptsarov Naval Academy, BG*

Abstract: This paper presents a method for selecting secure and practical project management platforms for civilmilitary cybersecurity collaboration. Security and functional requirements are established, with emphasis on alignment with international standards such as ISO/IEC 27001, NIST, GDPR, and NATO STANAGs. A multi-criteria evaluation approach is outlined, combining large language model (LLM)-assisted scoring with key performance indicators (KPIs) across security, usability, and interoperability. To enhance accessibility and operational relevance, the selection process prioritizes cloud-based, free solutions suitable for multinational, distributed teams. The Analytic Hierarchy Process (AHP) is applied as the final decision-making method, enabling a transparent, criteria-weighted comparison of the top-performing platforms. The highest-ranked platform is subsequently deployed in a controlled test environment and validated through scenario-based testing that reflects realistic civil-military operational contexts. The results provide actionable, evidence-based recommendations for secure, scalable digital collaboration in complex, multi-institutional settings. A novel method combining advanced AI evaluation and systematic decision-making approaches is introduced to address this gap.

SESSION C14 “VIRTUAL REALITY AND SIMULATION” **Stream 3**

Chairman: Kosta Boshnakov — Institute of Information and Communication Technologies-BAS, BG

Thursday, October 09th 17:00 – 18:30 Online

Virtual Reality Driving Simulation System for Critical Situations

Elitsa Bakalova *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Abstract: Driving is a complex process that combines cognitive, motor, and behavioral skills. Ensuring high-quality driver training is essential for reducing the risk of road traffic accidents. According to projections by the World Health Organization, by 2030 road accidents may become the fifth leading cause of death worldwide. Traditional driving courses do not allow realistic simulation of critical situations, such as a pedestrian suddenly crossing the road, loss of vehicle control on icy surfaces, or technical system failures, since such scenarios pose a high risk to the life and safety of trainees.

Comparative Analysis of Traditional and VR-Based Learning in Schools: Results and Challenges

Elitsa Bakalova *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Abstract: The present study presents a comparative analysis between traditional and VR-based learning in schools, aiming to evaluate the effect of virtual reality on students' knowledge, motivation, and concentration. The study involved 50 students from grades 8–10, divided into a control group (traditional learning) and an experimental group (learning through VR simulations using the Mozaik platform). The learning content covered three thematic areas—biology, physics/technology, and history—presented through 3D scenes. The methodology included pre- and post-tests to measure knowledge, survey questionnaires to assess motivation and concentration, as well as measurements of time and accuracy in performing learning tasks. The results showed that students in the VR group achieved nearly twice the knowledge gain (+35.8% compared to +18.4% in the control group), higher scores for motivation (4.5 vs. 3.2) and concentration (4.6 vs. 3.4), as well as better performance in terms of speed and accuracy. The conclusions of the study confirm that VR-based learning supports the acquisition of complex and abstract concepts, enhances emotional engagement, and stimulates active learning. The contribution of the research lies in providing new empirical data from the Bulgarian school context, validating the applicability of VR as an effective educational tool.

Conceptualization, modeling and simulation for 3D printed modular hand prosthesis

Vasil Lozanov *Institute of Information and Communication Technologies-BAS, BG*
Radoslav Vasilev *Institute of Information and Communication Technologies, BAS, BG*
Maya Staikova *Institute of Information and Communication Technologies, BAS, BG*
Nayden Chivarov *Institute of Information and Communication Technologies, BAS, BG*

Abstract: A way to design, model and simulate stress in wrist prostheses is presented in our study. Large-scale computational modeling was performed to predict the mechanical performance of parts under different loading conditions, modeling different use cases. Virtual stress testing commonly identifies failure points during simulation. Data captured during a test like this, can be used by designers to perform follow-on design changes, material selection choices, and structural tuning. This method could help a great deal with the creation of less expensive prostheses that were more durable and functional than typical manufacturing. The final design balances performance demands and accessibility, which may extend prosthetic accessibility in underdeveloped areas. The material was the most difficult thing to decide on because everything seemed more important than anything else.

Simulation of large battery clusters based on multi-threaded programming using OpenMP and a hybrid-core CPU

Martin Minkov *Technical university of Sofia, BG*

Abstract: This paper investigates parallelization strategies for large-scale battery cluster simulations using OpenMP on a hybrid-core CPU. Two approaches are compared: grid-level parallelization, distributing independent grids across threads, and cell-level parallelization, dividing work within a grid. Tests on a hybrid Intel i5 CPU with performance and efficiency cores reveal that grid-level parallelization offers predictable, nearlinear scaling, while cell-level is advantageous only for small grid counts with large cell sizes. Dynamic scheduling improves heterogeneous-core utilization. Practical guidelines for selecting the optimal strategy are presented.

COMPANY PRESENTATIONS	**Stream 1**
Chairman: Hristo Valchanov	Technical university of Varna, BG
Thursday, October 09th 18:30 – 19:30	Hall 109TV

Siemens. Industrial Artificial Intelligence

Boyko Boykov *Siemens, BG*

Abstract: This paper explores the integration of Artificial Intelligence (AI) within industrial automation, emphasizing Siemens' approach to scalable and productive AI deployment. It contrasts traditional PLC programming paradigms—based on hard-coded rules—with machine learning methodologies that infer hidden patterns from historical data. The document introduces foundational concepts including Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), and Neural Networks (NN).

A detailed overview of supervised and unsupervised learning techniques is provided, highlighting their respective roles in classification, regression, clustering, and anomaly detection. The AI lifecycle is mapped through a

comprehensive workflow encompassing data acquisition, model training, validation, deployment, inference, monitoring, and retraining. Siemens' architecture for Industrial AI is presented, showcasing the use of edge computing, cloud infrastructure, and dedicated AI hardware to enable real-time, scalable solutions from shopfloor to cloud.

A practical case study illustrates the application of AI for predictive maintenance, where edge-based AI models successfully forecast spindle failures in milling machines up to 72 hours in advance, resulting in significant cost savings and operational efficiency.

Honeywell Protonium – design, control and optimization of green hydrogen production

Daniel Nikolov *Honeywell, BG*

Abstract:

Brand Overview: Honeywell Protonium™ is a comprehensive solution family focused on enhancing hydrogen production and management through advanced technologies and methodologies.

Sub-Brands:

1. **Honeywell Protonium CDO (Concept Design Optimization)**:
   - **Feasibility and Bankability**: Addresses project-specific design optimization and accounts for power intermittency.
   - Utilizes a green hydrogen plant model for fast processing and optimizes the plant lifecycle cost (LCOH).
   - Incorporates electrolyzer OEM performance curves and aims to optimize CAPEX, OPEX, and emissions.
2. **Honeywell Protonium HECS (Hydrogen Electrolyzer Control System)**:
   - **Electrolyzer Performance and Longevity**: Focuses on monitoring performance and degradation with alerts for performance issues and end-of-life warnings.
   - Provides standard human-machine interfaces (HMIs) and pre-built key performance indicators (KPIs) for electrolyzers while ensuring technology agnosticism.
   - Features ISA Secure Cyber Secure and Open Interface for enhanced security and is IIoT Ready for remote monitoring.
3. **Honeywell Protonium UCO (Unified Control & Optimization)**:
   - **Optimized OPEX and Effective Energy Management**: Manages power intermittency and dynamic power allocation to electrolyzer fleets and balance of plant (BOP).
   - Includes look-ahead scheduling of operations and energy forecasting based on weather data.

- Focuses on the optimization of the cost of hydrogen and energy, optimal energy mix management, and unifies process and energy control optimization.
- Utilizes digital twin technology and machine learning (ML) to drive operational efficiency.

Problems Addressed: The Honeywell Protonium™ solutions are designed to solve critical challenges in hydrogen production, ensuring feasibility and bankability of projects while optimizing performance, energy management, and overall operational efficiency.

SESSION A21 "Power Electronics and Motor Control	**Stream 1**
Chairman: Desislava Delicheva	Technical University of Sofia, BG
Friday, October 10th 10:00 – 11:30	Hall 109TV

Research of a low-power single-phase induction motor

Zlatan Ganev *Technical University of Varna, BG*

Abstract: This paper presents a comprehensive experimental investigation of a low-power single-phase induction motor, widely used in household and light industrial applications due to its simplicity, reliability, and affordability. The research aims to analyze the motor's performance under three operational scenarios: nominal load, variable voltage supply, and fault conditions. A custom-built experimental setup, incorporating a multifunctional Block for Measurement and Control (BMC), was employed at the Technical University of Varna to accurately measure electrical and mechanical parameters such as voltage, current, power and rotor speed. The results affirm the importance of precise experimental evaluation for validating theoretical predictions and improving the operational efficiency of single-phase motors. Furthermore, the study highlights the potential for integrating such motors with intelligent digital control and monitoring systems. The developed setup and methodology can be effectively utilized for educational purposes and extended research on the electric machines.

Robust Repetitive Control of a PWM Inverter in a Robotic System

Nina Nikolova *Technical University of Sofia, BG*
Boris Grasiani *Technical University of Sofia, BG*
Vesela Karlova-Sergieva *Technical University of Sofia, BG*

Abstract: This research explores the application of robust and repetitive control to a PWM inverter used in a robotic system for the mechanical processing of lightweight components. In studying this class of systems, the presence of parametric uncertainty and periodic disturbances—arising from the supply voltage and the load - is considered. The main objective is to ensure system stability and high control performance. The synthesized control systems

have been modeled, and their filtering properties have been analyzed.

Modeling of Synchronous Reluctance EV Propulsion Drive

Nikolay Djagarov — *Nikola Vaptsarov Naval Academy, BG*
Nikolay Yanev — *Nikola Vaptsarov Naval Academy, BG*
Valery Goldshtein — *Samara State Technical University, RU*
Vladimir Romanov — *Toglyatti State University, RU*

Abstract: The rapid development of electric vehicles and their widespread use posed many technical problems. The article examines the problems related to the modeling and control of a EV synchronous reluctance propulsion drive. With the help of a mathematical model, different modes of synchronous reluctance propulsion drive are investigated.

Braking Mode Investigation of Synchronous Reluctance EV Propulsion Drive

Nikolay Djagarov — *Nikola Vaptsarov Naval Academy, BG*
Nikolay Yanev — *Nikola Vaptsarov Naval Academy, BG*
Valery Goldshtein — *Samara State Technical University, RU*
Vladimir Romanov — *Toglyatti State University, RU*

Abstract: The rapid development of electric vehicles and their widespread use posed many technical problems. The article examines the problems related to the modeling and control of braking modes of EV a synchronous reluctance propulsion drive. With the help of a mathematical model, different braking modes of synchronous reluctance propulsion drive are investigated.

SESSION B21 "SOFTWARE DEVELOPMENT AND PROGRAMMING" — **Stream 2**

Chairman: Ivaylo Penev — Technical University of Varna, BG

Friday, October 10th 10:00 – 11:30 — Online

Common Dependency Injection Errors in C# for .NET: How to avoid them?

Daniel Damyanov — *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*
Zlatko Varbanov — *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*
Atanas Hristov — *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Abstract: Dependency Injection (DI) is a great way to reduce tight coupling between software components. In this article, we survey some of the most common mistakes when working with DI in C# .NET and offer several solutions for them. Using the presented methodology, we emphasize the most common mistakes and present short and effective solutions that reduce possible subsequent problems in software development (tests, code corrections, new functionalities, etc.). The presented results show what could be improved when writing code and reduce the time to fix problems that arise.

Comparison of Object-Relational Mapping Frameworks on C#, Python, Go, and Node.js using MSSQL With A Case Study

Rand Kouatly *UE university of Applied Science Berlin, DE*
Orkun Demirci *UE university of Applied Science Berlin, DE*

Abstract: Object-relational mapping (ORM) frameworks or tools have turned into a necessity for the development of modern applications. Thorough cross-language performance comparisons that particularly emphasize on Microsoft SQL Server (MSSQL) are still very rare even though ORMs have been widely used by lots of programming languages for different tasks. This paper presents a comparison of eight ORM tools that are SQLAlchemy (Python), GORM and SQLBoiler for Go, Prisma, Sequelize, and TypeORM for Node.js, and Entity Framework and Dapper for .NET Core (C#). Three separate Northwind databases containing Orders tables in different sizes (1,000, 10,000, and 100,000 records) were considered. To mimic practical situations, web API applications were employed for executing CRUD operations and reading queries. Execution time was used to evaluate the performance of ORMs. The findings reveal that the Go-based ORMs, mainly GORM and SQLBoiler, are much faster than the other ORMs. Dapper showed up as a strong candidate in the C# ecosystem. Performance is on the slow side for Node.jsbased ORMs, with TypeORM obviously the least efficient one. SQLAlchemy turned out to be a good option for Python projects with medium performance through midrange performance. This study provides developers with useful information on what kind of ORM tools or frameworks they should select in respect to their application needs.

A Modular Teaching-Oriented Chess Engine with Validated Move Generation and Classical Search Enhancements

Yulian Dashev *University of Plovdiv "Paisii Hilendarski", BG*
Martin Vassilev *University of Plovdiv "Paisii Hilendarski", BG*
Alexander Penev *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: We present a compact, reproducible report on the design and implementation of a modular chess engine suitable for research and education. The system combines classical game-tree search (iterative deepening, alpha–beta pruning, and quiescence search) with practical engineering techniques (bitboard representation, move ordering, transposition tables, and killer/history heuristics) and a standards-compliant UCI interface. We formalize the search and evaluation components, describe feasibilitypreserving move generation validated by standard perft suites, and provide a benchmark methodology encompassing nodesper-second, search depth under time constraints, and self-play strength against open baselines. We release the code, configuration, and test harness to facilitate further research and teaching.

Accelerating Spell Checking with Parallel Processing Techniques

Nikola Petrushevski *Ss. Cyril and Methodius University in Skopje, MK*

Vladimir Zdraveski *Ss. Cyril and Methodius University in Skopje, MK*

Abstract: Spell checking plays a vital role in ensuring the quality of written content across a wide range of applications. However, traditional sequential spell-checking methods become inefficient when handling large-scale text data. This paper explores a parallelized approach to spell checking, designed to leverage modern multi-core processors for improved scalability. By distributing the workload across multiple worker processes and incorporating both phonetic and edit-distance techniques, the system efficiently identifies and corrects spelling errors. Experimental results demonstrate that the parallel architecture significantly improves processing time while maintaining the accuracy of correction suggestions, making it well-suited for highvolume or real-time applications.

SESSION C21 "Computer Vision and Image Processing" **Stream 3**

Chairman: Albena Taneva Technical University of Sofia, Plovdiv branch, BG

Friday, October 10th 10:00 – 11:30 Online

Computational Limits and Breakthroughs in Deep Learning-Based Image Restoration

Jose Luis Bueso Vega *University of Europe for Applied Sciences-Berlin, DE*

M. Kamran Asif *King Saud University, DE*

Moumita Mukherjee *University of Europe for Applied Sciences-Berlin, DE*

Zeeshan Ali *Saudi Telecom Company, SA*

Debopriya Das *University of Europe for Applied Sciences-Berlin, DE*

Abstract: Image deblurring has become increasingly vital in applications ranging from medical imaging to security surveillance, where visual clarity can significantly impact decisionmaking and outcomes. Despite advances in deep learning, existing methods often struggle with non-uniform blurs, computational inefficiency, and subjective evaluation metrics, limiting their real-world applicability. Current approaches primarily focus on uniform blur removal while neglecting the challenges of spatially-varying blurs and lack standardized quality assessment frameworks that align with human perception. This study addresses these gaps by implementing and comparing two deep learning architectures - Convolutional Neural Networks (CNNs) and Generative Adversarial Networks (GANs) - trained on the CelebA and GoPro datasets using rigorous preprocessing and augmentation techniques. Our methodology incorporates both quantitative metrics (PSNR, SSIM) and

qualitative human evaluation to assess performance across different blur types and lighting conditions. Results demonstrate that while both architectures improved image quality (with PSNR gains of 2-3 dB and SSIM improvements of 0.1-0.15), GANs outperformed CNNs in handling complex motion blurs but required significantly more computational resources. Visual assessment revealed that enhanced images maintained better structural integrity, though some artifacts persisted in low-light conditions. The study provides a balanced framework for evaluating deblurring algorithms that combines computational metrics with human perception, offering practical insights for implementing these technologies in resource-constrained environments.

Wild Animals' Recognition System Based on Optimized YOLO Model and Camera Traps in Bulgarian Mountains

Petar Matov *Technical University of Sofia, BG*

Abstract: Automated wildlife monitoring in Bulgarian mountain ecosystems requires species-level recognition systems adapted to regional fauna and challenging environmental conditions. This work applies YOLOv8 object detection to camera trap images from Bulgarian protected areas, training on a dataset of 1,882 images covering 17 native wildlife species. While the dataset size is limited compared to large-scale computer vision applications, hyperparameter optimization and data augmentation techniques achieve practical performance for regional monitoring. The optimized model achieves 82.3% mAP@0.5, demonstrating competitive performance among evaluated detection architectures on the same dataset. The system provides a practical tool for biodiversity monitoring in Bulgarian mountain environments, where manual observation is challenging and existing detection models show limited applicability to European mountain species.

Microscopic Image-Based Classification of Honey Pollen Types Using Convolutional Neural Networks

Lyubomir Zaykov *University of Food Technologies - Plovdiv, BG*

Abstract: Ensuring the precise identification of honey pollen is crucial for confirming its botanical source and maintaining food authenticity. Traditional melissopalynology methods are time-consuming and require expert knowledge, limiting scalability. This study investigates the application of deep learning, specifically convolutional neural networks (CNNs), for automated pollen classification from microscopic images. A lightweight custom CNN and five pretrained models—MobileNetV2, ResNet152, Xception, InceptionResNetV2, and VGG19—were evaluated using an image dataset of five pollen types common in Bulgarian honeys. Images were preprocessed through region of interest extraction, grayscale conversion, and normalization. A 10-fold Monte Carlo cross-validation protocol was used for performance evaluation. The custom CNN achieved the highest average test accuracy of 97.59%, followed

by MobileNetV2 (97.49%), InceptionResNetV2 (97.01%), ResNet152 (96.82%), Xception (96.47%), and VGG19 (92.76%). These results demonstrate that a well-optimized, domain-specific CNN can match or outperform more complex transfer learning models, offering an efficient solution for real-time honey authentication.

Vision Quality Inspection in a Flexible Assembly System

Ivanka Dimitrova — *Technical University Sofia, Plovdiv branch, BG*

Albena Taneva — *Technical University Sofia, Plovdiv branch, BG*

Michail Petrov — *Technical University Sofia, Plovdiv branch, BG*

Yavor Boychev — *Institute of Metal Science, Equipment and Technology-BAS, BG*

Abstract: The article deals with an intelligent automatic quality control system based on machine vision applied in a production process. The dimensions and characteristics of the surfaces of the produced parts are decisive for their quality. A Flexible Assembly System (FAS) supplied with a vision system observes the surface of the assembled product and decides about the quality and size of the mounted caps by using statistical analysis. Statistical process control (SPC) implemented with quality control charts is used for a quality acceptance of the assembling parts. The effectiveness of the processing and use of the analysis that replaces human visual quality control have been tested and confirmed.

SESSION A22 "SIGNAL PROCESSING AND COMMUNICATIONS" — **Stream 1**

Chairman: Aydan Haka — Technicaal University of Varna, BG

Friday, October 10th 11:30 – 13:00 — Hall 109TV

A Method for Synthesis of Families of Orthogonal Matrix Signals, Processed by Mismatched Filters

Borislav Bedzhev — *"Vasil Levski" National Military University, BG*

Dobri Stoyanov — *"Vasil Levski" National Military University, BG*

Abstract: In the paper the known methods for synthesis of families of orthogonal matrix signals, processed by mismatched filters, are elaborated. The practical implementation of elaborated methods in the radio communication systems allows the self-interferences as well as the multi access interferences to be minimized or rejected.

Simulation Environment for Studying EnOcean Communication Processes

Georgi Genev — *Technical University of Varna, BG*

Aydan Haka — *Technical University of Varna, BG*

Abstract: The growth of the Internet of Things (IoT) technology continues at a rapid pace, with increasing attention being paid to technologies that are energy

efficient. One of the technologies with high energy efficiency and application in the fields of IoT is EnOcean. EnOcean technology is becoming increasingly used, and this naturally directs attention to its operation and research into its specifics. Simulation products are very often used to study such technologies, due to their easy applicability and the advantage of not purchasing physical equipment. Existing simulators of EnOcean technology are limited in number and have specific capabilities. This paper proposes a new simulation product (GEnOSim), which provides the opportunity to simulate various aspects of the functionalities of EnOcean technology. The object of research in this paper is the communication processes under the ERP1 and Smart Acknowledge protocols, with the aim of validating the operation of the simulator. The experiments performed show that the proposed GEnOSim simulator represents the processes under consideration and the structure and content of the exchanged messages in accordance with the definitions of the EnOcean standard.

A Method for Synthesis of Complementary Quads of Binary Signals, Processed by Mismatched Filters

Borislav Bedzhev *"Vasil Levski" National Military University, BG*

Deyan Atanasov *"Vasil Levski" National Military University, BG*

Abstract: In the paper a new method for synthesis of complementary quads of binary signals, processed by mismatched filters with very small losses in the processing gain, is developed. The method could be applied for improving the resistance of the radar sensor networks and the remote control devices in hostile radio electronic environment.

Machine learning dataset assembly interface

Georgi Enchev *Nikola Vaptsarov Naval Academy, BG*

Dimitar Tsvetanov *Nikola Vaptsarov Naval Academy, BG*

Nikolay Djagarov *Nikola Vaptsarov Naval Academy, BG*

Abstract: In this paper, we present a web-based platform named Training Data, designed to manage, preprocess, and annotate time-series data generated through MATLAB simulations. The system is tailored for preparing training datasets for machine learning applications, particularly in the field of fault detection in electrical drives and other dynamic systems. The platform allows users to upload simulation output, explore signals over time, apply normalization and segmentation, and annotate specific ranges with fault or operating labels. The backend relies on a MySQL database, while the frontend is developed in PHP and JavaScript, providing an interactive and user-friendly environment with role-based access control. The solution supports multiple datasets, versioning, merging of sources, and exporting in formats suitable for ML pipelines (CSV, XLS, PDF). By automating and structuring the data preparation process, this system plays a crucial role in ensuring

the quality and consistency of the data used in machine learning experiments.

SESSION B22 "Parallel Computing and Performance"	**Stream 2**
Chairman: Todor Ganchev	Technical University of Varna, BG
Friday, October 6th 11:30 – 13:00	Online

Prime Generation and Factorization Parallelization: A comparative Study of CPU and GPU Parallelization

Sofija Tasevska — *Ss. Cyril and Methodius University in Skopje, MK*
Viktor Kostadinoski — *Ss. Cyril and Methodius University in Skopje, MK*
Vladimir Zdraveski — *Ss. Cyril and Methodius University in Skopje, MK*

Abstract: Generation of prime numbers and factorization are very important topics in number theory and cryptography. Sieve-based methods like Sieve of Eratosthenes and Sieve of Euler have widespread usage. Pollard's Rho algorithm, a probabilistic method for integer factorization, is also widely used in cryptographic applications. This paper explores a parallel approach alternative to these methods employing CPU and GPU acceleration to improve efficiency. Although parallelization imposes overhead on small inputs, experience suggests significant speedup for bigger prime boundaries. Our experiments show the potential of parallel computation to improve cryptographic computations, and in particular, this paper aims to demonstrate how increasing the number of CPUs in a system impacts the performance of these algorithms.

Social Dynamics in Distributed Free and Open-Source Software Development: A Case Study

Gnanendra Bachu — *Wrexham Glyndwr University, UK*

Abstract: This paper investigates the role of social interactions within the Public Free Software (Software Publico Brasileiro - ´ SPB) portal, a Computer-Supported Collaborative Work (CSCW) system developed to facilitate distributed software development in the public sector of Brazil. By analyzing a community using this portal through semi-structured interviews, communication channels are explored, organizational practices, and the impact of social dynamics on collaborative work. The findings reveal diverse communication preferences based on experience levels, the effectiveness of public versus private interactions, and the challenges faced in virtual collaboration. The strategies for engaging contributors and managing conflicts are also highlighted, offering insights into fostering effective collaboration in distributed development environments. This study contributes to the understanding of social interactions in FLOSS communities and provides practical implications for enhancing collaborative platforms.

Analysis of spam detection techniques using machine learning

Ginka Marinova *Technical University of Varna, BG*

Abstract: In recent years, the receipt of spam by billions of users around the world has increased. In general, for spam emails are admitted all emails that is sent without the express consent of the recipient and has no genuine business or personal purpose. Spam messages are unwanted messages and also lead to loss of personal data and further attacks on users. Machine learning methods and algorithms are applied as an innovative approach to spam detection and are found to be effective and have a high classification accuracy rate. In this paper, examines various machine learning techniques for solving spam tasks. Various scientific papers have been analyzed for successful spam detection. In addition, this study examines various metrics that are used to evaluate spam detection algorithms. In this research, spam classification was performed for the Support Vector Machine (SVM), Naive Bayes (NB) and Random Forest (RF) classifiers and their performance was compared. The obtained classification results showed a high overall accuracy, which is in the range of 87% to 98%. Of the three classifiers SVM has the highest accuracy of 98%. Although Random Forest (RF) and Naive Bayes (NB) were less accurate than SVM, they achieved good classification of 97% and 87% respectively. For the metrics Precision, Recall and F1-score with the lowest values is the Naive Bayes (NB) classifier.

BAP-Blockchain-Assisted Attribute-Based Public Auditing for Secure and Transparent Cloud Storage

Vimala Manohara Ruth Padeti *JNTUH University of Engineering, Hyderabad, IN*

Ujwala Rekha Jinugu *JNTUH University of Engineering, Hyderabad, IN*

Abstract: The expeditious expansion of cloud computing has transformed external data storage and access paradigms, enabling scalability and on-demand services for all entities. However, outsourcing sensitive data to third-party raise significant security concerns, particularly when it comes to data integrity, privacy, and unauthorized modifications. Attribute-Based Encryption (ABE) provides fine-grained access control, whereas public auditing schemes reduce the computational burden on data owners by entrusting integrity verification tasks to trusted entities. Despite these advancements, conventional auditing methods face challenges in protecting sensitive information, supporting dynamic operations, and ensuring transparency in multi-cloud environments. Blockchain technology, with its immutable ledger and decentralized architecture, presents an effective opportunity to enhance auditability, traceability, and trustworthiness in cloud storage. Introducing a blockchainassisted attribute-based public auditing scheme that combines attribute-based signatures (ABS) with blockchain to provide fine-grained access control and decentralized verification will enable data owners to outsource information with attributebased authentication tags. The cloud server

must respond to random integrity challenges generated by blockchain nodes. A proof-of-concept prototype is implemented using Hyperledger fabric with smart contracts managing audit logs and challengeresponse protocols. Experimental evaluation demonstrates that the proposed scheme achieves high detection probability of corrupted data, low communication and computation costs, and strong resistance against collusion and forgery attacks. In addition, the use of ABS policies enables dynamic user revocation without requiring full data re-tagging, thereby improving scalability. The results confirm that integrating blockchain into attribute-based auditing provides a secure and efficient solution for maintaining data trustworthiness in cloud environments.

SESSION C22 "ENERGY SYSTEMS AND SMART GRIDS" **Stream 3**

Chairman: Nikolay Djagarov Nikola Vaptsarov Naval Academy, BG

Friday, October 10th 11:30 – 13:00 Online

Unified, ontology-based information model for smart energy management systems

Tsvetelina Ivanova *University of Chemical Technology and Metallurgy, BG*
Polina Kesova *University of Chemical Technology and Metallurgy, BG*
Yordan Belev *University of Chemical Technology and Metallurgy, BG*
Idilia Batchkova *University of Chemical Technology and Metallurgy, BG*

Abstract: Energy efficiency in industry is often hindered by scattered data and the absence of common semantics across operational and enterprise systems. This paper introduces a methodological framework for creating a unified, ontologybased information model of an energy management system that complies with ISO 50001. The proposed ontology integrates operational data from diverse operational and enterprise sources, reuses validated domain ontologies, and supports formal validation, semantic querying, and automated reasoning. This approach enhances data interoperability, lowers integration costs, and improves the reliability of key performance indicators, establishing a foundation for scalable and auditable smart energy management system solutions.

Simulation Model of a Solar Water Heating System with Vacuum Tubes Based on Real Data

Nikolay Komitov *University of Food Technologies, Plovdiv,, BG*
Margarita Terziyska *University of Food Technologies, Plovdiv,, BG*
Mariyana Sestrimska *University of Food Technologies, Plovdiv,, BG*

Abstract: This paper presents a simulation model of a domestic solar water heating system equipped with vacuum tube collectors, developed on the basis of real operational data. The studied installation consists of a solar collector integrated into a biomass heating system for a residential building. Measurements of water temperatures in the collector and storage tank during the summer season

were used as input for modeling and validation in MATLAB/Simulink. The system is controlled by a differential thermostat, which activates the circulation pump depending on the temperature difference. Two simulation models were created: one representing the solar radiation input through measured outlet temperatures, and another reproducing the heat transfer to the storage tank. The obtained results show a close match between simulated and experimental data, with root mean square errors of 1,60 for the tank and 5,86 for the collector. The developed model provides insights into the transient behavior of the system and can be used for optimizing control strategies, as well as for extending the analysis to spring and autumn operating conditions.

Lightweight CNN-Based Machine Learning Approach for Thermographic Anomaly Detection in Photovoltaic Panels

Antonio Karaganov — *South-West University "Neofit Rilski", Blagoevgrad, BG*

Filip Batalov — *South-West University "Neofit Rilski", Blagoevgrad, BG*

Abstract: This work presents a lightweight deep learningbased system for detecting thermal anomalies in photovoltaic (PV) panels using convolutional neural networks (CNNs). The developed pipeline focuses on real-time thermal image analysis. The model is trained on a growing dataset of categorized thermal images and achieves promising initial performance, demonstrating its potential for automated PV inspection.

Survey and analysis of different types of rechargeable batteries, applicable to EVs and hybrid EVs

Raycho Ilarionov — *Technical University of Gabrovo, BG*

Ivan Simeonov — *Technical University of Gabrovo, BG*

Hristo Kilifarev — *Technical University of Gabrovo, BG*

Egnar Özdikililer — *Technical University of Gabrovo, BG*

Borislav Nedev — *Technical University of Gabrovo, BG*

Abstract: In this paper is made a survey and comparative analysis of different types rechargeable batteries which can be used as energy source in electric and hybrid vehicles. Depending on the type of the chemistry the batteries have different characteristics and typical charge-discharge profiles, which define their main functions and applications. There are specific requirements for batteries that will be used as an energy source in electric vehicles (EV) and hybrid EVs (HEV), related to their properties, characteristics, operating modes and maintenance. Common terms, parameters, typical chargedischarge profiles and performance that characterizing rechargeable batteries are presented. With the growing interest in EVs, understanding the different types of batteries, their characteristics and charging methods is essential, not only for potential owners but also for

manufacturers.

SESSION A23 "EDUCATIONAL TECHNOLOGY AND AI IN EDUCATION"	**Stream 1**
Chairman: Valentina Markova	Technical University of Varna, BG
Friday, October 10th 14:00 – 15:30	Hall 109TV

Constructive thinking of students in educational telematics: the potential of robotics

Nurassyl Kerimbayev — *Al-Farabi Kazakh National University, KZ*
Arailym Meiran — *Al-Farabi Kazakh National University, KZ*
Aliya Akramova — *Al-Farabi Kazakh National University, KZ*
Vladimir Jotsov — *University of Library Studies and Information Technologies, BG*

Abstract: Modern educational technologies are increasingly being introduced into distance and telematic learning formats. One of the promising directions is the use of robotics as a means of forming constructive thinking among students. Robotics in education is a dynamically developing field of knowledge in modern conditions, which makes it possible to involve students of different ages in innovative scientific and technical creative processes. This article examines the potential of robotics in the context of educational telematics, analyzes its didactic capabilities, and offers practical recommendations for integrating robotics solutions into the educational process. In the course of the research, a pedagogical experiment was conducted. Building robotic models and systems and demonstrating their practical use in the classroom is an indicator of engagement, commitment to the future, and the desire and opportunity to transform the future with the power of knowledge. The study presents theoretical and hypothetical positions, main areas of activity and empirical data that are used to evaluate and verify these theories. The result of the experiment showed the ability to think constructively and solve problems, design and work independently, as well as develop robotics skills.

The influence of Generative AI on the transfer of algorithmic skills in students

Nurassyl Kerimbayev — *Al-Farabi Kazakh National University, KZ*
Zhanbota Menlibay — *Al-Farabi Kazakh National University, KZ*
Rustam Shadiev — *Zhejiang University, CH*
Esenbek Mambetakunov — *Kyrgyz National University named after Jusup Balasagyn, KGT*
Sholpan Kolumbayeva — *Abai Kazakh National Pedagogical University, KZ*
Ainar Nurymova — *Astana IT-University, KZ*
Karlygash Adamova — *Al-Farabi Kazakh National University, KZ*

Abstract: With the rapid development of generative artificial intelligence (AI) models, there is a growing need to critically assess their role not only as tools for automating problem-solving, but also as potential mediators in the development of complex cognitive and metacognitive skills. This study empirically investigates the impact of interaction with generative AI on students' ability to transfer algorithmic thinking—a key component of successful computer science education.

In a controlled experiment involving 76 students, we conducted a comparative assessment of academic performance across three task types: near transfer, far transfer, and metacognitive tasks. A mixed-methods approach was employed, combining quantitative analysis (success rates, subjective cognitive load, and confidence levels) with qualitative methods (behavioral log analysis and semistructured interviews). In the experimental group, which used generative AI as an interactive tutor, statistically significant improvements were observed across all task types ($p < 0.01$), with particularly strong gains in far transfer tasks. Additionally, the group demonstrated higher metacognitive confidence, more meaningful explanations of solution strategies, and a greater tendency toward reflective interaction with the AI.

The findings highlight the potential of generative AI not only as a support tool but also as a catalyst for cognitive transformation in learning—provided it is used in a constructive, non-instrumental manner. At the same time, risks related to superficial copying underline the importance of pedagogical guidance and the cultivation of self-regulation in students. This work lays the groundwork for future research on the integration of AI systems into educational trajectories aimed at fostering knowledge transfer and metacognitive development.

Enhancing Accessibility with AI Algorithms: Simulating and Evaluating Human Typing Behaviour

Radka Nacheva *University of Economics – Varna, BG*

Abstract: Artificial intelligence (AI)-powered systems can be tailored to support users with different profiles better to improve digital communication and inclusion. Studies have shown that simulated data on various types of disabilities can be utilized early in the design of AI systems to measure key indicators that enhance the customization of these algorithms to users with diverse needs. This is particularly valuable in educational systems to address potential accessibility issues early in their design. In this regard, this study aims to investigate the simulation of human typing errors, providing a controlled framework for evaluating the simulated text through AI algorithms. The research scope is narrowed only to simulate typing errors made by people with motor disabilities. This is achieved by generating realistic typing errors using a Python script. Through the proposed framework, it is evaluated how human

typing errors can be assessed by AI algorithms to improve the accessibility of educational systems.

Explainability of Multi-Agent AI Systems in Decentralized Educational Environments

Radka Nacheva — *University of Economics - Varna, BG*

Otmane Azeroual — *German Centre for Higher Education Research and Science Studies (DZHW) & University of Hagen, DE*

Abstract: Artificial intelligence (AI) is increasingly being implemented in education systems, such as intelligent systems to assist teachers and adaptive learning platforms, including for students with diverse profiles. There is a scientific gap in understanding how to achieve transparency and accountability in decentralized AI systems, especially in education context. This paper explores how multiagent systems can make understandable decisions for all parties in the educational process, such as teachers, learners, and administrators. It highlights the need for explainable AI (XAI) solutions to address the problems of decentralized systems where agents operate in different contexts. This research analyzes current approaches to explainability and proposes new framework for decentralized educational AI.

SESSION B23 "IoT AND SURVEILLANCE SYSTEMS" **Stream 2**

Chairman: Delyan Genkov — Technical University of Gabrovo, BG

Friday, October 10th 14:00 – 15:30 — Online

IoT Night Vision Goggles: A Dual-Camera System for Surveillance and Real-Time Streaming for Enhanced Detection

Paul Daniel D. Calimoso — *Mapua University Manila City, PH*

Kyle Siegfred K. Sumicad — *Mapua University Manila City, PH*

Joseph Bryan G. Ibarra — *Mapua University Manila City, PH*

Abstract: This research presents the development and evaluation of an IoT Night Vision Goggles system designed for surveillance and real-time streaming in low-light environments, utilizing a dual-camera setup. The prototype integrates an analog FPV RunCam camera for operator vision with a digital ESP32-CAM for WiFi streaming, supported by a custom protocol that achieves a 97% streaming success rate and 80ms latency. Real-time object detection, powered by a desktop-based YOLOv8 model, delivers 88% precision and 85% recall in identifying humans, vehicles, and obstacles. Testing in a 30-minute indoor warehouse scenario validated the ergonomic design, with a lightweight night vision goggle component and an ergonomically balanced total system, earning a usability rating of ≥4/5, though battery life ranged from 20-53 minutes. Designed to be cost-effective, the system outperforms more expensive commercial alternatives. This approach significantly enhances security

operations, event management, and content creation through cost-effective, real-time monitoring and situational awareness.

Compact wireless sensors for energy consumption analysis and cost optimization in small, medium, and large enterprises

Petar Georgiev *Technical University of Varna, BG*

Abstract: This study explores the development and application of energy sensors as a key component in modern energy monitoring and management systems. It traces the historical evolution—from analog measuring instruments to intelligent wireless sensors integrated into IoT and SCADA platforms. The main types of sensors (for current, voltage, temperature, etc.) are presented, along with their role in improving energy efficiency in buildings, industry, and renewable energy systems. A model of a monitoring system based on compact wireless sensors is proposed, capable of measuring key electrical parameters and sending alerts in case of deviations. The system enables both monitoring and active load management through predefined thresholds. A practical implementation was carried out in an enterprise in Plovdiv, where the deployment of the system resulted in a 10% to 15% reduction in energy consumption and annual savings of up to BGN 60,000. In conclusion, energy sensors are becoming the foundation of intelligent energy infrastructure. They hold sustainable resource management, integration of renewable sources, and process automation, while creating value through data and contributing to a more sustainable future.

Emerging Sensing Technologies in Crime Investigation: Applications and Innovations - A Comprehensive Review

Dimitar Rangelov *Data Management & Biometrics University of Twente, NL*

Radoslav Miltchev *Technical University of Sofia and Sofia Tech Park, BG*

Jaap Knotter *Police Academy of The Netherlands and Saxion University of Applied Sciences, NL*

Abstract: Emerging sensing technologies are revolutionizing crime investigation by enabling faster, more accurate, and non-invasive evidence collection. This paper reviews recent advancements, focusing on 3D reconstruction for virtual scene analysis, electronic nose for drug and explosive detection, and other innovative tools such as thermal imaging and ground-penetrating radar. Their applications, benefits, limitations, and integration potential are discussed, highlighting their growing role in enhancing forensic investigations.

Detection of Sunflower Oil in Olive Oil Using a Multisensor System of the Artificial Nose Type

Stefan Ivanov *Technical University of Gabrovo, BG*

Todor Todorov *Technical University of Gabrovo, BG*

Toshko Nenov *Technical University of Gabrovo, BG*
Jacek Wilk-Jakubowski *Kielce University of Technology, PL*
Stanimir Yordanov *Technical University of Gabrovo, BG*

Abstract: This article presents the use of an artificial neural network for classification to detect the presence of sunflower oil in olive oil. The classification data were collected using a multisensor system of the "electronic nose" type, which employs gas sensors MICS-6814 and MICS-4514. The trained neural network achieves recognition of sunflower oil content with a very high degree of accuracy. By using an artificial neural network, detection of food product adulterations, particularly in olive oil, can be done.

SESSION C23 "ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING APPLICATIONS"	**Stream 3**
Chairman: Veneta Aleksieva	Technical University of Varna, BG
Friday, October 10th 14:00 – 15:30	Online

Driving Disruptive LLM Adoption on Technology Markets with Bug Report-Enhanced Human-Value Alignment in RLHF

Teodora Nikolova *University of Library Studies and Information Technologies, BG*
Miglena Molhova-Vladova *University of Naional and World Economy, BG*

Abstract: Large Language Models (LLMs) as a disruptive innovation led to major transformative effects on industries by making powerful tools widely accessible.

In this paper, we investigate how the recent Reinforcement Learning from Human Feedback (RLHF) paradigm can be used to improve LLM alignment with human values over traditional binary feedback methods. We present a new methodology to affect value assurance by embedding structured bug report elements, for example, expected vs. actual results and contextual metadata, into RLHF to guarantee the AI responses are captive to users' specific intentions.

To illustrate how LLMs disrupt markets by redefining performance metrics and user expectations, the study uses a three-dimensional disruptive potential framework (novelty, information asymmetry, consumer needs). A case study on ChatGPT's unempathetic response to a potentially fragile question serves to illustrate the limitations of traditional feedback and the efficacy of bug report-style RLHF.

Results indicate that structured feedback more accurately captures user intent and context, making models align with experiential value as opposed to just factual accuracy. It curbs information asymmetry between the users and developers in a way that increases trust with lightning pace, making it ideal for regulated industries such as healthcare and education.

The paper presents evidence that bug report-enhanced RLHF not only improves alignment, but also it signifies a competitive advantage in technology markets, where human-centric AI is causing disruption. This approach positions LLMs as transformational tools, which satisfy unmet needs and reduce risk by shifting from quality assurance to value assurance.
In the end, the study proposes a scalable method by which unforeseen AI can be aligned with human values, enabling broader and safer market adoption.

LLM Implementation for Multi-Objective University Timetabling: Technical Description

Vitali Atias *Paisii Hilendarski University of Plovdiv, BG*
Emil Doychev *Paisii Hilendarski University of Plovdiv, BG*

Abstract: This paper evaluates large language models (LLMs) for multi-objective university timetabling optimization. The system utilizes a LangGraph-based state machine with specialized nodes to generate schedules, resolve conflicts, and perform multi-objective evaluations across five dimensions: minimizing conflicts, maximizing student satisfaction, optimizing resource utilization, accommodating professor preferences, and ensuring specialty compliance. Eleven LLMs (with 1 billion to 27 billion parameters) were tested on CPU-only infrastructure across five complexity scenarios, including the Gemma and Llama model families. Statistical analysis revealed that the Gemma3:12B model performed best, demonstrating superior consistency and reliability. In contrast, Llama models demonstrated faster processing but lower quality. Analysis of performance degradation showed that Gemma models were more robust (declining by 31%-32%) than Llama models (declining by 53%-60%) as complexity increased. Key findings indicate that models with fewer than 12 billion parameters consistently fail to produce viable schedules. The staged workflow successfully separates the phases of constraint interpretation and solution generation. This study provides empirical evidence for selecting LLMs for university timetabling and establishes performance benchmarks across model families and complexity levels.

Integration of Large Language Model Agents with Robot Operating System for Human-Robot Interaction and Task Allocation in Complex Environments

Kaloyan Yovchev *Bulgarian Academy of Sciences, BG*

Abstract: Nowadays, there is an increasing need to implement robotic systems that can be used in collaboration with humans. Such robotic systems operate in a complex non-deterministic environment. The development of effective methods for communication between robots and humans is of key importance. At the same time, AI Large Language Models (LLM) are increasingly being developed that allow for easy understanding and processing of natural language commands. This publication examines the possibility of integrating an LLM AI agent into the

Robot Operating System (ROS). This AI agent, which uses LLM, can process natural language requests that can be used to schedule tasks for robots. An architecture of the entire system is proposed. Several ways of developing agents are considered. Experiments are conducted in which the applicability of different models is assessed.

RAG augmented Large Language Models as a tool for Education

Samuel Teixeira — *Universidade de Aveiro, PT*
Mustafa Sonkaya — *Applied Sciences University of Isparta, TR*
Petia Georgieva — *Universidade de Aveiro, PT*

Abstract: Large Language Models (LLM) are widely used in Natural Language Processing (NLP) for various tasks, from basis questions, to serving as reliable sources of knowledge in specific research fields. However, LLMs may suffer hallucinations, that is give incorrect answers. Retrieval Augmented Generation (RAG) is a mechanism to give more context to the user's query by searching for the most relevant pieces of information within a database.
A survey of core RAG technologies with a focus on architecture design and the most important components is provided in this paper. Based on this survey the most promising building blocks of the RAG augmented LLM architecture are suggested (vector databases, embedding models, evaluation metrics, etc.). The proposed RAG-based Chatbot is recommended for further exploration as an AI-based tool to assist the teaching and learning educational process.

SESSION A24 "INDUSTRIAL INSTRUMENTATION AND CONTROL" — **Stream 1**

Chairman: Nikola Nikolov — Technical University of Varna, BG

Friday, October 10th 15:30 – 17:00 — Hall 109TV

Accuracy Optimization of Electromagnetic Flowmeter via Empty Pipe Diagnostic Calibration

Pavel Dimitrov — *Technical University of Varna, BG*

Abstract: This paper presents an in-depth analysis of the performance characteristics and diagnostic capabilities of a Rosemount 8732EF electromagnetic flowmeter, with a particular focus on Empty Pipe (EP) detection functionality and measurement accuracy under varying flow conditions. A custom-designed experimental setup replicating industrial conditions was developed to evaluate the device across a range of operating scenarios. Initial tests revealed significant startup- related fluctuations that adversely affected measurement accuracy. Digital signal filtering was applied to suppress these transients; however, it introduced processing delays and increased measurement error. To address this, EP diagnostics were optimized by adjusting trigger threshold and sample count parameters. The optimal configuration (trigger level 25, sample count 4) significantly reduced startup

fluctuations while preserving the device's dynamic response, achieving a lower average error (0.79%) compared to both unfiltered and digitally filtered configurations. The results demonstrate that tailored EP diagnostics offer a superior alternative to conventional filtering, delivering improved accuracy and operational stability. The findings underscore the importance of application-specific configuration for maximizing flowmeter performance.

Performance enhancement of PID control of nonlinear industrial plants via online fuzzy logic auto-tuning and genetic algorithms optimisation

Snejana Yordanova *Technical University of Sofia, BG*
Desislava Stoitseva-Delicheva *Technical University of Sofia, BG*

Abstract: Most industrial plants are characterized by nonlinearity, inertia, changing parameters and model uncertainty. The developed intelligent approaches for their control are still complex to replace the well mastered PID controllers as widely used in industrial implementations ensuring closed loop system stability and high performance around a given operation point. The present research focuses on development of an approach for PID performance enhancement in controlling nonlinear plants based on simple design and implementation in programmable logic controllers (PLC) for real time control. It steps on two types of fuzzy logic online PID parameters, auto-tuners and offline parameter optimization, using genetic algorithms and simulations. Experimental data provided from the present empirically tuned PLC PID real time control is used both for derivation of the necessary in the simulations TSK plant model and for reference data in the assessment of the achieved PID improvements. The provided system stability and robustness analysis ensures the industrial feasibility of the results. The approach is illustrated for the control of the temperature in a laboratory fruits dryer. Simulation investigations show that the systems with self-tuning PID controllers outperform in dynamic accuracy, robustness and economic and smooth control action the system with the empirically designed PID.

Design of a DCS-Based Experimental Platform for Evaluation of Industrial Flowmeters

Pavel Dimitrov *Technical University of Varna, BG*
Reneta Parvanova *Technical University of Varna, BG*
Ivan Grigorov *Technical University of Varna, BG*

Abstract: This paper presents the development of an experimental platform based on a Distributed Control System
(DCS), specifically designed for the standardised testing and evaluation of industrial flowmeters. The platform employs a modular integration of hardware and software components, ensuring interoperability with both analog and digitally interfaced devices through widely adopted communication protocols such as HART and FOUNDATION Fieldbus (FF). It facilitates fully automated

experimental procedures, real-time process monitoring, and high-resolution data acquisition, ensuring repeatability, traceability, and methodological rigor. The system's core functionalities encompass closed-loop flow control, synchronized execution of experimental scenarios, and algorithmic evaluation of measurement accuracy. Empirical validation under controlled dynamic conditions demonstrates the system's capability to replicate industrial environments with high fidelity, providing a robust framework for metrological verification, functional diagnostics, and performance benchmarking of flow measurement technologies.

Model Predictive Control of a Car Active Seat Suspension System

Ivan Ruškan — *University of Zagreb, HR*
Branimir Škugor — *University of Zagreb, HR*
Joško Deur — *University of Zagreb, HR*
Ivan Cvok — *Rimac Technology, HR*

Abstract: The paper presents design of a high-level control strategy for an active car seat suspension system based on model predictive control (MPC). The MPC formulation aims to improve ride comfort by minimizing vertical seat acceleration amplitudes, while explicitly enforcing physical constraints on the suspension stroke and actuator force. Simulation results gained through a linear half-car model demonstrate that the proposed MPC strategy significantly outperforms a baseline linear quadratic regulator (LQR), primarily due to its ability to directly account for the hardware constraints. Robustness of the proposed approach is illustrated through control system evaluation based on a more realistic and complex nonlinear seat mechanism model, including actuator dynamics and friction. When combined with a proper low-level controller, the overall system achieves performance close to that of the idealized linear system, highlighting the potential for real-world application.

SESSION B24 "NETWORK ARCHITECTURE AND CLOUD COMPUTING" — **Stream 2**

Chairman: Ivaylo Penev — Technical University of Varna, BG

Friday, October 10th 15:30 – 17:00 — Online

Architectural Transformations in Networking: The Journey From Traditional Systems to Cloud-Based

Mohammad Al Rawajbeh — *Al Zaytoonah University of Jordan, JO*
Evon M. Abu-Taieh — *The University of Jordan, JO*
Issam AlHadid — *The University of Jordan, JO*

Abstract: The significant evolution of technologies last decades, especially those used in computer network design, has had an impact in transferring from a traditional network paradigm into a more modern and effective cloud-based network that overcomes the challenges and problems in traditional network

structure. This research provided a comprehensive systematic review of the evolution of cloud networking according to the changes in technologies on which the networks are based. A review of the developing stages from virtualization, SDN, NFV, and CNF reaching the cloud-based network is conducted. The analysis shows the new concept's impact on overcoming the challenges in rigid traditional structures, such as scalability, hardware cost, operational efficiency, and migrating innovation and new technologies. Despite the benefits of obtaining cloud networking, several challenges are raised related to latency, operability, cost-benefit balancing, as well as security. Enterprises have to use an accurate plan for implementing the cloud concept that explains the degree of need for using the cloud provision fully or completely, and updating and following the emerging solutions and procedures for implementing the cloud is required.

Architecture of an Application for Software Defined Network

Delyan Genkov — *Technical University of Gabrovo, BG*
Tsvetan Raykov — *Technical University of Gabrovo, BG*
Miroslav Slavov — *Technical University of Gabrovo, BG*
Hristo Kilifarev — *Technical University of Gabrovo, BG*

Abstract: Software defined networks are an approach to the networking, which allows centralized monitoring and control of all the network devices through a software application. There are many possible approaches for the creation of such applications. Although some protocols and recommendations exist for communication between network devices and low-level software controllers, the upper layer applications are not standardized. This paper proposes a possible architecture for an application for software defined networks.

Optimizing Zscaler SASE Disaster Recovery: region-aware and latency optimized load balancing

Tsvetomir Bogdanov — *Bulgarian Academy of Sciences, BG*
Nayden Chivarov — *Bulgarian Academy of Sciences, BG*

Abstract: This is a project for geo-separated Disaster Recovery (DR) design for Zscaler Private Access (ZPA) that reduces application traffic latency by approximately 100ms and DNS resolution to below 500ms, while at the same time keeping data within its region of origin or destination. The original design used AppConnectors in the primary and secondary data centers (Austria and Greece). The final solution however, uses two Azure-hosted Private Service Edges (PSEs) and six Azure-hosted AppConnectors distributed in Ireland, Austria and Greece. During testing, an AppConnector in Washington D.C. (within a Zscaler Beta tenant) managed US traffic, to avoid exposing real production data and applications – this way reducing compliance risk. The DNS services vendor used was MarkMonitor which also provides a geo-location

pinning of the queries; Azure Traffic Manager feature was used to optimize and introduce load balancing and additional low-latency optimization. Since Zscaler Digital Experience (ZDX) was already deployed (integrated with the Zscaler Client Connector VPN), we used it to monitor performance and outcomes. Results showed up to 35% improvement in application latency in Europe. For DNS queries (which trigger a "red" alert at 500ms), the new production setup eliminated all previously observed latency spikes. We implemented a proof-of-concept traffic steering for Egypt (due to endpoint specifics) and Armenia (due to severe local transfer speed limitations) - we optimized the trans-region transfer speed during DR by nearly 50%.

Deployment and Verification of an automated backup solution for Zscaler Private Access (ZPA)

Tsvetomir Bogdanov — *Bulgarian Academy of Sciences, BG*
Nayden Chivarov — *Bulgarian Academy of Sciences, BG*

Abstract: This article presents the deployment and verification of an automated configuration-backup solution for Zscaler Private Access (ZPA). For the past four years, ZPA provided no client-accessible backup capability in its admin UI, creating operational and compliance risks; a later backup feature (introduced in April 2025) remains incompatible with SSL Inspection and AppProtection and can incur restoration delays of up to three days. We designed and deployed a vendor-agnostic backup framework using a Kubernetes cluster for scalability and AWX (open-source Ansible Tower) on an Ubuntu 22.04 LTS VM. The solution aligns operations with ISO/IEC 27001 and the NIST Cybersecurity Framework, enables rapid disaster recovery, and supports ancillary analyses (e.g., AutoDiscovery usage and tenant duplication). The contribution is a practically validated backup architecture that integrates zero-trust principles in ZPA environments via open-source automation, demonstrating reliable scheduling, retention, and audit-grade reporting. Contextual background on zero trust follows NIST SP 800-207 and 800-207A [8, 9].

SESSION C24 "MACHINE LEARNING IN HEALTHCARE AND BIOMETRICS" — Stream 3

Chairman: Cvetelina Georgieva — Bulgarian Academy of Sciences, BG

Friday, October 10th 15:30 – 17:00 — Online

Using Deep Learning Applications to Predict Brain Tumor Presence

Shaurrya Baheti — *University of Europe for Applied Sciences, DE*
M. Kamran Asif — *King Saud University, SA*
Moumita Mukherjee — *Universitatsmedizin Berlin, DE*
Pratik Pradeep Rughe — *University of Europe for Applied Sciences, DE*
Hafsa Allauddin Shaikh — *Ministry of Health, SA*

Abstract: Tumors are generally abnormal cell growths that can be dangerous depending on the type of cell or the location of the growth. While identifying what type of tumor someone has is a much more important part of the diagnosis, we believe that if we add just a normal layer of machine driven testing for whether or not a tumor is present in the first place in a brain Magnetic Resonance Imaging (MRI) scan will save time by providing the diagnosticians only tumorous MRI scans. We have chosen brain tumors for our subject as our brain is definitely the most important organ in our body, which is not to say the other organs are not important, but given the fact that people who lose a limb can get limb replacements these days that can solely be controlled by their brain by reading the neurological activity says more than enough. Hence, this project aims to use deep learning models to figure out whether a provided image is tumorous or not.
We also aim to find out which of the two (Xception and ResNet50) models are better for this task by comparing the results from both.

Automated COVID-19 Screening Using Convolutional Neural Networks: Performance and Interpretability Analysis

Nazar Zhanabergenov — *University of Europe for Applied Sciences, DE*
Hafsa Allauddin Shaikh — *School of Computing, Ministry of Health, SA*
Moumita Mukherjee — *Universitatsmedizin Berlin, DE*
Muhammad Saqib — *Arden University, DE*
Meerah Karunanithi — *University of Europe for Applied Sciences, DE*

Abstract: The COVID-19 pandemic underscored the urgent need for rapid and accurate diagnostic tools to mitigate healthcare burdens and curb viral transmission. While RT-PCR remains the gold standard, its limitations in accessibility and turnaround time have heightened interest in alternative methods, such as chest X-ray analysis, particularly in resource-constrained settings. Existing studies on AI-driven COVID-19 detection often lack comprehensive comparisons of deep learning architectures or fail to address model interpretability, leaving gaps in understanding their real-world applicability. This study bridges these gaps by evaluating and comparing two deep learning models—a custom Convolutional Neural Network (CNN) and a pre-trained ResNet—for classifying chest X-rays into COVID-19, viral pneumonia, and normal cases. Using a Kaggle dataset of 15,000 labeled images, we implemented data augmentation (rotation, zooming, flipping) and hyperparameter tuning to optimize performance, while incorporating explainability techniques to demystify model decisions. The ResNet model achieved superior accuracy (92%) compared to the CNN, with precision, recall, and F1-scores further validating its robustness. Hyperparameter tuning enhanced both models, though ResNet maintained a consistent edge, and

explainability methods provided critical insights into feature importance. This work not only demonstrates the efficacy of deep learning in COVID-19 diagnosis but also delivers a transparent, reproducible framework for future medical imaging research, combining performance optimization with clinical interpretability.

Deep-SimPPG: A GAN-Based Hybrid Framework for Realistic Photoplethysmographic Signal Synthesis

Galya N. Georgieva-Tsaneva — *Bulgarian Academy of Science, BG*
Yoan-Aleksandar Tsanev — *Technical University of Varna, BG*
Krasimir Cheshmedzhiev — *Bulgarian Academy of Science, BG*

Abstract: This paper presents an enhanced method for simulating photoplethysmographic (PPG) signals by integrating deep learning techniques into a previously established Gaussian-based framework. Building upon our previously established hybrid model composed of dual Gaussian functions and Autoregressive Integrated Moving Average (ARIMA)-based temporal variability, we propose a novel GAN-based architecture for the synthesis of physiologically plausible PPG signals. The Generative Adversarial Network (GAN) learns to replicate realistic noise patterns and dynamic variability observed in real-world recordings, while the ARIMA component models the temporal fluctuations of heart rate variability. The synthesized signals are evaluated using time and frequency domain heart rate variability (HRV) metrics, histogram distributions, and spectral power analysis. Comparative results demonstrate significant improvements in waveform fidelity, statistical similarity, and long-term variability compared to real PPG data and previous simulation models. The proposed approach enables the generation of high-quality synthetic datasets suitable for validating signal processing algorithms, developing diagnostic tools, and training deep learning models in biomedical applications.

A Privacy-Preserving Architecture for Biomedical Signal Acquisition and Transmission Using Hybrid Cryptography and Regulatory-Aware Protocols

Galya N. Georgieva-Tsaneva — *Bulgarian Academy of Science, BG*
Krasimir Cheshmedzhiev — *Bulgarian Academy of Science, BG*
Miroslav Dechev — *Bulgarian Academy of Science, BG*
Yoan-Aleksandar Tsanev — *Technical University of Varna, BG*

Abstract: The increasing ubiquity of wearable technologies in healthcare applications poses significant challenges regarding the security, authenticity, and privacy of biomedical signals, particularly electrocardiogram (ECG) and photoplethysmogram (PPG). These signals not only provide vital diagnostic information but also serve as biometric identifiers. This paper proposes a privacy-

preserving signal protection framework that integrates adaptive digital watermarking and hybrid cryptographic mechanisms to ensure data integrity, origin authentication, and confidentiality. The approach employs semantic region segmentation of the signal, entropy- and energy-based adaptive embedding, and quantization-based watermarking in the wavelet domain. A cryptographic layer combines AES and RSA to secure both the signal and watermark. Experimental evaluation on real ECG datasets demonstrates high robustness of the embedded watermark against noise and processing, with minimal signal distortion, as indicated by PSNR, RMSE, and BER metrics. The proposed framework aligns with GDPR and HIPAA privacy requirements and provides a lightweight, verifiable, and secure method for safeguarding biomedical signals in decentralized IoT (Internet of Things) environments.

SESSION A25 "ADVANCED MANUFACTURING AND MATERIALS"	**Stream 1**
Chairman: Nikolay Djagarov	Nikola Vaptsarov Naval Academy Varna, BG
Friday, October 10th 17:30 – 19:00	Hall 109TV

Tensile Testing at Elevated Temperatures of Test Specimens Made of Polymer Materials Obtained by Fused Deposition Modeling

Miglena Paneva — *Bulgarian Academy of Sciences, BG*
Peter Panev — *Bulgarian Academy of Sciences, BG*
Veselin Tsonev — *Technical University of Sofia, BG*

Abstract: Plastic products are increasingly used both in our daily lives and in industry. There are many methods for their manufacture, but the most widespread nowadays is three-dimensional printing using Fused Deposition modeling. Using the mentioned technology, test specimens for testing tensile strength have been made from different groups of polymer materials, which will be tested at elevated temperatures using a test stand. The analyses performed will verify the temperature to which each of the materials can withstand. A thermocouple and an infrared thermal camera were used to control the temperatures during testing. The testing temperatures were selected depending on the characteristics of the materials. Strength-strain curves were constructed for each material.

The Role of Additive Manufacturing in Advanced Cooling Channel Design

Todor Todorov — *Technical University of Sofia, BG*
Georgi Todorov — *Technical University of Sofia, BG*
Borislav Romanov — *Technical University of Sofia, BG*

Abstract: The paper presents comparative analysis of conformal cooling systems in injection molding, focusing on their design and implementation using additive manufacturing technologies. The study aims to compare the performance of conformal cooling channels with traditional cooling systems, pinpointing the advantages of proposed design by enhancing the efficiency of the injection molding process. The methodology involves a systematic approach to creating the cooling channels, where parameters such as melt flow rate and coolant temperature are constant to isolate and emphasize the geometric differences in channel design. The research emphasizes the critical role of effective cooling in the injection molding cycle, where cooling time can reduce significant percentage of the total process duration. By optimizing the cooling system, the study aims to reduce cycle times, thereby increasing productivity and profitability in manufacturing. The paper puts up for discussion on the potential for further research and development in this area, emphasizing the need for innovation in cooling technologies to meet the demands of modern manufacturing.

Investigation of Optimal Parameters for PLA Printed Details

Kliment Georgiev *Technical University of Sofia, branch Plovdiv, BG*

Abstract: Additive printing methods are becoming increasingly widespread in the production of prototypes and functional elements. It is imperative to acknowledge the significance of expertise in the domain of additive printing systems, as it plays a pivotal role in ensuring the precision and accuracy of the final product's geometry. This report presents the findings of an experimental study of some fundamental technological factors. The present study investigates the influence of nozzle temperature, table temperature, layer height, and infill type on the geometric accuracy of a selected part. The findings indicate that the nozzle temperature and the mass exert the most significant influence on the geometric parameters. The layer height and the type of filling have been shown to have a significantly weaker influence on the geometric accuracy of the part.

Investigating the Hardness of Test Specimens Made of Fused Deposition Modeling Materials

Peter Panev *Bulgarian Academy of Sciences, BG*
Miglena Paneva *Bulgarian Academy of Sciences, BG*
Gabriela Kotseva *Bulgarian Academy of Sciences, BG*

Abstract: The present work is based on the study of the hardness of printed test specimens using Fused Deposition Modeling technology. Materials with different characteristics and properties were used for the experiment - PLA, PLA Wood, PETG, ASA, PC, PA6, FilaFlex SEBS, CPE HG100. An analysis of the types of hardness testing methods was made, after which the appropriate one was selected. The Shore method was examined in more detail, and the three hardness scales were classified. Standard methods for determining hardness

were indicated. Test specimens were designed according to the Shore test standard for plastics ISO 868: 2003. They were printed depending on the individual characteristics of each filament, with a filling of 30%. After testing, they were subjected to accelerated aging, corresponding to one year of exposure to Sunlight and UV radiation in a selected latitude and climate. The measured values after aging were compared with those after 3D printing. The results show a decrease in values in hardness after aging for all materials.

SESSION B25 "5G NETWORKS AND TELECOMMUNICATIONS"	**Stream 2**
Chairman: Ventsislav Nikolov	Technical University of Varna, BG
Friday, October 10th 17:30 – 19:00	Online

Performance Analysis of 5G Advanced Synchronization Techniques using GNSS-Referenced Timing Analyzers Circuits Course

Teodor Iliev — *University of Ruse "Angel Kanchev", BG*
Ivelin Penkov — *University of Ruse "Angel Kanchev", BG*

Abstract: Precise network timing is essential for 5G TDD and advanced radio features. We evaluate how current synchronization approaches—GNSS-referenced time distributed over the transport network with IEEE 1588 and, where available, Synchronous Ethernet—perform in practice. Using a Global Navigation Satellite System (GNSS)-locked timing analyzer, we measured absolute time alignment of several multi-vendor solutions in a controlled setup. All systems achieved phase synchronization comfortably better than the 5G target of ±1.5, μs; observed errors were in the nanosecond range, providing headroom for operational variation. We discuss what drives the remaining offset and jitter and highlight deployment issues such as network asymmetry and dependence on satellite timing. Finally, we outline directions to improve robustness and prepare for beyond- 5G/6G requirements. The results are intended to guide network engineers in selecting and hardening synchronization strategies.

AI-Driven Trust Score-Based Synchronization Control for Robust 5G and Beyond Networks

Teodor Iliev — *University of Ruse "Angel Kanchev", BG*
Ivelin Penkov — *University of Ruse "Angel Kanchev", BG*

Abstract: Accurate time and frequency synchronization is a fundamental requirement for advanced mobile communication networks, particularly in the context of dense fifth-generation (5G) deployments and the transition towards sixth-generation (6G) systems with disaggregated radio access architectures. Conventional methods based on the Precision Time Protocol (PTP) and Synchronous Ethernet (SyncE) exhibit limited adaptability when exposed to asymmetric routing, variable queuing delays, interference, and other dynamic transport impairments. This work presents a synchronization control framework

that combines realtime evaluation of a composite trust score with predictive analysis using Long Short-Term Memory (LSTM) neural networks. The proposed design enables proactive, context-aware selection and aggregation of multiple timing sources, including Global Navigation Satellite Systems (GNSS), packet-based protocols, and oscillator holdover, while significantly reducing unnecessary source switching events. Simulation results indicate that the approach achieves a reduction in average Time Error (TE) exceeding 60% and shortens recovery time from synchronization degradation by more than 75% compared to conventional techniques. The architecture is lightweight, modular, and fully compliant with international timing and synchronization standards, supporting both centralized and distributed deployment models. These characteristics make the framework a strong candidate for practical integration into next-generation mobile transport networks, ensuring robust, scalable, and autonomous operation under highly dynamic conditions.

Digital disruptor of communication and navigation systems using phase manipulation

Nikolay Gueorguiev — *Bulgarian Academy of Sciences, BG*
Atanas Nachev — *University of Library Studies and Information Technologies, BG*
Konstantin Nesterov — *Bulgarian Academy of Sciences, BG*
Ognyan Todorov — *Technopol LTD, BG*
Yavor Boychev — *Bulgarian Academy of Sciences, BG*

Abstract: The material presents a block diagram of a digital disruptor for communication and navigation systems using phase manipulation. The creation of interference through the use of random phase modulation of signals is the subject of numerous studies, each applicable for solving a specific set of tasks. The development and widespread use of radio control systems and satellite navigation for aircraft, which utilize phase-modulated signals, determine the relevance of assessing various possibilities for creating a digital jammer with phase manipulation designed for these systems The object of the study is creation of a possible sample of disruptor with phase manipulation that can be quickly reconfigured to operate in different frequency ranges and with different modulation periods of the generated disturbances. The main results from laboratory and field tests with laboratory samples and a prototype of a multi-channel digital disruptor are presented. Based on this, it is demonstrated that the creation of single-channel and multi-channel disruptors with digitally synthesized signals, which utilize phase manipulation, is possible, along with the capability for rapid reconfiguration across a wide frequency and phase range.

System for emitting radio signals with a fictitious electromagnetic center

Nikolay Gueorguiev — *Bulgarian Academy of Sciences, BG*
Atanas Nachev — *University of Library Studies and Information Technologies, BG*

Yavor Boychev — *Bulgarian Academy of Sciences, BG*
Konstantin Nesterov — *Bulgarian Academy of Sciences, BG*
Kamen Vasilev — *Bulgarian Academy of Sciences, BG*
Svetlana Yaneva — *Technical University of Sofia, BG*

Abstract: In modern conditions, most transmitting systems are subject to electronic intelligence, which among other things, determines their location. This is related to the implementation of a number of destructive and non-destructive methods of influence against them. The aim of the study is to propose and analyze a System for the emission of radio signals with a fictitious electromagnetic center, designed to reduce the likelihood of determining the actual location of the emitting objects or the direction towards them. The report also presents the main results from field tests of a realized laboratory model of the system, conducted using a prototype developed by Great Bear Technology Bulgaria LTD, intended for the control of strike unmanned aerial vehicles that are self-guiding based on the radio signals of the emitting means.

SESSION C25 "FINANCIAL TECHNOLOGY AND MACHINE LEARNING"	**Stream 3**
Chairman: Idilia Batchkova	University of Chemical Technology and Metallurgy, BG
Friday, October 10th 17:30 – 19:00	Online

Comparative Evaluation of Machine Learning Models for Credit Scoring in FinTech Applications

Sayyed Khawar Abbas — *Corvinus University of Budapest, HU*

Abstract: Proper credit scoring is also crucial for controlling financial risks and targeting customers in the financial technology (FinTech) industry. Although conventional statistical modeling has always been the modeling choice, its successor, modern machine learning (ML) algorithms, demonstrates more outstanding predictive power. However, these models often involve a trade-off between predictive accuracy and interpretability. This study contrasts the results of three well-known ML models: Logistic Regression, Random Forest, and XGBoost. The tools were applied to a real-life dataset of a financial institution, namely, personal loan data. The evaluation metrics used were accuracy, precision, recall, F1-score, and Area Under the Curve (AUC), receiver operating characteristic. According to the results, XGBoost achieves the highest overall performance, with an impressive accuracy of 98.5% and a recall score of 96.9%. Close behind was Random Forest with its competitive performance. Logistic Regression provided better interpretability, but it was not as accurate as recall. This weak point suggests that more people who could actually be creditworthy will be discounted as applicants. These insights enable practitioners to make informed decisions about the most suitable ML methods to adopt in credit scoring tasks, particularly where accuracy and sensitivity are

key considerations. In addition, the current analysis will establish a performance reference that will be useful when attempting to enhance transparency and fairness in future credit decision processes driven by AI.

Leveraging Language Models and Technical Analysis for Real-Time Crypto Trading Signal Generation

Somesh Onkar Rewadkar — *Univ. of Europe for Applied Science, DE*
M. Kamran Asif — *King Saud University, SA*
Ahmed Hassan — *Arden University, DE*
Zeeshan Ali — *Saudi Telecom Company, SA*
Muhammad Saqib — *Arden University, DE*

Abstract: AI's capability to take decision on its own has become central attraction to combine volatile cryptocurrecy trading with large language models to increase profitability. But still there exist a gap when combining crypto trading and personalized trading styles. CryptoGPT scored 75% prediction accuracy when generating personalised trading signals. Greatly improving trading results. The combination of AI specifically LLMs with cryptocurrency trading greatly improved how financial sector works. Majorly due to rapid decision taking and data driven strategies. The way of trading give trader an edge while trading. Eventhough technical analysis and AI driven trading systems are in market they often fail to manage live data and user specified trading style which includes risk tolerance and trading strategy. This study make efforts in reducing this gap by developing CryptoGPT a novel way of that uses GPT 4 and real time crypto data to generate personalised trading signals. CryptoGPT uses Binance API where it takes historical and live crypto data and applies 150 technical indicators from the TALIB repository. This data is processed by GPT 4 keeping user defined preferences like strategy, timeframe, risk tolerance, and profit margin to generate tailored trading signals. CrptoGPT achieved 75% success rate in predicting trading signals that follows user's preference. The results states the huge potential of combining language models with technical analysis for personalized crypto trading. This study presents CryptoGPT that combines GPT-4 and technical analysis to generate user-tailored crypto trading signals.

Ensemble Methods for Predicting Continuous Cash Flow in Credit Risk Assessment

Dimitre Tomov — *University of Chemical Technology and Metallurgy, BG*
Iveta Grigorova — *Technical University of Sofia, BG*

Abstract: Accurate prediction of continuous cash flow is a pivotal component in credit risk assessment, directly informing lending decisions and risk management. This study evaluates the predictive efficacy of ensemble learning algorithms—Random Forest and XGBoost (latter implemented as HistGradientBoostingRegressor in scikit-learn) —against traditional baseline

models, namely Linear Regression and Decision Tree Regressor, in forecasting cumulative monthly loan repayments over a 12-month horizon. An ETL pipeline with categorical encoding is employed alongside rigorous data preparation steps addressing missingness and multicollinearity via Variance Inflation Factor analysis. Model hyperparameters are optimized through scikit-learn's GridSearchCV. Results demonstrate the superior accuracy and robustness of ensemble methods, emphasizing their applicability in practical credit risk frameworks.

Comparison of Classification Algorithms for Notebook Fault Prediction System Using Machine Learning

Ralitza Raynova *Technical University of Sofia, BG*

Abstract: This paper presents a comparative analysis of five machine learning classification algorithms that were applied to predict notebook hardware and software faults, using structured system logs and symptom descriptions. A Python-based microservice was developed to automate the construction of the dataset, including text normalisation and TF-IDF vectorisation. The models that were evaluated were Random Forest, XGBoost, Logistic Regression, Support Vector Classifier (SVC) and LinearSVC. The experimental results show that LinearSVC achieved the highest performance, with macro-averaged accuracy, precision, recall and F1-score of around 98.15%. These results highlight the effectiveness of integrating text-based features and lightweight classifiers for the automated prediction of faults in computing systems.

SESSION A31 "NEURAL NETWORKS AND AI APPLICATIONS" **Stream 1**

Chairman: Aydan Haka Technical University of Varna, BG

Saturday, October 11th 09:00 – 10:30 Hall 109TV

Camera calibration by a neural network with parallel sub-layers with different activation functions for robotic lab setup

Zhivko Zhekov *Technical University of Varna, BG*
Elena Vasileva *Technical University of Varna, BG*
Dian Dzhibarov *Technical University of Varna, BG*

Abstract: This article deals with one main problem in setting up the work of any industrial robot using camera - calibration of the coordinate systems of the camera images and the robot working field. To achieve this goal, a neural network with parallel sublayers with different activation functions is used and a single shot is needed.

Impact Of Classifier Choice On Automated Spam Detection: An Experimental Analysis

Stefka Popova *Technical University of Varna, BG*

Hristo Nenov *Technical University of Varna, BG*
Velislav Kolesnichenko *Technical University of Varna, BG*

Abstract: In recent years, an increasing amount of business and personal correspondence is conducted over the internet, making it convenient target for different cyber-attacks. Increasing numbers of studies are using different combinations of machine learning and deep learning algorithms along with artificial intelligence. Ensemble techniques such as bagging, boosting, stacking and voting are implemented to increase classification accuracy of spam detection. This paper continues previous research and focuses on impact model selection has over performance. Four combinations of models are studied, and best results are achieved by combination of Support Vector Machine, Logistic Regression and Multilayer Perceptron resulting in accuracy of more than 99.5%.

Binarization via Local Gradient-like Differences in four Directions

Stefka Popova *Technical University of Varna, BG*
Hristo Nenov *Technical University of Varna, BG*
Genoveva Dimitrova *Technical University of Varna, BG*

Abstract: Despite numerous studied and proposed solutions through the years, email spam remains a serious problem. Much of these solutions include usage of different combinations of classic machine learning algorithms along with artificial intelligence. Deep learning algorithms have gained vast popularity in recent years, mainly due to their adaptability and ability to detect complex nonlinear relationships. This paper continues the idea of hybrid scoring models for spam detection processing both English and Bulgarian language written emails. Focus this time is on training and testing Multilayer Perceptron with experimental hyperparameter tuning. Performance is compared with the performance of the classic machine learning algorithms reported before. Multilayer Perceptron-based hybrid scoring model achieves 98.67% accuracy which confirms the suitability of the model for automatic spam detection.

The Serbian Retrieval Augmented Generation System based on Hybrid Search

Harun Aksaya *Marmara University, TR*
Sevinç Gülseçen *Istanbul University, TR*
Natalija Lepkova *Vilnius Gediminas Technical University, LT*

Abstract: In this study, aspect-based sentiment analysis was conducted using both dictionary-based and machine learning approaches. Within the dictionary-based method, three different lexicons were tested, and the highest accuracy rate (87.7%) was obtained with the Turkish-based SentiTurkNet. In the machine learning approach, multi-layer recurrent neural networks (RNN) with GRU units were applied. The best performance was achieved with a three-layer structure, reaching an accuracy rate of 96.12%. Evaluation of precision, recall, and f-score values showed that the developed model successfully classified both

positive and negative sentiment poles with high reliability (positive f-score=0.96; negative f-score=0.92). Overall, the findings indicate that while dictionary-based approaches achieve notable results, machine learning-based models demonstrate significantly higher accuracy and robustness.

SESSION B31 "CRYPTOGRAPHY AND SECURITY SYSTEMS"	**Stream 2**
Chairman: Ventsislav Nikolov	Technical University of Varna, BG
Saturday, October 11th 09:00 – 10:30	Online

Simulation and evaluation of a quantum aware chaotic OTP generator in MATLAB

Dilyana Dimitrova *Nikola Vaptsarov Naval Academy, BG*

Abstract: This paper presents a quantum-aware chaotic one-time password (OTP) generator that integrates Logistic, Tent, and Hénon maps with hashed seed initialization to produce high-entropy sequences. Developed in MATLAB, the system supports multiple OTP formats and includes simulations of both classical brute-force and quantum search attacks based on Grover's algorithm. Evaluation metrics - Shannon entropy, character distribution, and attack success probability - demonstrate that the generator achieves near-theoretical maximum entropy and uniformity, ensuring strong unpredictability. The inclusion of quantum-aware analysis provides forward-looking insight into post-quantum security. The proposed framework serves as both a practical tool for secure OTP generation and a research platform for exploring chaos-based and quantum-resilient authentication methods.

Design of a quantum aware chaotic one time password generator

Dilyana Dimitrova *Nikola Vaptsarov Naval Academy, BG*

Abstract: The growing threat of quantum computing against conventional cryptographic methods highlights the need for stronger and more resilient authentication mechanisms. This paper presents the design of a quantum-aware chaotic one-time password (OTP) generator. The system uses Logistic, Tent, and Hénon chaotic maps to generate high-entropy sequences, which are then converted into numeric, alphabetic, or alphanumeric OTPs. A hash-based seeding mechanism ensures unpredictability in map initialization. The proposed design addresses gaps in OTP systems, particularly the lack of quantum resilience and real-time entropy evaluation. This work establishes a practical foundation for quantum-aware authentication and opens pathways for future hardware and software implementations.

Secure communication scheme based on chaotic switching between non-identical systems

Hristina Stoycheva *Technical University of Gabrovo, BG*

Abstract: This paper presents a communication scheme for secure transmission of digital information, based on chaotic switching between two non-identical chaotic systems—the classical Lorenz system and a modified Sprott system. In the transmitter, the digital sequence of zeros and ones is encrypted through the selection of an output coordinate from the corresponding system. The resulting chaotic signal is transmitted over an unsecured communication channel with added Gaussian noise. At the receiver side, a synchronization scheme based on marginal synchronization is implemented, enabling reliable recovery of the original information sequence. The analysis demonstrates that the proposed scheme ensures high robustness against disturbances and reliable reconstruction of the transmitted signal, making it suitable for secure data transmission systems.

Comparative analysis of different types of chaotic synchronization

Hristina Stoycheva *Technical University of Gabrovo, BG*

Abstract: This paper presents a comparative analysis of five different types of chaotic synchronization — complete, anti-, hybrid, marginal, and projective — implemented between two identical third-order Lorenz chaotic systems in a unidirectional (master–slave) configuration. The comparison is based on the transient response characteristics of the synchronization error components, under identical initial conditions and parameter settings. Key performance metrics, including maximum error, RMSE, decay rate, and settling time, are used for quantitative comparison. Results reveal notable differences in convergence speed and accuracy, highlighting the relevance of transient process analysis as a unified criterion for selecting synchronization schemes in secure communication applications.

SESSION C31 "E-LEARNING AND EDUCATIONAL TECHNOLOGY"	**Stream 3**
Chairman: Galina Ivanova	University of Ruse "Angel Kanchev", BG
Saturday, October 11th 09:00 – 10:30	Online

Development of an Information System for Accreditation and Assessment in Education

Baktygul Akulova *Ministry of Education and Science of the Kyrgyz Republic, KG*
Burul Tashtobaeva *Razzakov Kyrgyz State Technical University, KG*
Tzvetomir Vassilev *University of Ruse "Angel Kanchev", BG*
Bibigul Koshoeva *Razzakov Kyrgyz State Technical University, KG*

Abstract: The paper justifies the necessity of developing a management information system for accreditation of educational organizations. The structure and functions of the developed Information System (IS), called ASULA, for managing the processes of internal and external evaluation during accreditation are presented. ASULA consists of three subsystems. This article presents the

features of the second subsystem, which automates the processes of self-assessment and application for accreditation, external evaluation, decision-making, collection and processing, presentation of information and analytical reporting, and its integration into the national infrastructure of electronic services. In addition, ASULA also automates the processes of appointing external evaluation experts, which are selected by the software in a random order. System validation was carried out by means of on-line survey of experts who participated in the external evaluation of accredited organizations. Representatives and heads of accredited educational organizations, as the main users, also took part in the survey. According to the survey results it was found that automation increases the efficiency of accreditation process. Taking into account the results of the online survey, the IS was further developed.

The Role of Intelligent Systems in E Learning for Financial Education in the Digital Age

Angel Popgeorgiev *University of Ruse "Angel Kanchev", BG*
Elitsa Ibryamova *University of Ruse "Angel Kanchev", BG*
Galina Ivanova *University of Ruse "Angel Kanchev", BG*

Abstract: Intelligent systems are proving to be highly adaptable in the digital transformation of modern education, offering new opportunities to facilitate teaching activities and the acquisition of educational content.

This report explores the role of intelligent systems in enhancing learning processes, particularly in the study of financial calculations within programmatic systems for business modelling, through personalized learning and interactive program models. The focus is on platforms and tools that adapt to different educational contexts, supporting the understanding of complex financial concepts through data visualization and system performance analysis. The integration of AI-driven environments allows learners to experiment with financial decisions in real time, bridging the gap between theory and practice. These technologies are improving knowledge retention and fostering independent, critical thinking in financial contexts.

Assessment of the use of e-learning resources and platforms in the education of students in general education schools

Milena Velikova *University of Ruse "Angel Kanchev", BG*
Galina Ivanova *University of Ruse "Angel Kanchev", BG*

Abstract: The advancement of technology facilitates the development and creation of a wide range of e-learning resources and digital platforms for various stages of modern education. However, there are ongoing debates among specialists regarding whether teachers effectively integrate the wealth of electronic resources into their work with students and whether they possess the necessary skills to develop learning-appropriate materials. These uncertainties motivate further investigation into teachers' perspectives. This study presents

the evaluation of teachers from general education schools in Bulgaria concerning: the usefulness of e-learning tools in their work; the impact of digital technologies on students' learning processes; the extent to which digital tools enhance teaching practices; and the challenges teachers face in utilizing e-learning resources and digital platforms in education. The goal is to assess teachers' satisfaction with the available digital support materials and to identify the need for developing new resources.

Gamification and AI: Rethinking E-Learning Experiences

Aleksandra Kovacheva — *University at Albany, USA*
Neviana Krasteva — *Sofia University "St.Kliment Ohridski", BG*
Tsvetan Davidkov — *Sofia University "St.Kliment Ohridski", BG*

Abstract: This study explores how generative AI can help scale the use of gamification in e-learning by lowering design barriers for higher education instructors. Based on a survey of 114 Bulgarian university educators, we find strong enthusiasm for both gamification and AI, but limited knowledge of how to combine them effectively. Technological aptitude, current use of gamification, and use of AI tools emerged as significant predictors of educators' readiness to apply AI for gamified learning. The findings also highlight an implementation gap: while interest is high, practical support is lacking. We offer practical ideas to help educators experiment with AI-powered gamification in accessible and scalable ways. This work contributes to advancing e-learning pedagogy by outlining a roadmap for integrating AI-enhanced gamification into higher education.

SESSION A32 "SOFTWARE ARCHITECTURE AND DEVELOPMENT"	**Stream 1**
Chairman: Hristo Valchano	Technical university of Varna, BG
Saturday, October 11th 10:30 – 12:00	Hall 109TV

Keeping Up When Disconnected: Applying Conflict-Free Replication to Digital Twin Architectures

Petar Chakalov — *University of Plovdiv Paisii Hilendarski, BG*
Svetoslav Enkov — *University of Plovdiv Paisii Hilendarski, BG*

Abstract: Digital Twins (DTs) have emerged as a cornerstone of Industry 4.0, providing virtual replicas of physical assets for advanced monitoring, simulation, and optimization. Mainstream adoption is driven by major cloud platforms and open-source frameworks that offer sophisticated tools for their development. However, a survey of these contemporary solutions reveals a dominant architectural pattern: a centralized, cloud-dependent model where data from the physical world is pushed to a master replica in the cloud. While effective under ideal conditions, this paradigm is built on the implicit assumption of stable, continuous network connectivity. This paper argues that

this assumption creates a fundamental conflict with the operational reality of many critical industrial environments, leading to data loss, state inconsistency, and a loss of operational autonomy during network partitions. This paper surveys dominant Digital Twin architectures, analyzes their limitations in the face of network partitions using evidence from academic and industrial case studies, and argues that a model based on Conflict-Free Replicated Data Types (CRDTs) offers a more resilient and robust solution for state synchronization, enabling truly available and autonomous Digital Twins.

SASet: A Unified Approach for Modeling and Interaction of Multiple Architectures in Large Software Applications

Hristo Hristov *Technical university of Varna, BG*

Abstract: This paper introduces the concept of the Software Architectures Set (SASet) as a logical and organizational unit designed to integrate and coordinate multiple architectures within one or more large-scale applications. Beyond architectures, SASet may also incorporate additional extended elements (EEs) such as patterns, technologies, frameworks, standards, methodologies and etc., forming a comprehensive architectural ecosystem. As a result, SASet can be regarded as a composite architecture, where the combined behavior of its elements defines the system-level qualities. A methodology for constructing and applying SASet is proposed, including phases of initialization, architecture (or EE) selection, relation definition and interaction mechanisms. The proposed concept has the potential to make a substantial contribution to the evolution of architectural engineering especially toward large scale software systems. The primary objective of SASet is to replace the notion of a single architecture in methodologies, tools and analytical frameworks, thereby enabling them to address systems composed of multiple architectures and EEs.

Supply Chain Logistics Marine Simulator with Smart AI Assistant

Danail Dimitrov *Technical university of Varna, BG*
Plamena Atanasova *Technical university of Varna, BG*
Milena Karova *Technical university of Varna, BG*
Gergana Spasova *Technical university of Varna, BG*
Bozhidar Dyakov *Technical university of Varna, BG*

Abstract: This paper extends the Supply Chain Logistics Marine Simulator (SCLMS) with a context-aware AI assistant to support maritime logistics training. The assistant uses a Retrieval-Augmented Generation (RAG) approach with an on-premise large language model (Llama 3.1 8B Instruct) to provide students with real-time access to rules, regulations, and domain terminology. By adding interactive guidance to simulation exercises, the system enhances learner engagement and supports the development of decision-making and compliance skills in digitalized maritime workflows.

Structural Analysis of a Smart Home System in Accomodation Residence

Desislava Mihaylova *Technical university of Varna, BG*
Miroslav Akbatirov *Technical university of Varna, BG*

Abstract: This report examines a smart system designed for implementation in hotel conditions. Apart from the problem of choosing technical means for the execution of the project, the posed task here is to present an original solution about the working principle of the system and to describe it by using the automation theory. Hotel room conditions propose that the "smart" system would be responsive to customer presence and actions. The number of states when the system waits for incoming signals from different sensors or direct impact upon input devices is a comparative criterion about the complexity of similar projects. Consequently, an optional algorithm is presented, and automaton is created referring to the general states of a group events. It facilitates the assessment of the logical composition in terms of coding constraints.

SESSION B32 "AI APPLICATION IN SOCIO-PROBLEMS" **Stream 2**

Chairman: Delyan Genkov Technical University of Gabrovo, BG

Saturday, October 11th 10:30 – 12:00 Online

An Approach to Network Key Encryption in the Zigbee Network for IoT

Marieta Haka *Technical university of Varna, BG*
Aydun Haka *Technical university of Varna, BG*
Veneta Aleksieva *Technical university of Varna, BG*
Hristo Valchanov *Technical university of Varna, BG*

Abstract: This paper proposes an adaptive approach to improve security in ZigBee-based Internet of Things (IoT) networks by selecting the AES wrap key size (128, 192 or 256 bits) for encrypting the standard 128-bit network key. The proposed approach is applicable to devices authenticated via Install Code (IC), as the ZigBee standard recommends IC for end device authentication. Using the proposed adaptive approach, the Trust Center (TC) selects the AES wrap key length-128, 192, or 256 bits-based on the cryptographic capabilities of each device. Key assignment can be performed in either automatic or manual mode. When operating in automatic mode, the TC selects the highest AES wrap key size based on the cryptographic capabilities of the end device. Alternatively, in manual mode, the administrator explicitly configures the desired wrap key size for each device.

Enhancing the Security of Computer Systems Through the Use of Specialized Supplementary Modules

Dako Dimov *University of Economics Varna, BG*

Vladimir Sulov *University of Economics Varna, BG*

Abstract: This paper suggests an enhancement of computer system security through the integration of supplementary specialized modules for encryption, hashing, memory monitoring, authentication and other possible uses. Unlike traditional TPM and HSM solutions, the proposed architecture offers dynamic expandability, improved data protection, and resilience against real-time attacks. These modules execute cryptographic operations in a secure environment without revealing the original content to the outside world. Thus, they are suitable for a wide range of applications—from personal data protection to critical infrastructure.

Development of experimental device for data acquisition from accelerometric sensor

Dimitar Dimitrov *Technical University of Gabrovo, BG*
Stefan Ivanov *Technical University of Gabrovo, BG*

Abstract: The collection of reliable experimental data represents a crucial stage in the development of new electronic devices. It enables researchers to evaluate system behavior and plan subsequent stages of development. This paper presents the design and implementation of an experimental hardware platform intended for the acquisition and storage of data from an accelerometric sensor. The primary goal is the creation of a reliable and cost-effective system for extracting information related to motion and vibration of observed objects. The collected data is stored directly on a USB flash drive, allowing the system to operate autonomously and facilitating subsequent data analysis. Potential applications include preliminary assessment of mechanical processes, as well as the use of the data in machine learning algorithms, including neural network training. The project lays the foundation for further refinement and integration into more advanced measurement platforms.

Algorithm for Generation of Bent Functions using Wavelet Transform

Ilya Shibakin *Saint Petersburg Electrotechnical University "LETI", RU*
Alla Levina *Saint Petersburg Electrotechnical University "LETI", RU*

Abstract: Bent functions are a subset of Boolean functions that have the property of maximum nonlinearity, which conditions their use in cryptography and coding theory. This paper describes and analyzes two existing bent function generation algorithms, the first of which uses a modification of the truth table of the original function, and the second one uses the addition of suitable terms to the algebraic normal form (ANF) of the function. This paper proposes a novel algorithm for bent function generation based on the wavelet transform. The new algorithm is compared with an algorithm based on modifying the truth table and an algorithm that extends the ANF by adding terms to it. Possible example of practical application of the proposed algorithm is given as well.

SESSION C32 "EDUCATIONAL ASSESSMENT AND QUALITY"	**Stream 3**
Chairman: Milena Karova	Technical University of Varna, BG
Saturday, October 11th 10:30 – 12:00	Online

Aware Foreign Language Assessment with Integrated Speech to Speech Translation and Multimodal Learning Analytics

George Pashev — *University of Plovdiv Paisii Hilendarskii, BG*
Silvia Gaftandhieva — *University of Plovdiv Paisii Hilendarskii, BG*

Abstract: This paper presents a novel formal model for intelligent foreign language assessment, which integrates Bloom's Taxonomy cognitive levels with advanced speech-to-speech translation and multimodal learning analytics. The mathematical framework enables automated generation of pedagogically sound units across different cognitive complexity levels, incorporating real-time speech recognition, semantic understanding, and adaptive feedback. The system, leveraging transformer-based architectures and neural text-to-speech synthesis within a unified assessment framework, supports over 60 languages and integrates spoken and written assessment. This research contributes to educational technology, computational linguistics, and cognitive science by offering a theoretical and practical foundation for next-generation language learning systems.

Using Software Solution for Quality Assessment in School Education

Silvia Gaftandzhieva — *University of Plovdiv "Paisii Hilendarski", BG*
Rositsa Doneva — *University of Plovdiv "Paisii Hilendarski", BG*
Mariya Docheva — *Language High School "Plovdiv", BG*
George Pashev — *University of Plovdiv "Paisii Hilendarski", BG*
George Totkov — *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: Quality assurance in educational institutions is often achieved through complementary internal and external control and evaluation systems. Based on an in-depth analysis of existing models for quality assessment and consultations with school leaders and teachers, this paper presents a model for comprehensive quality assessment and a corresponding software tool SchoolQA, which offers a platform for experts to streamline external evaluations. It allows stakeholders to oversee a school's progress, find opportunities for improvement, set future goals, and measure its performance against other institutions. The experimental implementation of SchoolQA in two Bulgarian schools proved its applicability and effectiveness for quality assessment in school education.

Automated Analysis Of Results Obtained From The Most Widely Used Online Testing Platform

Monika Petrunova *University of Chemical Technology and Metallurgy, BG*
Atanas Atanassov *University of Chemical Technology and Metallurgy, BG*
Dimitar Pilev *University of Chemical Technology and Metallurgy, BG*

Abstract: This study examines the most widely used online testing platforms among teachers, with a particular focus on identifying the most frequently utilized platforms in Bulgaria. A further objective is to investigate the types of results generated by these platforms in order to provide a comprehensive analysis of students' knowledge and learning gaps. In Bulgaria, such analyses are required for the so-called entry and exit level assessments, which are mandatory across nearly all subjects in primary and secondary education. The results of these analysis are reported to the teachers' council at the beginning of each academic year, and the grades are incorporated into students' ongoing formative evaluation. The procedure is as follows: all students from a given graduating class complete the same test, after which the results are aggregated by calculating the number of correct and incorrect answers for each question. Questions with the highest proportion of incorrect responses highlight areas where students experience difficulties. The corresponding subject matter should therefore be revisited through repetition and targeted practice. This approach can be applied across all areas of education to provide insights into the knowledge of a particular group or class. It enables a systematic assessment of learning gaps at the beginning and end of an academic term, school year, or course.

A Study of Affordable Online Proctoring Solutions with AI and Moodle Integration

Tzvetomir Vassilev *University of Ruse "Angel Kanchev", BG*
Hristo Beloev *University of Ruse "Angel Kanchev", BG*

Abstract: The COVID-19 pandemic made the distance learning (or e-learning) more popular all over the world. Many education institutions were forced to switch to online teaching and online exams. However in online exams it is much more difficult to provide a fair environment for all and to identify cheating students, therefore specialized online proctoring software becomes important. However, this type of software is quite expensive and many small universities cannot afford it. This paper addresses several online proctoring solutions which utilize artificial intelligence (AI) and reviews in more detail three of them, which are most affordable. Type of online proctoring systems and their most important features have been reviewed. Several criteria have been identified, where cost is one of the most important, and the systems have been compared. Advantages and disadvantages were also outlined. The conclusion summarizes the results of the review and gives recommendations about use cases of each solution.

SESSION A33 "HEALTHCARE INFORMATICS AND MEDICAL APPLICATIONS"	Stream 1
Chairman: Nikola Shakev	Technical University of Sofia, Plovdiv branch, BG
Saturday, October 11th 12:00 – 13:30	Hall 109 TV

Comparative Analysis of Main Methods for ADHD Diagnosis Using EEG – systematic review

Elena Nikolova — *Technical University of Sofia, BG*

Abstract: In recent years, the social significance of Attention Deficit/Hyperactivity Disorder (ADHD) has taken an increasingly prominent place among the diagnoses that hinder the normal emotional and academic development of children. Learning difficulties and personality traits in many children and adults could be significantly improved through appropriate therapeutic interventions. This creates a need to enhance the methods for accurate and timely diagnosis, which is essential for the adequate application of necessary compensatory approaches when working with children (and adults) affected by this condition. As a method for studying brain activity, electroencephalography (EEG) has no equivalent in medical practice. Therefore, this article will focus on the various possible methods based on EEG, aiming to systematize the available

Design and Evaluation of an Ergonomic Ultralight Face Shield for Enhanced Protection Against Aerosol Transmission in Children

Todor Todorov — *Technical University of Sofia, BG*
Georgi Todorov — *Technical University of Sofia, BG*
Yavor Sofronov — *Technical University of Sofia, BG*

Abstract: The work presented explores the development and optimization of a lightweight protective shield designed for children, focusing on ergonomic design and material efficiency. The study aims to enhance the production process by integrating virtual prototyping and physical validation to ensure optimal fit, durability, and ease of use. The analysis emphasizes minimizing material deformation, ensuring a secure yet comfortable fit, and optimizing the attachment mechanism for stability. The process includes injection molding simulations to predict material behavior and a physical prototype to validate functionality and compliance with safety standards. This approach seeks to preemptively identify and mitigate potential design flaws, improving product reliability and overall manufacturing efficiency.

Conveying respiratory care towards sub-symbolic models: Data-Centric Approaches to Mitigate VILI and Patient-Ventilator Asynchrony

Ivelin Karageorgiev — *Technical University of Sofia, Plovdiv branch, BG*
Sevil Ahmed-Shieva — *Technical University of Sofia, Plovdiv branch, BG*

Nikola Shakev *Technical University of Sofia, Plovdiv branch, BG*
Ivaylo Minev *Medical University of Plovdiv, BG*

Abstract: Mechanical ventilation is a timeseries rich critical care appliance, it provides insightful bio-signals and metadata about a patient admission. Still invasive respiratory care is a delicate balancing act, for suboptimal control can lead to unfavorable outcomes such as ventilator-induced lung injury (VILI), patient-ventilator asynchrony (PVA) and strain exhaustion. We develop a framework that showcases opportunities for open data acquisitions, and conveys common ventilatory complications to quire solutions via exploratory data analysis and sub-symbolic models. Foremost as an attempt to mitigate and prevent adverse respiratory outcomes, then demonstrate a formalized a datacentric topological opportunities of mechanical ventilators to contribute it's use as a future component of physiological digital twin.

Pre-processing and data analysis of Mechanical Ventilation parameters used in Mechanical Power

Ralitsa Petrova *Technical University of Sofia, Plovdiv branch, BG*
Sevil Ahmed-Shieva *Technical University of Sofia, Plovdiv branch, BG*
Nikola Shakev *Technical University of Sofia, Plovdiv branch, BG*
Ivaylo Minev *Medical University of Plovdiv, BG*

Abstract: This research aims to provide a detailed analysis of the parameters employed in the existing Mechanical power (MP) formulas, the correlation between each parameter, and the relative importance of each parameter individually. The results could be applied in further research to model the MP parameter using neural networks, fuzzy logic, or other approaches.

SESSION B33 "UAV AND RADAR SYSTEMS" **Stream 2**

Chairman: Ivan Garvanov — University of Library Studies and Information Technologies, BG

Saturday, October 11th 12:00 – 13:30 — Online

Comparative Analysis of Algorithms for Detection and Classification of UAV in Video Surveillance

Ivan Garvanov *University of Library Studies and Information Technologies, BG*
Miroslav Tsintsarski *University of Library Studies and Information Technologies, BG*
Magdalena Garvanova *University of Library Studies and Information Technologies, BG*

Abstract: This article presents a comparative analysis of the deep learning models MobileNetV2 and MobileNetV3, designed for mobile devices and convenient for use with stationary and mobile cameras for detection and classification of unmanned aerial vehicles (drones). The models are studied and compared under the same test scenarios. From the results obtained, conclusions and recommendations are made for the practical use of the models for detection and classification of drones in a real environment.

Moving Object Detection with Doppler Radar

Ivan Garvanov — *University of Library Studies and Information Technologies, BG*
Magdalena Garvanova — *University of Library Studies and Information Technologies, BG*
Georgi Tsonkov — *University of Library Studies and Information Technologies, BG*
Daniela Borissova — *Bulgarian Academy of Sciences, BG*
Gabriela Garvanova — *Bulgarian Academy of Sciences, BG*
Maria Mindova — *University of Library Studies and Information Technologies, BG*

Abstract: This article studies an algorithm for detecting moving ground objects with a Doppler radar with continuous emission of a phase-shifted signal. The detection is performed in the frequency domain of the radar signal, with the width of the selected velocity channel being a function of the dimensionality of the Fast Fourier Transform. Real radar recordings of various moving objects (people, vehicles and trees in the presence of wind) were used to study the proposed algorithm. The obtained results show very good characteristics of detecting moving objects. The speed of movement of the objects is determined by the channel in which the detection is registered. The studied algorithm can be used for road traffic monitoring.

Logical Data Corruption in UAV Storage: Forensic Analysis and Recovery Techniques

Azamat Baibussinov — *National Defense University of the Republic of Kazakhstan, KZ*
Kaisarbek Yesbergenov — *National Defense University of the Republic of Kazakhstan, KZ*
Gulnara Abitova — *National Defense University of the Republic of Kazakhstan, KZ*

Abstract: This article explores the causes and methods of data recovery from unmanned aerial vehicles (UAVs) in cases of software-related (logical) damage to onboard storage devices. The loss of mission-critical data without physical destruction of memory modules is a growing concern, especially in combat and reconnaissance scenarios. The study analyzes common types of logical failures, including file system corruption, logical file deletion, MBR/GPT partition errors, fragmentation, and metadata overwrites. The aim of the research is to justify and classify effective recovery techniques based on digital forensic tools. The methodology includes comparative analysis, low-level inspection, empirical testing, and statistical validation. The effectiveness of various tools – R-Studio, X-Ways Forensics, TestDisk, and PhotoRec – was evaluated. Results show that hybrid approaches combining structural and signature-based analysis yield the best recovery accuracy. The article proposes a diagnostic and recovery algorithm tailored to the type of failure. These findings are of practical importance for military digital forensics and the development of automated recovery systems for specialized UAV platforms.

Advanced Non-Volatile Memory Technologies for Military Robotics: Architecture, Applications, and Future Trends

Azamat Baibussinov *National Defense University of the Republic of Kazakhstan, KZ*
Kaisarbek Yesbergenov *National Defense University of the Republic of Kazakhstan, KZ*
Gulnara Abitova *National Defense University of the Republic of Kazakhstan, KZ*

Abstract: This study presents a comparative analysis of current non-volatile memory technologies—namely flash memory, solid-state drives (SSDs), hard disk drives (HDDs), optical media, and cloud storage—in the context of military robotic systems. The evaluation is based on five key performance metrics: data access speed, shock resistance, energy efficiency, write endurance, and compliance with military standards. Using technical documentation, academic literature, and defense guidelines, the research identifies flash memory and SSDs as the most suitable options for deployment in dynamic and high-risk operational environments. The findings indicate that these technologies offer a superior balance between performance and resilience, enabling longer mission duration, improved autonomy, and higher data integrity in hostile field conditions. The paper concludes with recommendations for the integration of adaptive memory architectures and hybrid storage solutions in next-generation military robotics.

SESSION C33 "E-GOVERNMENT AND PUBLIC SERVICES" **Stream 3**

Chairman: Tzvetomir Vassilev University of Ruse "Angel Kanchev", BG

Saturday, October 11th 12:00 – 13:30 Online

Leveraging Open Data for Transparency and Efficiency in Katarungang Pambarangay in Malabon City

Ezekiel Borja *National University Philippines, PH*
Rodolfo Raga *Jose Rizal University, PH*

Abstract: This study investigates the use of data analysis and government datasets to enhance the transparency and efficiency of the Katarungang Pambarangay of Malabon City. The Katarungang Pambarangay serves as the mechanism for the community-based justice system. Despite its objective of solving community-level issues, it still suffers from several problems, including a lack of transparency, inconsistent data recording and tracking, and difficulties in identifying the performance of each barangay. To address the issues, this study will utilize the two calendar years of Katatrungang Pambarangay, from 2022 to 2023, covering twenty-one (21) barangays in the City of Malabon. The data were processed and analyzed using linear regression and classification models to identify patterns in case volumes and resolution rates. The regression model revealed a significant positive correlation between the number of cases filed and the number of cases settled, highlighting the potential of predictive modelling in identifying the performance trends of twenty-one (21) barangays. In addition, the

classification model categorized the barangays into two (2) categories, "Majority Settled" and "Not Majority Settled" classes, supporting possible policy interventions. The outcomes of the processed data identified the top-performing and low-performing barangays, providing solutions and actions for resource and budget allocation, personnel training, and accountability of barangay officials. By applying data-driven decision-making in local government, this study demonstrates how open data can help the LGU achieve good governance that supports more transparent, efficient, and citizen-centered justice results at the community level.

Analysis of Learning Management System of Selected Private HEI: An Assessment

Ezekiel Borja — *National University Philippines, PH*
Cristine Erica Untalan — *National University Philippines, PH*
Mark Anthony Gipit — *National University Philippines, PH*
Irish Delos Santos — *National University Philippines, PH*
Cheryl Lou Tinaan — *National University Philippines, PH*
Michael Carlo Carriedo — *National University Philippines, PH*

Abstract: This research aims to assess how the Learning Management System platforms help the selected Higher Education Institution ensure the quality of education by delivering instructional materials, and accessing assessment and learning tools. The study will seek the answer through a quantitative research approach by surveying students, teaching, and non-teaching personnel of a Private Higher Education Institution. The survey will be used to ask about their experiences in using different Learning Management System platforms. The findings will be a reference for the possible integration of a new Learning Management System or improvement of the current Learning Management System platform that could improve what the institution offers to its constituents regarding academic services, delivery of instructional materials, and assessment.

Information and Communication Technologies in Education: Challenges and Opportunities for the Classroom System

Julia Doncheva — *University of Ruse "Angel Kanchev", BG*
Tzvetomir Vassilev — *University of Ruse "Angel Kanchev", BG*

Abstract: This paper examines the importance of information and communication technologies (ICT) in modern education, and in particular in the context of classroom work. With the increasing level of digitalization and the integration of new technologies in the educational process, teachers, students, and parents are faced with a number of challenges and opportunities. In addition to the challenges and opportunities, an analysis of a survey conducted among user groups of teachers, students and parents was made. The conclusion is that the successful integration of information and communication technologies in

education requires strategic approaches that address the challenges, while at the same time taking advantage of the opportunities provided. The need for ongoing teacher training and ensuring equal access to technologies is a key to realizing the potential of ICT in the classroom system.

Competency-Based Training in Artificial Intelligence - an Innovative Approach in E-Learning

Silvia Parusheva *University of Economics – Varna, BG*
Petya Strashimirova *University of Economics – Varna, BG*
Bistra Vassileva *University of Economics – Varna, BG*

Abstract: The growing presence of artificial intelligence is reshaping both academic and professional environments, which brings forward the pressing task of supporting university staff in acquiring new skills. This paper argues that Competency-Based Education (CBE) offers an effective pathway for preparing educators to work with AI in a responsible and purposeful way. Unlike conventional training formats, CBE emphasizes demonstrable mastery of abilities instead of the length of study, allowing for greater flexibility and personalisation. Such an approach is particularly suitable for professionals with varied backgrounds and limited time resources.

The discussion outlines a set of essential AI-related competences for teaching staff, grouped into four domains: technical, pedagogical, functional, and ethical. It also examines several established frameworks, including those promoted by UNESCO, pointing out their strengths as well as the challenges related to adapting them to specific institutional and cultural contexts. Additionally, the paper proposes a simplified, customized CBE framework for higher education institutions and presents insights from pilot implementation.

The paper concludes that adopting a CBE perspective in AI training is not only beneficial but strategically necessary for higher education. By integrating core competences and focusing on outcomes, this model prepares educators to combine technological proficiency with ethical sensitivity and sound pedagogical practice. In doing so, it helps institutions build the capacity for sustainable transformation in an academic landscape where AI is

SESSION A34 "SUPPLY CHAIN AND AGRICULTURAL INFORMATICS" **Stream 1**

Chairman: Milena Karova Technical University of Varna, BG

Saturday, October 11th 14:30 – 16:00 Hall 109 TV

Intelligent supply chain management, emphasizing the public procurement requirements for supplying food to kindergartens

Laska Kostadinova-Tsankova *University of Plovdiv "Paisii Hilendarski", BG*
Stanimir Stoyanov *University of Plovdiv "Paisii Hilendarski", BG*

Veneta Tabakova-Komsalova — *University of Plovdiv "Paisii Hilendarski", BG*
Ivan Stoyanov — *Bulgarian Academy of Sciences, BG*
Asya Stoyanova-Doycheva — *University of Plovdiv "Paisii Hilendarski", BG*
Katharina Wassilew — *Bulgarian Academy of Sciences, BG*

Abstract: This paper presents an intelligent supply chain management system tailored for public procurement processes, with a specific focus on food deliveries to kindergartens. The study explores current trends in logistics, including the integration of artificial intelligence, machine learning, and the Internet of Things for real-time tracking and route optimization. A knowledge-based expert system prototype is developed to support planning and coordination of deliveries from regional producers. The system employs forward and backward chaining inference mechanisms, modular architecture, and an intuitive user interface. Embedded in the "ZEMELA" smart agriculture platform, the solution enhances transparency, efficiency, and sustainability in the public sector. The regulatory framework and specific challenges related to traceability and food safety for children are discussed. Future developments envision the integration of machine learning, blockchain technologies, and intelligent management of plant genetic resources.

Power Supply Units in Bee Behaviour Monitoring Systems

Dimitar Avramov — *Technical University of Varna, BG*
Ivaylo Penev — *Technical University of Varna, BG*

Abstract: Power supply units are an integral part of bee behaviour monitoring systems. These power supply units typically consist of a solar panel, batteries or accumulators, and a charge controller. The paper proposes three solutions, implemented by the authors. The advantages and disadvantages of each solution are discussed. The proposed solutions are applicable in real-world operational environments.

Cross Platform Integration of Ontologies and Information Extraction for Plant Genetic Resources for the Bulgarian National GeneBank

Pencho Malinov — *University of Plovdiv "Paisii Hilendarski", BG*
Sebiha Madanska — *University of Plovdiv "Paisii Hilendarski", BG*
Emil Doychev — *University of Plovdiv "Paisii Hilendarski", BG*
Laska Kostadinova-Tsankova — *University of Plovdiv "Paisii Hilendarski", BG*
Ivan Stoyanov — *Bulgarian Academy of Sciences, BG*
Katharina Wassilew — *Bulgarian Academy of Sciences, BG*

Abstract: This paper presents a cross-platform approach that integrates various ontologies and methods for information extraction. The case study used for the experimentation phase focuses on an ontology for Plant Genetic Resources for Bulgarian National GeneBank in Sadovo. The ontology contains structured

knowledge about plants, including genus, orders and others. The system also incorporates a database, with the key feature that the information extraction is performed from both ontological and database sources, improving the precision of the search and retrieval – an advancement of significant value for research and scientific studies.

Generative Adversarial Network for Cold Nuclear Fusion Data Set Generation

Todor Malchev — *Technical University of Sofia, BG*
Milena Lazarova — *Technical University of Sofia, BG*
Yordan Paunov — *Technical University of Sofia, BG*
Dimiter Alexandrov — *Lakehead University, CA*

Abstract: Understanding and analyzing the process of cold nuclear fusion beyond human observation needs the use of artificial intelligence and machine learning. These technologies rely on vast and diverse datasets to extract patterns and improve predictive performance. In the cold nuclear fusion experiments, that are conducted at Lakehead University, the dataset from the experiments consists of around a few hundred thousand timesteps (seconds). However, expanding it is essential to enhance the accuracy and reliability of the analysis and predictions in further research of the subject. This paper introduces a novel methodology for generating high-quality simulation data based on existing experimental results using Generative Adversarial Networks (GANs), with a particular focus on the TimeGAN architecture. This approach enables the creation of synthetic time series data that enhances the training process, adding synthetic data to the overall data set.

SESSION B34 "DIGITAL INNOVATION IN TECHNICAL AND ENVIRONMENTAL APPLICATIONS" — **Stream 2**

Chairman: Kosta Boshnakov — University of Chemical Technology and Metallurgy, BG

Saturday, October 11th 14:30 – 16:00 — Online

Democratizing IVDR Technology: Low-Cost Real-Time Driver Feedback Using Consumer Hardware

David Trajkoski — *University of Information Science and Technology "St. Paul the Apostle", MK*
Aleksandar Karadimce — *University of Information Science and Technology "St. Paul the Apostle", MK*
Dijana Capeska Bogatinoska — *University of Information Science and Technology "St. Paul the Apostle", MK*

Abstract: In-Vehicle Data Recorders (IVDRs) have emerged as promising tools for improving road safety and driving efficiency by providing continuous monitoring and feedback to drivers. Despite their proven effectiveness in commercial applications, IVDR adoption remains limited due to high costs and

accessibility issues, with most systems designed for commercial fleets rather than individual consumers. This paper presents a comprehensive study on the impact of IVDR feedback mechanisms on driver performance, integrating both literature review and practical experiments involving smartphone sensors and On-Board Diagnostics (OBD) data. The research combines findings from existing studies with newly collected datasets to analyze driving behavior across various conditions. We examine the influence of real-time feedback on key metrics such as harsh acceleration, braking frequency, speed variation, and fuel consumption through a dual-approach methodology. Our experiments achieved 89.2% classification accuracy using consumer-grade smartphone sensors and successfully extracted critical vehicle parameters from OBD-II ports across different vehicle generations, demonstrating broad compatibility with existing vehicle infrastructure. We developed four real-time feedback algorithms to provide immediate driver guidance, addressing safety, efficiency, and vehicle maintenance. The findings reveal the effectiveness of IVDRs in promoting safer driving habits and highlight opportunities for technological enhancements. Additionally, the research proposes innovative solutions to enhance the accessibility and affordability of IVDR technology, thereby democratizing safer driving practices. By offering actionable recommendations for integrating IVDR technology into vehicles, this research aims to contribute to broader-scale improvements in road safety and efficiency.

Analysis and Validation of the Mechanical Ventilator performance

Arbnor Pajaziti — *University of Prishtina, XK*
Petrit Abdyli — *University of Prishtina, XK*

Abstract: In this study, we developed and implemented a functional prototype of a mechanical ventilator operating in volume-controlled ventilation mode. The device supports IPPV (Intermittent Positive Pressure Ventilation), CPPV (Continuous Positive Pressure Ventilation), and CMV (Controlled Mechanical Ventilation) using air–oxygen mixtures. Its performance was evaluated through experiments with measurement devices designed to capture and analyze key respiratory parameters.

Spatiotemporal Analysis of Forest Degradation and Avian Habitat Stress in the Varna Region Using Satellite Data

Philipa Aleksandrova — *Nikola Vaptsarov Naval Academy, BG*
Chavdar Alexandrov — *Nikola Vaptsarov Naval Academy, BG*
Miroslav Tsvetkov — *Nikola Vaptsarov Naval Academy, BG*

Abstract: This paper presents an integrated remote sensing analysis of deforestation and vegetation stress across the Varna region of Bulgaria between 2017 and 2024. Multitemporal satellite indices — delta NDVI, delta NDWI, and delta EVI—were combined with thermal stress maps and CORINE Land Cover data to assess forest degradation across key habitat types. Results reveal that

coniferous and mixed forests have undergone the greatest vegetation decline, while broad-leaved forests remain relatively stable. To assess the ecological impact, spatial overlays with Important Bird Areas (IBAs) were used, followed by zonal statistics in QGIS. Several protected zones, including Kamchia and Beloslav Lakes, were identified as hotspots of thermal and moisture stress. These findings demonstrate how deforestation and climate anomalies may undermine critical bird habitats and ecosystem integrity. The proposed methodology supports early-warning systems and targeted biodiversity

Stitch-agnostic, Technique-aware Data Model for Digital Embroidery Pattern Design

Stefan Bozov — *Technical University of Gabrovo, BG*

Elena Zaharieva-Stoyanova — *Technical University of Gabrovo, BG*

Abstract: This paper considers problems related to craft software development. It presents a new data model for digital representation of embroidery stitches in Cross-stitch software. The proposed data model is developed to be stitch-agnostic and technique-aware to describe all possible stitch types. It avoids allocation of objects for describing stitches since objects can occupy many resources – memory, CPU. Instead of objects, it uses integer arrays to describe stitches, and this way of arrangement reduces the needed resources while increasing the system performance.

SESSION C34 "TOURISM AND AI APPLICATIONS" **Stream 3**

Chairman: Aldeniz Rashidov — Technical University of Gabrovo, BG

Saturday, October 11th 14:30 – 16:00 — Online

Contextual Sentiment Analysis for Tourism with Hybrid Models: Evidence from YouTube Reviews of Kazakhstan

Arseniy Bapanov — *M.Kh. Dulaty Taraz University, KZ*

Aslanbek Murzakhmetov — *M.Kh. Dulaty Taraz University, KZ*

Nurbol Beisov — *Al-Farabi Kazakh National University, KZ*

Maxatbek Satymbekov — *Shakarim University, KZ*

Abstract: This paper investigates sentiment analysis of tourist reviews about Kazakhstan using 11,125 English comments from YouTube travel channels. We compare four sentiment analysis approaches NLPTown's BERT model, TextBlob, VADER, and Stanza, evaluating their accuracy and robustness across different linguistic contexts, short vs. long reviews, sarcasm, neutral tone. Each algorithm's strengths and weaknesses are examined: lexicon-based tools (TextBlob, VADER) are fast and effective on short, informal texts, but struggle with subtle nuances like sarcasm, whereas advanced NLP models (Stanza, NLPTown) handle longer, context-rich reviews more effectively. Classification performance is assessed with standard metrics to ensure a fair comparison. In

addition, we explore hybrid ensemble methods, majority voting, weighted voting, and stacking, to improve sentiment classification. Our findings show that ensemble models significantly outperform individual algorithmsijirss.com, particularly in addressing class imbalance and mixed sentiments (reviews containing both positive and negative cues). Notably, the best results are achieved by a stacking ensemble using a Random Forest meta-classifier, which achieved the highest overall accuracy and F1-score in our experiments.

Multilingual Semantic Analysis of Tourist Destinations with Transformer-Based Language Models

Aslanbek Murzakhmetov — *M.Kh. Dulaty Taraz University, KZ*
Nurbol Beisov — *Al-Farabi Kazakh National University, KZ*
Arseniy Bapanov — *M.Kh. Dulaty Taraz University, KZ*
Maxatbek Satymbekov — *Shakarim University, KZ*

Abstract: In the context of rapidly evolving digital tourism and the exponential growth of user generated textual data, there is a growing demand for personalized recommender systems capable of effectively interpreting the semantic nuances of user queries. This study presents a comparative evaluation based on models RuBERT, TinyBERT, and XLM-RoBERTa for the task of recommending tourist destinations from textual user preferences. We propose a system architecture that includes data preprocessing, generation of query embeddings, retrieval of relevant tourist locations using the Faiss library, and subsequent ranking of results. For experimentation we compiled a corpus of 28,104 user reviews and queries collected from tourism platforms. The results indicate that XLM-RoBERTa delivers the strongest performance in multilingual settings, particularly for cross-lingual queries. RuBERT attains higher accuracy on Russian language texts and TinyBERT provides a favorable balance between effectiveness and computational cost, which makes it suitable for resource constrained applications. The findings can inform the development of intelligent tourism services, conversational agents, and generation personalized recommendation systems.

Industry 5.0 - the use of new business models and artificial intelligence in tourism in Bulgaria

Neviana Krasteva — *Sofia University "St.Kliment Ohridski", BG*

Abstract: The report is dedicated to exploring possible business approaches in tourism in the context of AI and Industry 5.0, a new production model that focuses on human-machine collaboration. The main objective of the research is to clarify the general directions of change in business approaches and marketing in tourism in the age of AI and Industry 5.0. The primary research question is: "How does AI affect the customer experience in tourism and how can these technologies be applied to improve the tourism sector in Bulgaria?" Research methods include a desk study and content analysis as well as questions asked to ChatGPT. Currently,

the tourism sector demonstrates the capacity to generate a wide range of diverse products. Conclusions will be drawn about the need to change strategies for tourism business and staff training through the knowledge of new technologies and their use. This necessitates the development of qualitatively new training programs in universities and specialized schools.

SESSION A35 "DIGITAL SOCIETY AND SOCIAL INFORMATICS" **Stream 1**

Chairman: Veneta Aleksieva Technical University of Varna, BG

Saturday, October 11th 16:30 – 18:00 Hall 109 TV

Obfuscating online gambling and addiction behind progression in digital card games

Boris Bankov *University of Economics - Varna, BG*

Abstract: Multiplayer games provide a competitive environment where despite cultural, regional or financial status, users can prove on equal footing their abilities. However, monetizing the gaming experiences has brought the attention of regulatory agencies. This study aims to frame the key features of digital collectable card games in terms addictive mechanics by analyzing three examples which originate from other successful franchises – Hearthstone: Heroes of Warcraft, Gwent: The Witcher Card Game and Marvel Snap. An analysis of their design is given interaction, their player progression systems explained, and four interactive harmful aspects framed into a template. We define these as money, luck, time and community. This template can be used by regulators and researchers as a metric system of twenty characteristics that stimulate spending real currency in an addictive manner in digital card games.

E-Learning And Quality Of Life In Older Age

Irina Todorova *Technical University of Varna, BG*

Dimana Dilova-Vasileva *Technical University of Varna, BG*

Abstract: This article focuses on the positive effects that digital technologies have on the cognitive development of older adults. It is based on the understanding that cognitive decline is not the result of regression in cognitive functions, but rather of the limited opportunities for their stimulation as age advances. The study presented here demonstrates that digital technologies, and in particular the Internet, provide a continuous process of purposeful, intentional, and conscious self-learning among older adults, which significantly improves their quality of life. The research shows that digital technologies increase the amount of time older adults spend reading; expand the volume of new information entering their minds; help them overcome various sensory limitations—such as reduced visual capacity, hearing difficulties, and others—in order to provide them with new knowledge; assist in training their memory; support their decision-making; offer alternative solutions to their problems, and more. All of this

enhances the overall functioning of people during the period of late adulthood.

From Books to Screens: How Older Adults Use the Internet to Sustain Cognitive and Social Activity

Irina Todorova *Technical University of Varna, BG*

Dimana Dilova-Vasileva *Technical University of Varna, BG*

Abstract: This study examines the role of the Internet as a source of knowledge, information, and social engagement among adults across different stages of maturity, with a particular focus on late adulthood (65 years and older). Contrary to common assumptions about declining cognitive activity in older age, our results demonstrate that older adults show strong cognitive initiative and actively use digital technologies to meet their informational and educational needs. The findings indicate that the Internet has become a primary source of knowledge, preferred over traditional sources such as books, libraries, or personal interactions. Older adults use it to read articles and books in foreign languages, explore places they cannot visit physically, and learn strategies to manage daily tasks and health independently. Furthermore, digital technologies help maintain and even expand social contacts, compensating for reduced physical interactions. Surprisingly, older adults spend more time online daily than younger age groups, reflecting a shift in how they engage with information and social resources. These findings suggest important implications for education, cognitive development, and social support programs for older adults, emphasizing the potential of digital resources to foster lifelong learning and autonomy in late adulthood.

Cyberbullying between children and adolescents: perceptions of caregivers

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Plamena Markova *Technical University of Varna, BG*

Abstract: Technology, especially in the last 15 years, has had a significant impact on relationships, both between adults and between children. Nowadays, children often communicate with each other in a larger extent online than “face to face”. Technological improvement broadens the opportunities for communication and development, not only during childhood but also throughout their entire life. At the same time, the scope of inappropriate online behaviors carried out by children against children is expanding.

The purpose of this article is to explore the extent to which society can identify child-on-child cyberbullying, and more specifically, in our role as caregivers of children. What are the perceptions of the categories of cyberbullying committed by children against children.

In this regard, we conducted a survey with 66 caregivers, whose responses provided us with a starting point for a larger study related to perceptions of children and adolescents' online behavior. The results of the study show that a significant number of respondents do not consider cyberbullying to be a harmless

act, but another part of them does not see it this way.

SESSION B35 "DIGITAL SYSTEMS AND INTERFACES: APPLICATIONS ACROSS DISCIPLINES"	**Stream 2**
Chairman: Nikola Nikolov	Technical University of Varna, BG
Saturday, October 11th 16:30 – 18:00	Online

Digital Immortality — A Comprehensive Survey of Technologies, Ethics and Societal Impacts

Svetlana Syarova — *University of Library Studies and Information Technologies, BG*
Elina Petkova - Gueorguieva — *Medical University Sofia, BG*
Victoria Angelova — *University of Library Studies and Information Technologies, BG*
Evelina Zdravkova — *University of Library Studies and Information Technologies, BG*
Yoana Hadzhiyska — *University of Library Studies and Information Technologies, BG*
Stefka Toleva-Stoimenova — *University of Library Studies and Information Technologies, BG*

Abstract: The emergence of artificial intelligence and immersive technologies has introduced the concept of digital immortality—the virtual preservation of human identity beyond biological death. This paper surveys the current state of technologies used to create posthumous digital personas and critically examines their ethical, psychological, and legal implications. The analysis reveals that while such avatars offer novel opportunities for memory preservation and grief support, they also raise concerns regarding consent, data ownership, and identity authenticity. Unlike previous surveys, this paper provides an integrated analysis that bridges technical, ethical, psychological, and legal perspectives, accompanied by practical recommendations for governance and design. This interdisciplinary framing constitutes the main contribution of our work.

Dot-based, Dual-view User Interface for Realistic Embroidery Simulation in Cross-stitch Software

Stefan Bozov — *Thecnical Universuty of Gabrovo, BG*
Elena Zaharieva-Stoyanova — *Thecnical Universuty of Gabrovo, BG*

Abstract: This paper examines problems, related to craft software development. It presents to the user interface (UI) for new Cross-stitch software related to digital presentation and preservation of handmade embroidery. Unlike the existing applications, the software is built as a simulator of the embroidery process. The paper proposes user interface introduced dual-view canvas, showing both the front and the back sides of the embroidery in real time. It includes a dot-based interaction giving user the possibility to digitalize every known embroidery

technique. The offered software solution can be used as an environment for embroidery patterns design as well as for sharing information among craftsmen.

Exploring the potential of NDVI derivatives for monitoring in precision agriculture

Asparuh Atanasov *Technical University of Varna, BG*

Plamen Petrov *Technical University of Varna, BG*

Radostina Yankova *Technical University of Varna, BG*

Abstract: This article is a study of the possibilities for obtaining key data from the first and second derivatives of the NDVI index from a winter wheat field. The dynamics of the index change was studied using images obtained from an Unmanned Aerial Vehicle (UAV) equipped with a multispectral camera. The results obtained were compared with meteorological data and the field condition of the wheat. It has been shown that the first derivative can diagnose deviations from the expected values. The second derivative emphasizes sharp changes and a more pronounced change in the curve in the presence of stress.

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