IEEE

TECHNICAL UNIVERSITY OF VARNA

120th ANNIVERSARY of JOHN ATANASOFF'S BIRTH

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 2023,

VARNA, BULGARIA

Welcome to ICAI'2023

Dear participants,

It is a great honor and pleasure to welcome you to the International Conference Automatics and Informatics`2023 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.

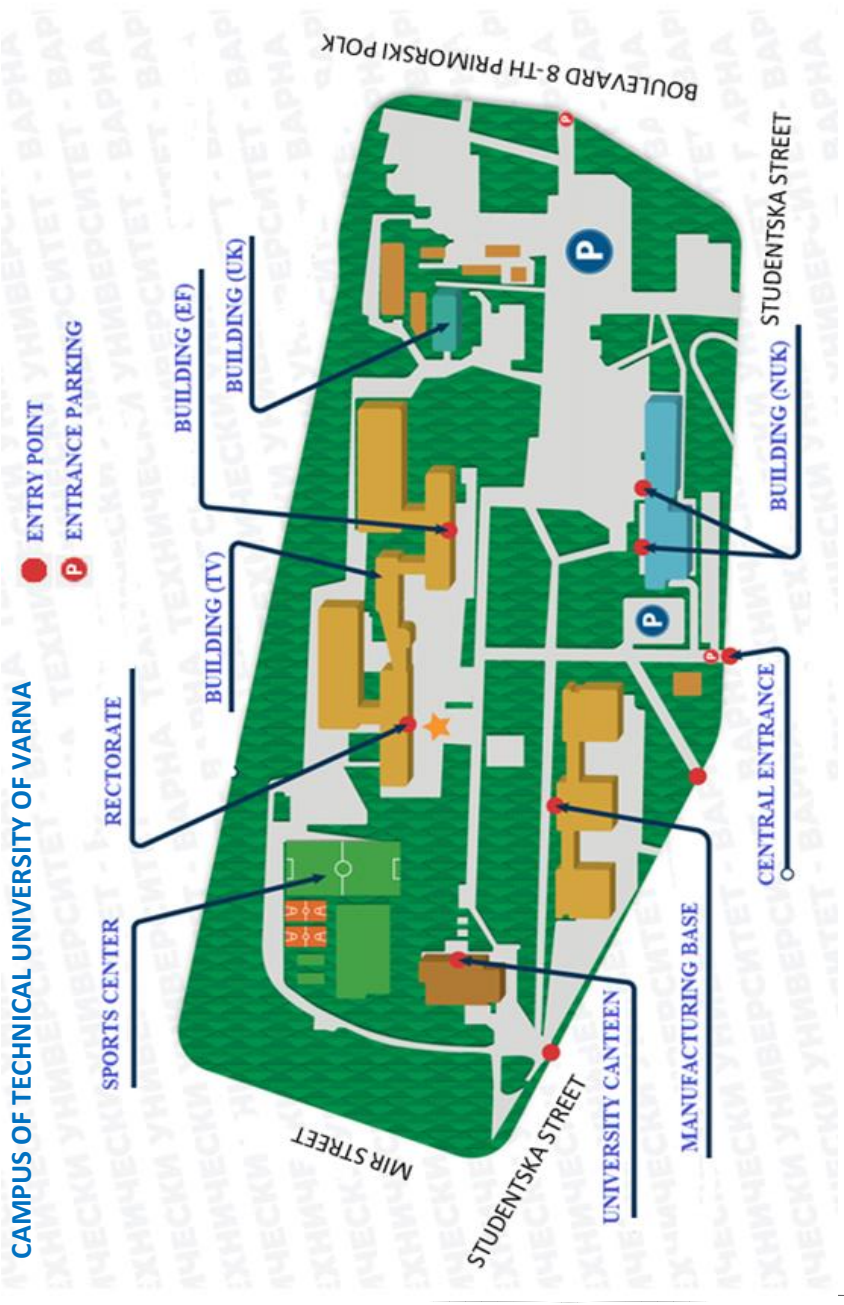
We would like to express our deepest gratitude to hard working reviewers whose effort contributed for high quality of the paper selection process.

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'2023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IEEE INTERNATIONAL CONFERENCE AUTOMATICS AND INFORMATICS'2022 (ICAI'23),

5 - 7 October 2023, VARNA (Technical University of Varna)

http://icai-conf.org

CONFERENCE PROGRAM

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

Thursday, October 5th

In the NUK gallery
08.00 - 09.00 REGISTRATION OF PARTICIPANTS

Stream 1 (Conference Hall NUK)
09.00 - 09.15 WELCOME AND OPENING CEREMONY

Stream 1 (Conference Hall NUK)
09.15 - 09:50 PLENARY SESSION 1

Chairman: Kosta Boshnakov

Methods, Models and Algorithms of the Computational Intelligence Analyzed from a Practical Point of View

Gancho Vachkov
Baku Higher Oil School

09.50 - 10:00 DISCUSSION

Stream 1 (In attendance) **(Room A – Hall 109TV)**	**Stream 2 (Online)** **(Room B)**
10:00 – 11:30 SESSION A1 **"MACHINE LEARNING"** **Chairman: Ivaylo Penev**	**10:00 – 11:30 SESSION B1** **"CONTROL THEORY"** **Chairman: Aleksandra Grancharova**
1. Simulating an Lack of Phase Fault on SynRM and Integrate Results with Machine Leearning, Nikolay Djagarov, Hristo Milushev and Georgi Enchev (8915) **2. Detection of Cyber Attacks in Self-Driving Vehicles By Machine Learning,** Ivaylo Penev, Kristian Ivanov, Georgi Kostadinov and Zahari Stoyanov (4042) **3. Comparative Analysis of the Bernoulli and Multinomial Naive Bayes Classifiers for Text Classification in Machine Learning,** Neli Kalcheva, Ginka Marinova and Maya Todorova (3558) **4. Detailed investigation of ML algoritms for diagnostics of IM on board vessel,** Georgi Enchev (6257)	**1. Model-free non-singular fast terminal sliding mode controller using extended sliding mode observer for series elastic actuator-based robotic arm**, Hongfei Sun, Haoping Wang and Yang Tian (7330) **2. Synchronization of Chaotic Systems Using Novel Sliding Mode Neural Network Controller**, Junhong Xie, Alexandra Grancharova and Liping Fan (8369) **3. Fuzzy-logic Energy Management Strategy of Fuel Cell Hybrid Electric Vehicle Based on Whale Optimization Algorithm**, Yuxuan Liu, Xuejun Zong, Kan He, Lian Lian and Yifei Sun (3830) **4. A Compact and Secure Access Control Solution Based on a Deterministic Finite Automaton**, Akbota Kulzhanova, Timur Bakibayev, Nurassyl Kerimbayev, Kalinka Kaloyanova and Diana Rakhimova (813)
11:30 – 13:00 SESSION A2 **"CLASSIFICATION AND VERIFICATION PROBLEMS"** **Chairman: Valentina Markova**	**11:30 – 13:00 SESSION B2** **"CONTROL APPLICATION"** **Chairman: Nencho Deliiski**
1. Study of the K-Nearest Neighbors Method with Various Features for Text Classification in Machine Learning, Neli Kalcheva, Maya Todorova and Ivaylo Penev (7117) **2. Comparing Accuracy and Time of Support Vector Machine with Different Kernels for Handwritten Digits Classification,** Neli Kalcheva, Maya Todorova, Ginka Marinova and Ivaylo Penev (4448)	**1. Development of a Microcontroller Based Automated Greenhouse Cultivation System for Mushrooms – Hardware,** Hristo Kilifarev and Delyan Genkov (3709) **2. Development of a Microcontroller Based Automated Greenhouse Cultivation System for Mushrooms – Software**, Hristo Kilifarev and Delyan Genkov (6104) **3. Computing the Heat Balance of Boiling Pits during Defrosting of**

3. Development of a Java Syntax Analyzer for C/C++ code recognition, Gergana Spasova and Iliyan Boychev (8569) **4. Automated Verification of the Program Code in The Development Process According to Team Defined Rules,** Velislav Kolesnichenko, Hristo Nenov and Donika Stoyanova, (9807)	**Frozed Logs in them,** Mincho Hadjiski, Nencho Deliiski, Pavlin Vitchev and Dimitar Angelski (121) **4. Reversing BLE Remote Control Protocols of Dual Channel LED Lamps with CCT and Illumination Control**, Rostislav Kandilarov and Yordan Yordanov (8303)
13:00 – 14:00 LUNCH in the UNIVERSITY CANTEEN	
14:00 – 15:30 SESSION A3 "INTELLIGENT CONTROL SYSTEMS" **Chairman: Nikola Nikolov**	**14:00 – 15:30 SESSION B3 "INTELLIGENT COMPUTER SYSTEMS"** **Chairman: Ventsislav Nikolov**
1. Control of ROV Thrusters via Discrete Modal State Controller, Nikola Nikolov, Ivan Grigorov and Konstantin Chterev (7970) **2. Development of a Recipe Analysis System for Technological Processes Controlled by PLCs,** Iliyan Boychev and Gergana Spasova (1455) **3. ICPGF: An Industrial Control Protocol Format-Aware and Feedback-Guided Fuzzing,** Xuejun Zong, Bowei Ning, Guogang Wang, Kan He, Lian Lian and Yifei Sun (3220) **4. Integrated Environment for Monitoring Data from Wireless Sensor Technologies for IoT,** Aydan Haka, Diyan Dinev, Veneta Aleksieva and Hristo Valchanov (4359)	**1. Improving the process of training staff in software companies through specialized software**, Slavka Stamenova (5744) **2. Towards blockchain wallets classification and implementation**, Ivan Popchev, Irina Radeva and Miroslava Dimitrova (8327) **3. Semantic interoperability as a tool for the management of an e-Governance project**, Lyubo Blagoev, Rumen Trifonov and Kamen Spassov (6743) **4. Hamming Code: An Analysis of its Reliability and Efficiency in Computer Networks**, Alla Levina and Nawras H. Sabbry (109)
15:30 – 17:00 SESSION A4 "ADVANCED INDUSTRIAL CONTROL" **Chairman: Mariela Alexandrova**	**15:30 – 17:00 SESSION B4 "ADVANCED COMPUTING 1"** **Chairman: Georgi Tsochev**
1. Software system for determining and visualizing locations and routes of underwater robots, Milena Karova and Ivaylo Penev (2201)	**1. Accessible UX/UI design**, Todor Todorov and Juliana Dochkova-Todorova (9496)

2. Visual Servoing in Door Opening Task for Omnidirectional Mobile Manipulator, Tihomir Stoyanov, Vasil Popov, Andon Topalov, Sevil Ahmed-Shieva, Nikola Shakev and Bozhidara Nedelcheva (1909) **3. Digitalization and Sustainable Development in the Creation and Operation of Automation and Control Systems,** Alexander Georgiev (Rittal) **4. Industrial Cybersecurity and how Regulation Support Industrial Manufactu-ring,** Nikola Petkov, Anton Naumov (Siemens)	**2. Android Agile Test-Driven Development**, Mohammed Alimam, Rand Kouatly and Manish Kaushik (8395) **3. Analysis of source code based on changes in its state over time – using user behavior models**, Mihail Petrov and Vladimir Valkanov (535)
17:00 – 17:30 COFFEE BREAK	
17:30 – 19:00 SESSION A5 "ADVANCED ANALYSIS AND CONTROL OF ELECTRICAL DRIVES" **Chairman: Nikolay Djagarov**	**17:30 – 19:00 SESSION B5 "ADVANCED COMPUTING 2"** **Chairman: Idilia Batchkova**
1. Modeling and Analysis of Shipboard DC Grid System, Nikolay Djagarov and Dimitar Tsvetanov (6507) **2. Analysis of the induction motor load characteristics at different frequencies,** Marin Todorov, (1011) **3. Migration form PLC-5 to ControlLogix and Improvement of an Excavator Positioning System Using Frequency Converter and Induction Motors,** Plamen Bahov (9905) **4. Analysis of the induction motor losses and T-equivalent parameters at different frequencies,** Marin Todorov, Marin Marinov and Maik Streblau (5426) **5. Equipment and Methodology for EV Battery Testing**, Viktor Mashkov and Milena Karova (9261)	**1. Development of an Ontology for Bulgarian Wild, Cultivated and Protected Flora**, Zornica Radeva, Asya Stoyanova-Doycheva, Ivan Popchev and Stanimir Stoyanov (6276) **2. Development of an ontology for Bulgarian soil types**, Asya Stoyanova-Doycheva, Sebiha Madanska and Sheban Bilyanov (2363) **3. Pareto Optimal Solutions of the Biobjective Bottleneck Assignment Problem**, Lasko Laskov and Marin Marinov (2082) **4. Software for animation and graphic visualization of mechatronic elements and control process of FMS**, Javanshir Mammadov, Gafar Atayev, Ulduz Agayev, Sabina Aliyeva, Tarana Safarova and Agil Huseynov (205)
19:00 COCKTAIL in the NUK gallery	

Friday, October 6th

Stream 1 (Conference Hall NUK)
09.00 - 09:45 PLENARY SESSION 2

Chairman: Todor Ganchev

The Artificial Intelligence Perspective

Arthur Kordon
Kordon Consulting LLC

09.45 - 10:00 DISCUSSION

Stream 1 (In attendance) (Room A – Hall 109TV)	Stream 2 (Online) (Room B)
10:00 – 11:30 SESSION A6 "INTELLIGENT POWER CONTROL SYSTEMS" Chairman: Bohos Aprahamyan	**10:00 – 11:30 SESSION B6 "ARTIFICIAL INTELLIGENCE 1" Chairman: Valeri Mladenov**
1. Exogenous Disturbance Observer-based Distributed Bipartite Consensus of Nonlinear Multiagent Systems with Multiple Time-varying Delays, Zhen Tang, Ziyang Zhen, Zhengen Zhao and Geert Deconinck (8725)	**1. Multivalued Network Logic with One Real and Two Imaginary Logic Structures**, Vassil Sgurev and Lyubka Doukovska (692) **2. Unraveling the Elements of Effective Altruistic Appeals through Machine Learning and Natural Language**

2 Estimation of Power Consumption for an Electric Vehicle Through Variable Parameter Modelling, Viktor Mashkov and Milena Karova (2275) **3. Improving Power Quality in Shipboard Power System using a Static Synchronous Compensator: A Simulation Study**, Nikolay Djagarov and Dimitar Tsvetanov (7343) **4. Investigation of Power Quality Using a Laboratory Experimental Setup of a Shipboard Power Plant**, Nikolay Djagarov and Dimitar Tsvetanov (4341)	**Processing**, Sourav Yadav, Sankalp Arora, Akash Kumar and Kaveri Verma (8061) **3. Comparative Analysis of Different Wavelet Transforms for Noise Reduction in CT Images**, Miroslav Petrov (7505)
11:30 – 13:00 SESSION A7 **"AI-BASED PERSONALIZED EDUCATION"** **Chairman: Vladimir Jotsov**	**11:30 – 13:00 SESSION B7** **"ARTIFICIAL INTELLIGENCE 2"** **Chairman: Valeri Mladenov**
1. The use of mobile technologies in education with an emphasis on a student-centered approach, Vladimir Jotsov, Gulnar Madyarova, Zhanat Umirzakova, Aliya Akramova, Galina Tkach, Nurassyl Kerimbayev and Nurbol Beisov (6586) **2. Recursive Estimation Library For Education**, Ivan Grigorov, Nasko Atanasov and Nikola Nikolov (5453) **3. Compact EEG Features for Person Identification**, Firgan Feradov and Todor Ganchev (553)	**1. Memristor-Based Neural Network Implementation with Adjustable Synaptic Weights in LTSPICE**, Valeri Mladenov, Georgi Tsenov and Stoyan Kirilov (9736) **2. Network Intrusion Detection through Classification Methods and Machine Learning Techniques**, Dimitrios Simeonidis, Pavel Petrov and Jordan Jordanov (8686) **3. Predicting High-Resolution Maps of Atmospheric Formaldehyde Concentration Using Vision Transformers**, Ryan Rad (5291)
13:00 – 14:00 LUNCH in the UNIVERSITY CANTEEN	
14:00 – 15:30 SESSION A8 **"ARTIFICIAL INTELLIGENCE 3"** **Chairman: George Mengov**	**14:00 – 15:30 SESSION B8** **"INTELLIGENT DIAGNOSIS IN HEALTH CARE"** **Chairman: Tania Pencheva**
1. A Neural Model Forecasts Macroeconomic Indicators, Iliyan Nenov, Ralitsa Simeonova-Ganeva, Kaloyan Ganev and George Mengov (3023)	**1. Diagnosing diseases for Prostate Cancer Prediction Using Hybrid Learning**, Sathesh Abraham Leo Ebi (5066)

2. Agent Irrationality in Socio-Economic Choices, Anton Gerunov, Ilia Atanasov and George Mengov (6934) **3. Efficient Generative Adversarial DAG Learning with No-Curl**, Hristo Petkov and Feng Dong (4638) **4. An Algorithm for Random Tessellation using a Steppe Fire Model**, Ognyan Zhelezov and Valentina Petrova (8835)	**2. Autism Spectrum Disorder Detection through Facial Analysis and Deep Learning: Leveraging Domain-Specific Variations**, Anupam Agrawal and Krishna Sai Koppula (8527) **3. A model of a two-stage classification system for glial tumors in magnetic resonance imaging**, Miroslav Petrov (4801) **4. Robust Intelligent System for COVID-19 Detection using CT-Scan**, Ahmad Al Smadi, Ahed Abugabah and Ahmad Mohammad Al-Smadi (8814)
Stream 1 (Online) **(Room A)**	**Stream 2 (Online)** **(Room B)**
15:30 – 17:00 SESSION A9 **"INTELLIGENT ROBOTICS"** **Chairman: Andon Topalov**	**15:30 – 17:00 SESSION B9** **"ADVANCED MONITORING AND MODELING IN HEALTH"** **Chairman: Gancho Vachkov**
1. Longitudinal Stability of Wheeled Mobile Robots - Permissible Forces and Accelerations, Stoyan Lilov, Vanya Markova, Nickolay Popov and Ventseslav Shopov (5819) **2. Payload Stabilization in Multidirectional Robot Motion by Applying Trajectory Analysis Algorithm and Feedback Encoders**, Tsvetelina Georgieva, Aleksandar Ivanov and Anton Anchev (7328) **3. An application of artificial potential functions method in the robotic formation control**, Vanya Markova and Ventseslav Shopov (2677) **4. Intelligence in Human-Robot Collaboration – Overview, Challenges and Directions**, Katya Madzharova-Atanasova and Nikola Shakev (3955)	**1. Monitoring heart rate and udder surface temperature in dairy cows under heat stress conditions by infrared thermography**, Hristo Hristov and Toncho Penev (415) **2. Towards Enhanced Well-being: Monitoring Stress and Health with Smart Sensor Systems Muhammad Moazam Shahid**, Georgina Enuwa Agada, Mohammed Kayyali, Isibor Kennedy Ihianle and Pedro Machado (1097) **3. Model-free based neural network time delay estimation control for a 3-DOF ankle exoskeleton**, Hao Gu, Yang Tian and Haoping Wang (3062) **4. Intelligent Triage: Integrating Artificial Intelligence, Queuing Theory and Game Theory for Automated Patient Prioritization in Infectious Disease Wards**, Angel Ivanov (7023)
17:00 – 17:30 COFFEE BREAK	

17:30 – 19:00 SESSION A10 "ADVANCED ROBOTIC APPLICATION" Chairman: Nikola Shakev	**17:30 – 19:00 SESSION B10 "ADVANCED MEASUREMENT APPLICATION 1" Chairman: Kosta Boshnakov**
1. Use of KUKA KR300 Industrial Robot in Electric Arc Furnace Operation, Georgi Georgiev, Nikolay Todorov and Alexandra Grancharova (8847) **2. An Object Detection And Tracking Approach To Control Of a Mobile Agriculture Robot**, Vladimir Kotev, Ivan Ivanov, Georgi Komitov, Georgi Stanchev and Kostadin Kostadinov (1059) **3. Comparative analysis of algorithms for wheat weed recognition**, Asya Toskova and Borislav Toskov (2636) **4. Studying the influence of working fluid temperature on the performance of an electrohydraulic servo system in dynamic mode**, Stanimir Yordanov, Krasimir Ormandzhiev, Georgi Mihalev, Krasen Kostov and Veselin Mitev (1102)	**1. Impact Evaluation of the Optical Devices for Obtaining Soil Color Characteristics**, Antonina Mihaylova, Tsvetelina Georgieva and Plamen Daskalov (3866) **2. Cultivator-based soil density measurement sensor**, Asparuh Atanasov, Svilen Stoyanov and Desislava Mihaylova (5700) **3. An Expert System for the Diagnosis of Livestock Poisoning, Veneta Tabakova-Komsalova**, Stanimir Stoyanov, Asya Stoyanova-Doycheva, Ivan Stoyanov, Lyubka Doukovska and Atanas Dukovski (5961) **4. Simple conditioning interfaces for strain measurement**, Desislava Mihaylova, Svilen Stoyanov, Asparuh Atanasov, Svetlozar Zahariev, Angel Marinov and Kaloyan Solenkov (9411)
19:00 GALA DINNER in the Old Chinar restaurant	

Saturday, October 7th

Stream 1 (Online) (Room A)	Stream 2 (Online) (Room B)
09:00 – 10:30 SESSION A11 "INTELLIGENT COMMUNICATION" Chairman: Ivan Garvanov	**09:00 – 10:30 SESSION B11 "AI TECHNOLOGIES BASED LEARNING 1" Chairman: Margarita Todorova**
1. Investigation of Underwater Packet Radio Communication at 433 MHz, Nikolai Kolev, Darin Peev and Neli Stoycheva (8466) **2. Mobile application for creating and exporting geofences**, Victoria Velkova and Rosen Ivanov (2983) **3. Geocodes in Geographic Information Systems**, Pavel Petrov (5801) **4. Drone Detection Approach Based on Radio Frequency Detector**, Ivan Garvanov, Denislav Kanev, Magdalena Garvanova and Vladimir Ivanov (551)	**1. Using Big Data and Hadoop in the Student Learning Process - Enhancing the Educational Process through Real Experience**, Irena Valova (3719) **2. Implementing Gamified Learning in University Environment**, Milen Sotirov, Valentina Petrova and Donika Nikolova-Sotirova (5502) **3. Prolog Education in Selected High Schools in Bulgaria**, Veneta Tabakova-Komsalova, Ivan Stoyanov, Laska Kostadinova-Tzankova, Atanas Dukovski and Tsvetomira Ivanova (7849) **4. STEM educational kit for assistance of individuals with special needs**, Todor Todorov and Pajtim Vela (2949)
10:30 – 12:00 SESSION A12 "ADVANCED PROCESS CONTROL" Chairman: Mariela Alexandrova	**10:30 – 12:00 SESSION B12 "AI-TECHNOLOGIES BASED LEARNING 2" Chairman: Margarita Todorova**
1. IEC/EN 62264 Energy-based Restriction Knapsack Optimization Scheduling for Wood Processing SME, Plamen Vasilev, Tsvetelina Ivanova and Yordan Belev (6105) **2. Pareto Optimal Solutions of the Minimal Cost Minimal Time Assignment Problem**, Lasko Laskov and Marin Marinov (2438) **3. Steady State Optimization and Model Predictive Control of a Tubular Reactor**, Alexandra Grancharova,	**1. System Tempura - a modern approach for describing and managing temporal processes in a virtual educational space**, Mihail Petrov and Vladimir Valkanov (8903) **2. The Nine-Steps Gamification Process: Increasing Student Engagement in LMS**, Milen Sotirov and Valentina Petrova (1540)

Junhong Xie and Jus Kocijan (5360) **4. Technological Machines Diagnostics of Grain Processing Enterprises as the Object of Automation**, Palvan Kalandarov, Shakhnoza Ubaydullayeva, Nikola Nikolov, Aziz Hayitov and Husen Sharifov (8996)	
12:00 – 13:00 LUNCH	
13:00 – 14:30 SESSION A13 "MODELING AND CONTROL OF POWER SYSTEMS" Chairman: Kamen Perev	**13:00 – 14:30 SESSION B13 "AI APPLICATION IN SOCIAL SYSTEMS" Chairman: Kamen Spasov**
1. Model Predictive Control for a Single Machine Infinite Bus Power System of Full and Reduced Order, Andrey Yonchev and Kamen Perev (3181) **2. Modelling of grid-connected PV-systems using real meteorological data**, Svetlozar Zahariev, Desislava Mihaylova, Angel Marinov and Kaloyan Solenkov (8181) **3. Study of output mechanical energy, developed by a small permanent magnet direct current motor, using simulations of linear motor models**, Nickolay Popov, Stoyan Lilov, Ventseslav Shopov and Vanya Markova (4458) **4. Generation of Electricity Using Compression Piezoelectric Harvesters**, Rumyana Stoyanova, Velimira Todorova and Dimo Kolev (5848)	**1. A Deep Learning Wheat-Weed Dataset**, Asya Toskova and Borislav Toskov (8692) **2. Opportunities and Challenges of Using Artificial Intelligence in Energy Communities**, Vitali Atias (9616) **3. An Evaluation of Web3 Concepts and Technologies and Relation with Digital Forensics**, Blerim Krasniqi and Eliza Stefanova (7407)
14:30 – 16:00 SESSION A14 "ADVANCED MEASUREMENT APPLICATION 2" Chairman: Kosta Boshnakov	
1. Research and Analysis of the Method for Measuring the Moisture Content of Cottonmaterials at Ultrahigh Frequencies, Palvan Kalandarov, Khasan Turkmenov, Shakhnoza Ubaydullayeva, Nikola Nikolov and Mariela Alexandrova (134)	

2. Automation of Technological Processes for Controlling Grain Moisture in the Flow, Palvan Kalandarov, Shakhnoza Ubaydullayeva, Rano Gaziyeva, Nikola Nikolov and Mariela Alexandrova (2311) **3. Compensation of the Temperature Impact on the Characteristics of a Titania-Silica Thin Film Humidity Sensor element**, Stefan Ivanov, Nedyu Nedev and Zvezditsa Nenova (6509) **4. Multisensor Sunflower Oil Quality Assessment System Based on "Electronic Nose"**, Stefan Ivanov, Todor Todorov, Toshko Nenov and Jacek Wilk-Jakubowski (120)	
16:00 – 16:15 CLOSING CEREMONY **Stream 1 (In attendance)** **(Room A – Hall 109TV)**	

PLENARY SESSION 1	**Stream 1**
Chairman: Kosta Boshnakov	University of Chemical Technology and Metallurgy, BG
Thursday, October 5th 09:00 – 10:00	Conference Hall NUK

Methods, Models and Algorithms of the Computational Intelligence Analyzed from a Practical Point of View"

Gancho Vachkov *Baku Higher Oil School, AZ*

Abstract: Currently we are living in an environment with large available batch data sets or endless real time data streams around us that come from various sensors in complex systems, machines, vehicles and industrial plants. Therefore, it is a challenging task to be able to assess, process, analyze and use such bulk amount of information for producing meaningful and plausible, human interpretable solutions and decisions about the operation status of the observed systems and processes. Here the large variety of methods, models and algorithms provided by the Computational Intelligence being able to detect a distinguishable change or deterioration in the system performance are increasingly important from a practical point of view. The talk is focused on several possible methods and algorithms that can give an approximate but still realistic solution to the above problem. For example, the weighted moving

window approach to continuously monitoring and estimating the operation status of industrial system is used as a base tool for continuous extraction of different "data clouds" from the real operation. Then each data cloud is compared to a "typical" predefined operation by applying several possible measures of similarity in order to find a plausible classification of the operation status. Theoretically the definition of this problem is close to the standard supervised classification, but it has also some uniqueness that comes from the endless chain of different data clouds in the data stream. Here several clustering methods, such as Fuzzy C-means, along with Data Compression and the Grid Fuzzy Models are extremely useful and efficient for capturing the different modes and behaviors of the real time operating industrial system. In the case of analyzing large batch data sets, the problem is often stated as finding all regions of interests (ROI) within the data set that are closest by characteristics to a predefined (known) object in the form a given image or portion of a data set. More details and application results are given in the talk on different examples of monitoring systems for anomaly detection in the operation of petrochemical plant, hydraulic excavators, photovoltaic systems, metallurgical plants as well as a biomedical application for analyzing the status and anomaly of the heart coronary artery. All the examples are part of the authors research and practical experience.

PLENARY SESSION 2	**Stream 1**
Chairman: Todor Ganchev	Technical University of Varna, BG
Thursday, October 6th 09:00 – 10:00	Conference Hall NUK

The Artificial Intelligence Perspective

Arthur Kordon *Kordon Consulting LLC, US*

Abstract: The talk will focus on the key components that AI will shape science, the economy, and social life in the near future. It will discuss the dynamic nature of AI progress in the last decade, including the recent developments of Large Language Models, such as ChatGPT. The explosive innovations of various AI methods and their impact on different sciences will also be illustrated. The critical role of AI as the engine of the digital economy will be clarified and presented with proper applications. The social impact of AI, especially of the ChatGPT, will be discussed. The various options to participate in this new AI-driven perspective of our future will be considered shortly.

SESSION A1 "MACHINE LEARNING"	**Stream 1**
Chairman: Ivaylo Penev	Technical University of Varna, BG
Thursday, October 5th 10:00 – 11:30	Hall 109TV

Simulating an Lack of Phase Fault on SynRM and Integrate Results with Machine Leearning

Nikolay Djagarov — *"Nikola Vaptsarov" Naval Academy, BG*
Hristo Milushev — *"Nikola Vaptsarov" Naval Academy, BG*
Georgi Enchev — *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: Modern intelligent systems for diagnostics of electric drives widely use the methods of artificial intelligence. In the article, a complex mathematical model of synchronous reluctance machine (SynRM) is proposed, with the help of which various fault can be simulated. With the help of the model, a lack of phase fault was simulated. Using a machine learning method, the fault was identified with an accuracy of over 97 percent.

Detection of Cyber Attacks in Self-Driving Vehicles By Machine Learning

Ivaylo Penev — *Technical University of Varna, BG*
Kristian Ivanov — *Technical University of Varna, BG*
Georgi Kostadinov — *Technical University of Varna, BG*
Zahari Stoyanov — *Technical University of Varna, BG*

Abstract: The paper describes three machine learning models for detecting cyber attacks in self-driving vehicles. The aim is recognition of abnormal data, inserted into the CAN bus of self-driving car. Two of the models are neural networks and the third one is implemented by logistic regression. The models are simple and at the same time the results show that some of them have high accuracy. The models are trained and tested on a widely accessible hardware. Experimental results from training and validation of the models are presented and discussed.

Comparative Analysis of the Bernoulli and Multinomial Naive Bayes Classifiers for Text Classification in Machine Learning

Neli Kalcheva — *Technical University of Varna, BG*
Ginka Marinova — *Technical University of Varna, BG*
Maya Todorova — *Technical University of Varna, BG*

Abstract: The purpose of the report is a comparative analysis of the Bernoulli and Multinomial Naive Bayes classifiers in text classification for machine learning. The conducted research demonstrates that when classifying English user comments, the accuracy and precision of the Multinomial Naive Bayes classifier are higher than those of the Bernoulli Naive Bayes classifier, with the difference increasing with the volume of data. Both the Bernoulli and Multinomial Naive Bayes classifiers have identified a higher percentage of

negative comments as belonging to their respective classes and a lower percentage of positive comments as belonging to their respective classes when classifying English user opinions. The Multinomial Naive Bayes classifier has higher values for the recall parameter of positive comments compared to the Bernoulli Naive Bayes classifier, whereas the Bernoulli Naive Bayes classifier has higher values for the recall parameter of negative comments compared to the Multinomial Naive Bayes classifier.

Detailed investigation of ML algoritms for diagnostics of IM on board vessel

Georgi Enchev *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: The use of AI for the purpose of optimizing the operation of electric motors is a topic that deserves attention. This article discusses a machine learning algorithm for the diagnosis of ships electric drives, as well as the different types of results that can be obtained using it.

SESSION B1 "CONTROL THEORY" **Stream 2**

Chairman: Aleksandra Grancharova — University of Chemical Technologies and Metallurgy, BG

Thursday, October 5th 10:00 – 11:30 — Online

Model-free non-singular fast terminal sliding mode controller using extended sliding mode observer for series elastic actuator-based robotic arm

Hongfei Sun *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 proposes an adaptive admittance controller and a model-free non-singular fast terminal sliding mode controller based on an extended sliding mode observer for hybrid force and position control of a robotic arm driven by series elastic actuators (SEA) with external disturbances and model uncertainty. According to the ultra-local model method, simplifying the robotic arm driven by SEA dynamic model and all unknown terms which include the uncertainty of the model and unknown disturbance are integrated into one term called lumped total disturbance. In order to estimate the integrated unknown disturbance terms, an extended sliding mode observer (ESMO) is constructed. For better position control performance, a model-free non-singular fast terminal sliding mode controller was constructed by combining ultra-local model with non-singular fast terminal sliding mode control. In the outer loop, in order to accurately control the contact torque generated by interaction with the external environment in the hybrid force and position control of the robotic arm with changes in external environmental stiffness, an adaptive admittance controller is designed. To validate the effectiveness of the control strategy and the

optimization effect on control performance, co-simulations of the SEA driven robotic arm are realized by using SolidWorks and MATLAB. Compare the co-simulation results with time-delay estimation-based intelligent proportional-derivative controller (TDE-iPD) to show the high accuracy and fast convergence characteristics of this control method.

Synchronization of Chaotic Systems Using Novel Sliding Mode Neural Network Controller

Junhong Xie — *University of Chemical Technology and Metallurgy, BG*

Alexandra Grancharova — *University of Chemical Technology and Metallurgy, BG*

Liping Fan — *Shenyang University of Chemical Technology, CN*

Abstract: In this paper, a novel exponentially perturbed sliding mode neural (NEPSMN) control scheme is investigated for the synchronous control problem of chaotic systems. The proposed control scheme synchronizes the master-slave system by designing a disturbance observer that reduces the switching gain of the sliding mode control. In addition to that, a radial-basis functions neural network (RBF-NN) with adaptive wights is used to describe the uncertainty in the master-slave dynamics. It is shown that by using this control scheme, the synchronization error dynamics is stable and the error quickly convergences to zero. In addition, it has a strong ability to suppress external disturbances. By using the Lyapunov's stability theory, it is proved that the new control scheme guarantees the stability of a third-order nonlinear chaotic master-slave system. Beside that, the simulation results show the performance superiority of the proposed controller in comparison to a conventional (PI) controller.

Fuzzy-logic Energy Management Strategy of Fuel Cell Hybrid Electric Vehicle Based on Whale Optimization Algorithm

Yuxuan Liu — *College of Inf. Eng. Shenyang University of Chemical Technology, CN*

Xuejun Zong — *College of Inf. Eng. Shenyang University of Chemical Technology, CN*

Kan He — *College of Inf. Eng. Shenyang University of Chemical Technology, CN*

Lian Lian — *College of Inf. Eng. Shenyang University of Chemical Technology, CN*

Yifei Sun — *College of Inf. Eng. Shenyang University of Chemical Technology, CN*

Abstract: The energy management strategy based on traditional fuzzy logic control relies heavily on expert experience, which makes control results unsatisfactory. To address this problem, the research proposed a fuzzy-logic fuel cell hybrid vehicle energy management strategy based on the Whale Optimization Algorithm (WOA-F-EMS). The Whale Optimization Algorithm was used to optimize the fuzzy-logic energy management strategy (F-EMS) with hydrogen consumption as the objective function. The proposed strategy was compared with the F-EMS and the ADVISOR strategy under two driving

conditions. The results show that the WOA-F-EMS can effectively reduce the hydrogen consumption of fuel cells and enhance the stability of the battery's state of charge.

A Compact and Secure Access Control Solution Based on a Deterministic Finite Automaton

Akbota Kulzhanova — *Al-Farabi Kazakh National University, KZ*
Timur Bakibayev — *Almaty Management University, KZ*
Nurassyl Kerimbayev — *Al-Farabi Kazakh National University, KZ*
Kalinka Kaloyanova — *Sofia University St. Kliment Ohridski, BG*
Diana Rakhimova — *Al-Farabi Kazakh National University, KZ*

Abstract: Access control systems are critical in ensuring the security of various facilities, ranging from residential buildings to corporate offices and government institutions. Traditional access control mechanisms usually use a hash function to generate specific signatures. However, these signatures are unable to meet the security requirements of high-security environments. In this paper, we introduce a new secure access control solution based on a deterministic finite automaton (DFA). We also provide a simulation of the solution to demonstrate its potential for use in access control systems. The automaton's adaptability and customizability allow it to cater to a wide range of security requirements. The automation's unique hash value generation mechanism enhances its preimage resist, second preimage resistance, and collision resistance properties, further contributing to its security. The paper presents these results to demonstrate that the proposed approach significantly outperforms traditional filter schemas, opening up new possibilities for secure and reliable access control in the future.

SESSION A2 "CLASSIFICATION AND VERIFICATION PROBLEMS" — **Stream 1**

Chairman: Valentina Markova — Technical University of Varna, BG

Thursday, October 5th 11:30 – 13:00 — Hall 109TV

Study of the K-Nearest Neighbors Method with Various Features for Text Classification in Machine Learning

Neli Kalcheva — *Technical University of Varna, BG*
Maya Todorova — *Technical University of Varna, BG*
Ivaylo Penev — *Technical University of Varna, BG*

Abstract: The aim of this publication is to compare the accuracy of the K-Nearest Neighbors method using various distance calculation functions between two objects from the training sample in text classification within machine learning. The study involves classifying English language texts representing movie reviews. The compared functions are: LP metric

(Minkowski), Manhattan metric (L1), Euclidean distance (L2), and cosine similarity. The results indicate that the highest accuracy in text classification using the K-Nearest Neighbors method was achieved when employing the cosine similarity function, with a difference of approximately 19 percent compared to the other functions, especially with larger data sets. When classifying opinions from user comments in English using the k-nearest neighbors method with the cosine similarity function, the examined parameters of accuracy, precision, and recall increased as the data volume expanded.

Comparing Accuracy and Time of Support Vector Machine with Different Kernels for Handwritten Digits Classification

Neli Kalcheva — *Technical University of Varna, BG*
Maya Todorova — *Technical University of Varna, BG*
Ginka Marinova — *Technical University of Varna, BG*
Ivaylo Penev — *Technical University of Varna, BG*

Abstract: The aim of this publication is to compare the accuracy and time performance of the Support Vector Machine method with different kernels in image classification within the field of machine learning. In the classification of handwritten digits using the Support Vector Machine approach, we employed the following kernels: polynomial kernel, linear kernel, sigmoid radial kernel, and radial basis kernel. The results indicate that the algorithm employing the radial basis kernel achieved the highest accuracy, while the linear kernel algorithm demonstrated the fastest performance.

Development of a Java Syntax Analyzer for C/C++ code recognition

Gergana Spasova — *Technical University of Varna, BG*
Iliyan Boychev — *Technical University of Varna, BG*

Abstract: This article describes the development of a parser in the Java programming language. The analyzer recognizes a program written in C code. The implemented parser recognizes and separates words from C program code and recognizes the type of each word. The types of words that the implemented parser recognizes are keyword, identifier, constant, operator, and delimiter. The result of the execution of the designed parser is in the form of a pair of values: <word – type>. Performed testing of the analyzer with C code submission in stages and at once.

Automated Verification of the Program Code in The Development Process According to Team Defined Rules

Velislav Kolesnichenko — *Technical University of Varna, BG*
Hristo Nenov — *Technical University of Varna, BG*
Donika Stoyanova — *Technical University of Varna, BG*

Abstract: Verification of the program code in the development process is crucial to ensure a quality and reliable software product. It is a systematic and

structured process for checking and confirming if the code fulfills the requirements laid down for its creation. The paper aims to outline the main points related to the verification of program code. Clarifies the essence of the concept and the activities related to its implementation; reveals appropriate types of testing and tools for conducting it; describes the sequence of steps through which its execution passes. The described specifics are basis for the future development of a universal, technologically independent expert system for verifying the program code.

SESSION B2 "CONTROL APPLICATION"	**Stream 2**
Chairman: Nencho Deliiski	University of Forestry, BG
Thursday, October 5th 11:30 – 13:00	Online

Development of a Microcontroller Based Automated Greenhouse Cultivation System for Mushrooms – Hardware

Hristo Kilifarev *Technical University of Gabrovo, BG*
Delyan Genkov *Technical University of Gabrovo, BG*

Abstract: This paper presents the development of a microcontroller based automated system for greenhouse cultivation of mushrooms. For more successful greenhouse production, it is important to get the most out of each period or phase of development of the grown product. The system is fully automatic in the individual phases of development of the grown products, and the monitoring of the microclimate and soil parameters, as well as the control of the processes, is by means of measuring sensors and executive mechanisms located in selected places in the greenhouse. There are similar controllers and systems for large-scale production plants from various manufacturers, but the main drawback is their high cost. This gives reason to look for a solution at a lower price with components offered in the commercial network, using the Arduino platform. The main goal for the developed prototype of the system is to be built with relatively cheap components, but to offer enough functionality and adaptability to monitor and control the different technological processes in the all phases of the greenhouse cultivation of different types of mushrooms. The developed automation system is dedicated for small-scale production greenhouses with a local simplified user interface to select the operating mode and to visualize the parameters.

Development of a Microcontroller Based Automated Greenhouse Cultivation System for Mushrooms – Software

Hristo Kilifarev *Technical University of Gabrovo, BG*
Delyan Genkov *Technical University of Gabrovo, BG*

Abstract: This paper presents the software development for a microcontroller based automated system for greenhouse cultivation of mushrooms. The system is designed to be fully automatic in the individual phases of development of the

grown products, and the monitoring of the microclimate and soil parameters, as well as the control of the processes, is by means of measuring sensors and executive mechanisms located in selected places in the greenhouse. The hardware of the prototype system is built with relatively cheap components and is based on Arduino platform, but can offer enough functionality and adaptability to monitor and control the different technological processes in the all phases of the greenhouse cultivation of different types of mushrooms. A local simplified user interface to the system is designed to select the operating mode and to visualize the currently measured and set parameters. The working algorithm is presented, as well as the used program libraries. Various tests were carried out on the system prototype to prove its operability in different modes and situations.

Computing the Heat Balance of Boiling Pits during Defrosting of Frozed Logs in them

Mincho Hadjiski — *Bulgarian Academy of Sciences, BG*
Nencho Deliiski — *University of Forestry, BG*
Pavlin Vitchev — *University of Forestry, BG*
Dimitar Angelski — *University of Forestry, BG*

Abstract: An approach for computing the heat balance of boiling pits during defrosting of logs in them intended for veneer production has been presented. With the help of our own non-stationary model, the defrosting times of beech logs with a diameter of 0.4 m, initial temperature of −10 oC, and moisture content of 0.6 kg·kg-1 were determined at water temperatures in the pit equal to 70, 80 and 90 oC. Using the determined logs' defrosting durations and the mentioned approach, the change in the total energy required to completely defrost the logs in the pit from their initial average mass temperature of −10 oC to 0 oC and that required for each of the individual components of the heat balance was calculated. Computer simulations were conducted for a concrete pit with overall dimensions 8.0 × 2.6 x 2.5 m, working volume of 20 m3, and a degree of filling with logs equal to 25, 50, and 75%. The approach can be applied to compute heat balances of pits both during defrosting only and during complete defrosting and subsequent boiling of frozed logs to a desired final average mass temperature required for the mechanical processing of the plasticized logs.

Reversing BLE Remote Control Protocols of Dual Channel LED Lamps with CCT and Illumination Control

Rostislav Kandilarov — *University of Ruse "Angel Kanchev", BG*
Yordan Yordanov — *University of Ruse "Angel Kanchev", BG*

Abstract: In this paper various BLE protocols for communication between remote or Android applications and intelligent dual channel (cool and warm white) LED lamps were reverse engineered. Three protocols were fully decoded

and several partially. Replay attack is tested and confirmed working. Demo C++ library was developed and a proof-of-concept firmware for esp32 based development board was used to verify the decoding and the attacks applicability.

SESSION A3 "INTELLIGENT CONTROL SYSTEMS" **Stream 1**

Chairman: Nikola Nikolov Technical University of Varna, BG

Thursday, October 5th 14:00 – 15:30 Hall 109TV

Control of ROV Thrusters via Discrete Modal State Controller

Nikola Nikolov *Technical University of Varna, BG*
Ivan Grigorov *Technical University of Varna, BG*
Konstantin Chterev *Black Sea Research Fund, BG*

Abstract: Most of the underwater activities are carried out with a Remotely Operated Vehicle (ROV). ROVs are driven by thrusters, and controlling the movement of the ROV underwater is related to continuous regulation of the speed of the electric motors driving its thrusters. This paper presents one variant of ROV propulsion control using a discrete modal state controller. A mathematical description in the state space has been made for one of the most commonly used electric motors. The operation algorithm of the discrete modal state controller to calculate the feedback vector was developed and simulation modeling was done in MATLAB/Simulink.

Development of a Recipe Analysis System for Technological Processes Controlled by PLCs

Iliyan Boychev *Technical University of Varna, BG*
Gergana Spasova *Technical University of Varna, BG*

Abstract: In this article, it is proposed to develop a system consisting of a parser and a translator, which receives as input information a procedure for a technological process, called a recipe, validates it for correctness, corrects the necessary data (if possible), and translates this data into a suitable format for recording in the controller. The present development envisages the use of SIEMENS controllers.

ICPGF: An Industrial Control Protocol Format-Aware and Feedback-Guided Fuzzing

Xuejun Zong *College of Inf. Eng. Shenyang University of Chemical Technology, CN*
Bowei Ning *College of Inf. Eng. Shenyang University of Chemical Technology, CN*
Guogang Wang *College of Inf. Eng. Shenyang University of Chemical Technology, CN*
Kan He *College of Inf. Eng. Shenyang University of Chemical Technology, CN*

Lian Lian *College of Inf. Eng. Shenyang University of Chemical Technology, CN*
Yifei Sun *College of Inf. Eng. Shenyang University of Chemical Technology, CN*

Abstract: To address the issues of low efficiency and poor protocol extensibility in current fuzzing frameworks, this paper proposes a universal fuzzing method for industrial control protocols, ICPGF. Innovatively, we adopt the bootstrap voting expert algorithm to extract the unique format and semantic features of the protocols. By combining optimized mutation strategies and state-feedback mechanism, we guide the generation of testcases and the fuzzing process. The aim is to efficiently discover vulnerabilities in industrial control systems. In a realistic industrial scenario of attack-defense range, we conduct fuzzing on control systems from multiple manufacturers. In comparison experiments with general fuzzing frameworks like AFL and Peach, ICPGF outperforms AFL and Peach in terms of fuzzing efficiency, branch coverage and exception triggers numbers. This fully demonstrates the potential of ICPGF to be an efficient and universal solution in the field of industrial control vulnerability discovery.

Integrated Environment for Monitoring Data from Wireless Sensor Technologies for IoT

Aydan Haka *Technical University of Varna, BG*
Diyan Dinev *Technical University of Varna, BG*
Veneta Aleksieva *Technical University of Varna, BG*
Hristo Valchanov *Technical University of Varna, BG*

Abstract: Modern IoT networks connect devices operating according to different standards that generate data in diverse formats. This led to the need to combine data from different technologies and present them in a single format. In this paper, a solution for integrating and monitoring data from LoRa, ZigBee and BLE wireless sensor networks is proposed. The proposed environment makes it possible to analyse the data received from the considered technologies. Additionally, it allows setting sensitivity thresholds for monitored parameters and generating notifications.

SESSION B3 "INTELLIGENT COMPUTER SYSTEMS" **Stream 2**

Chairman: Ventsislav Nikolov Technical University of Varna, BG

Thursday, October 5th 14:00 – 15:30 Online

Improving the process of training staff in software companies through specialized software

Slavka Stamenova *University of Economics - Varna, BG*

Abstract: Modern human resource management practice advocates personnel training processes. Traditional ways of training can be replaced by specialized software, through which each employee can follow an individual line of training. The development and implementation of this type of software is essential in the process of innovation of training programs and increasing competitiveness in the software business. Theoretical aspects of the need to develop a human resources training system are presented, and the advantages and necessity for its development are analyzed. The ways of functioning and development of the training system are described, based on the results of a study, and a test application in a real working environment was also made.

Towards blockchain wallets classification and implementation

Ivan Popchev — *Institute of Information and Communication Technologies - BAS, BG*
Irina Radeva — *Institute of Information and Communication Technologies - BAS, BG*
Miroslava Dimitrova — *Institute of Information and Communication Technologies - BAS, BG*

Abstract: The blockchain technology continues to evolve, and new use cases and applications are emerging. A key component of the blockchain ecosystem is the blockchain wallet. This paper presents the key components in the concept behind blockchain wallets, analyzes and systematizes their classification, and proposes an extended working definition. The proposed classification can be viewed as a classical multi-criteria problem for framework design selection of various custom wallet solutions. As a practical solution, the implementation of a desktop version of a non-custodial, software hot wallet, which supports tokens/NFT (ERC-20, ERC-721) with biometric authentication. The wallet is designed for the Antelope/IPFS based platform for data exchange in smart crop production. The technology framework requirements are presented, along with two groups of functionalities – account management and working with tokens, and three main applications for token transfer and user file exchange authentication. The wallet is an extension of the infrastructure and functionalities of the platform prototype. The obtained results provide opportunities for future development in direction of deployment a web-based application and wallet, enabling the client-side of the platform to be implemented as a dApp.

Semantic interoperability as a tool for the management of an e-Governance project

Lyubo Blagoev — *Technical University of Sofia, BG*
Rumen Trifonov — *Technical University of Sofia, BG*
Kamen Spassov — *Sofia University "St. Kliment Ohridski", BG*

Abstract: Managing a project to build e-Governance is a heavy and large-scale task, especially in terms of quality control of the created ICT resources. The optimal solution to such a task is the application of the "control of control"

principle, which in general requires the creation of additional funds. The specificity of resources to support Semantic Interoperability enables them to be used to implement this principle. This material presents ways to achieve this.

Hamming Code: An Analysis of its Reliability and Efficiency in Computer Networks

Alla Levina *LETI University, RU*

Nawras H. Sabbry *LETI University, RU*

Abstract: Hamming code and Extended Hamming code are linear error-correcting codes used for detecting and correcting errors in digital data transmission. They help in maintaining data integrity and reliability by detecting and correcting errors introduced during transmission in various communication systems, including computer networks, storage devices, digital communication channels and other applications.

This paper aims to analyze the reliability and efficiency of using of these codes for the purpose of detecting and correcting errors within computer networks. The performance of these codes was tested by developing a program in two steps: one for Hamming Code, and the other for Extended Hamming Code. Both codes were designed to test their error detection and correction capabilities under different scenarios. This study offers a detailed analysis of the strengths and limitations of Hamming Code and Extended Hamming Code in relation to error detection and correction, which shed light on why communication systems extensively rely on this type of coding, and how it significantly improves their dependability and effectiveness.

SESSION A4 "ADVANCED INDUSTRIAL CONTROL" **Stream 1**

Chairman: Mariela Alexandrova Technical University of Varna, BG

Thursday, October 5th 15:30 – 17:00 Hall 109TV

Software system for determining and visualizing locations and routes of underwater robots

Milena Karova *Technical University of Varna, BG*

Ivaylo Penev *Technical University of Varna, BG*

Abstract: This paper presents a software system for visualization of location and route of an underwater robot. The visualization is based on photos of seabed, which are taken by the camera of the robot. The robot also takes records for the photographed objects and stores them into KML format. The photos and the KML data are transferred to a device (a laptop or a computer), where the data are processed and the location and the traveled route of the robot are shown on a map in the web interface of the system. The robot and the presented system can be used to research the seabed relief and habitats, thus avoiding participation of divers and decreasing the risks for human lives under water.

Visual Servoing in Door Opening Task for Omnidirectional Mobile Manipulator

Tihomir Stoyanov — *Technical University of Sofia, Branch Plovdiv, BG*
Vasil Popov — *Technical University of Sofia, Branch Plovdiv, BG*
Andon Topalov — *Technical University of Sofia, Branch Plovdiv, BG*
Sevil Ahmed-Shieva — *Technical University of Sofia, Branch Plovdiv, BG*
Nikola Shakev — *Technical University of Sofia, Branch Plovdiv, BG*
Bozhidara Nedelcheva — *Technical University of Sofia, Branch Plovdiv, BG*

Abstract: The general door opening task takes special place among the mobile robot operation challenges. Research interest in the topic grows in various directions, from mathematical modelling to energy saving solutions. Still, door recognition and locating, and further robot/manipulator approaching algorithms are the main and must tasks have to be solved. The paper presents a study on a door opening task for an omnidirectional mobile manipulator based on visual information. Moreover, a custom configuration of mobile manipulator is going to be introduced.

Digitalization and Sustainable Development in the Creation and Operation of Automation and Control Systems

Alexander Georgiev — *Rittal EOOD – Bulgaria, part of FLG, BG*

Abstract: The end products we use in our daily lives are becoming increasingly complex and high-tech. For their production, the industry needs increasingly complex and efficient production processes. This is associated with a high degree of automation and production control, which is achieved with the use of a large number of sensors and actuators. In the process of design, construction and operation of such systems, a huge volume of documentation is created and used, which is generally found on paper (locally at the system) and/or in digital format at the designers' premises.

Due to its volume, handling this documentation - quickly finding a specific part of it and making corrections during its life cycle - is extremely difficult.

RITTAL is changing that by creating the cloud-based digital document pocket - ePOCKET.

With its help, specialists have quick and secure access to all available documentation and its most up-to-date version. The use of paper for printing schematics, specifications, certificates, etc. is over now.

Industrial Cybersecurity and how regulations support industrial manufacturing

Nikola Petkov — *Siemens EOOD, Digital Industries, BG*
Anton Naumov — *Siemens EOOD, Digital Industries, BG*

Abstract: Megatrends are bringing nowadays new challenges to discrete and

process industries. Globalization, digitalization, lack of skilled working force, are setting new requirement to different manufacturers. The keyword in digitalization of product lifecycle processes is data availability. It requires different multi-connections starting from the field sensors, trough the control systems, to MOM/MES, ERP, and cloud systems. The interoperated data exchange at different levels leads to new challenges in the OT (Operational Technologies) world. Currently the major one of them is the highly increased number of cyberthreats and both IT (Information Technology) and OT are at risk. In the last five years hundreds of manufacturers were attacked by different ransomware viruses that caused tens of billions in losses. But how to protect our production sites? Most common used solutions are DMZ, firewalls, whitelisting, end-point protection, integrated security in automation, industrial network segmentation, asset inventory scan and many others. Here the knowledge of automation theory is essential for finding and implementing sufficient, secure, and safe solutions for OT protection.

Because of the importance of the topic, European Union set a context of cybersecurity related legislations. Last one is NIS2 (Network and Information Systems Security) started in 2023. Requirements and recommendations in NIS 2 are supporting the industry by setting regulation and do not act as limitations and restrictions.

The purpose of this presentation is to explain how Siemens by following these recommendations, using the certified products and solution, and having the right knowledge on automation technologies supports different industries in their new challenges regarding the cybersecurity of OT.

SESSION B4	"ADVANCED COMPUTING 1"	**Stream 2**
Chairman: Georgi Tsochev	Technical University of Sofia (BG)	
Thursday, October 5th 15:30 – 17:00	Online	

Accessible UX/UI design

Todor Todorov — *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Juliana Dochkova-Todorova — *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Abstract: The paper reviews the UX/UI design requirements to websites that are specified for their accessibility for people suffering from vision loss. Specific recommendations for content construction, layout and markup in code are systematized. The possibilities for researching the expectations of the user group and increasing the usability of a learning site have been analysed. Automated accessibility testing tools are discussed, and their usage is presented.

Android Agile Test-Driven Development

Mohammed Alimam — *University of Europe for Applied Sciences, DE*
Rand Kouatly — *University of Europe for Applied Sciences, DE*
Manish Kaushik — *University of Europe for Applied Sciences, DE*

Abstract: In today's technological world, one of the industries that are growing the fastest is the market for mobile apps. The things that mobile apps need to do change all the time, so software developers need to be able to adapt. After many failed attempts to overcome problems with mobile computer programming, it was decided that the agile project process was the best way to make an application for various devices. This project report goes into detail about how Agile methodologies within Kotlin programming language that is utilized to deal with the many problems that come up when making mobile software. As a way to deal with these problems, agile methods have been suggested as the guidelines for making mobile apps. The principal objective of this study is to find out more about the agile approach and how it can be used to make mobile apps. For this study, the researcher would search the published research and other databases for relevant papers to utilize as secondary research. As a group struggles to create and keep software that works, they will go through these steps of the DevOps entire life cycle over and over again. TDD can also help to make software quickly. The findings/results of this research are to consider through several testing like unit, UI, Instrumentation, and non-functional along with knowing about the developer's viewpoint on the findings by underpinning Kotlin programming language. The main limitation of this research is that TDD cuts down on the time spent fixing insects and recreating work.

Analysis of source code based on changes in its state over time – using user behavior models

Mihail Petrov — *University of Plovdiv "Paisii Hilendarski", BG*
Vladimir Valkanov — *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: One of the popular trends to increase productivity in the development of software products is related to integrating tools based on artificial intelligence, which actively supports software engineers' actions in dealing with syntactic and semantic problems. A parallel can quickly be drawn between a similar class of tools and the platforms to train future developers. However, the main drawback of most media of this nature is the focus on the result of the problem and the complete ignoring of the intermediate steps aimed at analyzing the behavior of the developer. In this article, we will pay attention to analyzing syntactic, semantic, platform, and analytical problems generated as a result of working on programming problems in a virtual educational environment.

SESSION A5 "ADVANCED ANALYSIS AND CONTROL OF ELECTRICAL DRIVES"	**Stream 1**
Chairman: Nikolay Djagarov	"Nikola Vaptsarov" Naval Academy, BG
Thursday, October 6th 17:30 – 19:00	Hall 109TV

Modeling and Analysis of Shipboard DC Grid System

Nikolay Djagarov *"Nikola Vaptsarov" Naval Academy, BG*

Dimitar Tsvetanov *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: Microgrids with DC distribution schemes are finding increasing application in various electrical schemes due to their advantages. This paper introduces a mathematical model of a DC microgrid, which is detailed and allows for solving many of the tasks related to the research, control, and protection of such systems.

Analysis of the induction motor load characteristics at different frequencies

Marin Todorov *Technical University of Varna, BG*

Abstract: Microgrids with DC distribution schemes are finding increasing application in various electrical schemes due to their advantages. This paper introduces a mathematical model of a DC microgrid, which is detailed and allows for solving many of the tasks related to the research, control, and protection of such systems.

Migration form PLC-5 to ControlLogix and Improvement of an Excavator Positioning System Using Frequency Converter and Induction Motors

Plamen Bahov *Technical University of Varna, BG*

Abstract: This paper discusses the application of a frequency converter in v/f mode to control the position of an excavator using twenty shorted-rotor induction motors connected to a common bus. First, the current system is discussed along with its problems. Then, solution is applied to increase positioning accuracy, and the developed new system was implemented in the existing site. Finally, a conclusion of the effectiveness of the new management is made.

Analysis of the induction motor losses and T-equivalent parameters at different frequencies

Marin Todorov *Technical University of Varna, BG*

Marin Marinov *Technical University of Varna, BG*

Maik Streblau *Technical University of Varna, BG*

Abstract: This article presents an approach for calculating the losses inside induction motors at different frequencies, based on the T-equivalent electrical circuit. The parameters of the circuit are calculated for the different frequencies, according to machine design methodology and the most used constant torque

V/f pattern.

Equipment and Methodology for EV Battery Testing

Viktor Mashkov *Technical University of Varna, BG*
Milena Karova *Technical University of Varna, BG*

Abstract: This paper focuses on designing and implementing a programmable device for testing lithium-ion battery cells with constant current or constant power loading. The presented design is scalable, possesses highly versatile battery loading capabilities, allows data-logging, and is inexpensive. Electrical components, as well as a Raspberry Pi Pico were used. The main purpose of this device is to simulate real-world driving cycles and gather data about the battery cell's current load and voltage.

SESSION B5 "ADVANCED COMPUTING 2" **Stream 2**

Chairman: Idilia Batchkova — University of Chemical Technologies and Metallurgy, BG

Thursday, October 6th 17:30 – 19:00 — Online

Development of an Ontology for Bulgarian Wild, Cultivated and Protected Flora

Zornica Radeva *Institute of Information and Communication Technologies, BAS, BG*
Asya Stoyanova-Doycheva *University of Plovdiv "Paisii Hilendarski", BG*
Ivan Popchev *Bulgarian Academy of Sciences, BG*
Stanimir Stoyanov *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: The article presents the development of an ontology for wild, cultivated and protected flora as a part of National Research Program "Smart crop production". The ontology is focused on description of the plants distributed on territory of Republic of Bulgaria with accent of protected plants and their ecological characteristics. The work presents the analysis of plant species data and the selected concepts and relations between them according to development of intelligent system for representing knowledge about Bulgarian wild, cultivated and protected flora. There are exhibited the structure of the ontology and concepts of its basic and additional classes that introduce external and specific characteristics of plants and their ecological and habitat existence. All properties are performed according of basis of plant taxonomy and the botany scientific sources and also include some different data about plants as their biodiversity, monitoring and protection. The implemented concepts, their properties and relations are represented by using the ontology editor in open-source software Protégé.

Development of an ontology for Bulgarian soil types

Asya Stoyanova-Doycheva *University of Plovdiv "Paisii Hilendarski", BG*

Sebiha Madanska *University of Plovdiv "Paisii Hilendarski", BG*
Sheban Bilyanov *University of Architecture, BG*

Abstract: The article presents the development of an ontology for the taxonomy of soils in Bulgaria. In addition to soil types, the ontology includes knowledge about the different soil regions in Bulgaria that are suitable for cultivating various agricultural crops. The ontology is part of the knowledge base of the ZEMELA platform for smart agriculture.

Pareto Optimal Solutions of the Biobjective Bottleneck Assignment Problem

*Lasko Lasko*V *New Bulgarian University, BG*
Marin Marinov *New Bulgarian University, BG*

Abstract: In this paper we describe the computation of all Pareto optimal solutions of a fundamental biobjective variant of the assignment problem (AP). The examined problem is the MAXMIN-MINMAX AP in which both criteria are non-linear bottleneck functions: maximal capacity and minimal time. We introduce the main algorithm that solves the biobjective bottleneck AP, along with its helper functions that are needed for its implementation. We prove the correctness of the algorithms, and we show their computational complexity. The presented method is applicable to majority of the MAXMIN-MINMAX versions of the AP, and with few modifications can be adopted to solve the other standard biobjective bottleneck APs.

Software for animation and graphic visualization of mechatronic elements and control process of FMS

Javanshir Mammadov *Sumgait State University, AZ*
Gafar Atayev *Sumgait State University, AZ*
Ulduz Agayev *Sumgait State University, AZ*
Sabina Aliyeva *Sumgait State University, AZ*
Tarana Safarova *Sumgait State University, AZ*
Agil Huseynov *Sumgait State University, AZ*

Abstract: The issue of graphical visualization of the simulation, animation and design of mechatronic elements and control process in the example of the mechanical assembly shop of the flexible manufacture system (FMS), which is considered a complex technical system, is set. The purpose of the work is the development of graphics-mode software that provides computer experiments of 2D, 3D designer-modeling, animation and graphic visualization of the interface for evaluating the feasibility of the design process of the flexible mechanical assembly cell (FMAC) As the main research issues, the construction of the 2D and 3D grouping scheme of the static and dynamic elements of the research object, the development of 3D software for the animation models of the activities of its active elements, and the development of the generalized software for the graphic visualization of the interface for the design of the

management system were set. Based on the issues raised, the 3D grouping scheme of static and dynamic elements of the FMAC was established, the positioning coordinates of the 2D static and dynamic elements of the FMAC were determined in the PROOF Animation system, the analysis of the technological process of the FMS was carried out to build an animation model, and the animation movements of technological operations were MOVE (management unguided movement) or PATH (guided movement) operators. An animation model of the static and dynamic active elements of the FMAC was built, experiments were conducted, and as a result, it was possible to calculate a technological cycle in the research object and determine the productivity of the workshop. The software for the graphic visualization of the design of the control system of the FMAC was developed, and the procedures and operations of each software module of the interface were planned.

SESSION A6 "INTELLIGENT POWER CONTROL SYSTEMS" **Stream 1**

Chairman: Bohos Aprahamyan Technical University of Varna, BG

Friday, October 6th 10:00 – 11:30 Hall 109TV

Exogenous Disturbance Observer-based Distributed Bipartite Consensus of Nonlinear Multiagent Systems with Multiple Time-varying Delays

Zhen Tang *Nanjing University of Aeronautics and Astronautics, CN*
Ziyang Zhen *Nanjing University of Aeronautics and Astronautics, CN*
Zhengen Zhao *Nanjing University of Aeronautics and Astronautics, CN*
Geert Deconinck *Katholieke Universiteit Leuven, BE*

Abstract: The paper tackles the leader-following bipartite consensus problem of continuous-time nonlinear multiagent systems with multiple time-varying delays and exogenous disturbances. The multiple time-varying delays are considered to be unknown and bounded, occurring in system states, nonlinear dynamics and communication networks. First, for the disturbances generated by a measurable exogenous system, an exogenous disturbance observer is designed for each nonlinear agent to observe and estimate the exogenous disturbances. Then, based on the states, communication delays and estimated exogenous disturbances, a distributed leader-following bipartite consensus protocol is proposed. According to the Lyapunov-Krasovskii method and linear matrix inequality techniques, sufficient bipartite consensus conditions are established, and the control gain and observe gain are obtained. Finally, a numerical simulation is presented to prove the effectiveness of derived results.

Estimation of Power Consumption for an Electric Vehicle Through Variable Parameter Modelling

Viktor Mashkov *Technical University of Varna, BG*
Milena Karova *Technical University of Varna, BG*

Abstract: Electric vehicles are massively gaining popularity due to their smaller environmental impact, higher energy efficiency and lower operating costs. This in turn dictates the necessity for a standardized power consumption estimation methodology for electric vehicles, based on varying driving conditions. This paper aims to create a vehicle model that transforms standardized driving cycles, which represent vehicle speed as a function of time, into a power draw cycle. The model considers mechanical effects, such as tire rolling resistance, aerodynamic drag, inertia, vehicle parameters – weight, power, torque, transmission parameters as well as tire parameters – class, pressure, and loaded height. This work presents examples of the developed model with a 2018 BMW i3 electric vehicle, and the Urban Dynamometer Driving Schedule (FTP-72, UDDS) and Inspection & Maintenance Driving Cycle (IM240).

Improving Power Quality in Shipboard Power System using a Static Synchronous Compensator: A Simulation Study

Nikolay Djagarov *"Nikola Vaptsarov" Naval Academy, BG*
Dimitar Tsvetanov *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: The present paper conducts an in-depth simulation investigation into the efficacy of a Static Synchronous Compensator (STATCOM) in power quality improvement in shipboard power systems, primarily through reactive power compensation. Unlike traditional strategies, which depend on the type, number, size, and location of the loads, this study presents a novel approach that incorporates the STATCOM directly into the Main Switchboard (MSB) busbars, thus minimizing these dependencies and enhancing overall system efficiency. Utilizing a developed mathematical model, a detailed simulation was performed to observe and analyze the power quality and synchronous generator parameters before and after the implementation of the STATCOM. The results indicated significant improvements in power quality. Moreover, an efficiency analysis showcased the potential of STATCOM as a highly effective solution for power quality improvement in shipboard power systems.

Investigation of Power Quality Using a Laboratory Experimental Setup of a Shipboard Power Plant

Nikolay Djagarov *"Nikola Vaptsarov" Naval Academy, BG*
Dimitar Tsvetanov *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: This research article investigates the power quality of ship power systems using a laboratory experimental setup of a shipboard power plant. The study focuses on analyzing the impact of power disturbances, including nonlinear and asymmetric loads, on the electrical energy supplied onboard. The laboratory experimental setup allows intentional introduction of these loads to simulate realistic operating conditions and evaluate their effects on power quality. Through simulation techniques, critical modes and parameters are

assessed, leading to recommendations for avoiding and suppressing power quality issues. The experimental results emphasize the challenges posed by nonlinear and asymmetric loads, highlighting the importance of understanding their effects on power quality in shipboard applications. The findings contribute to the overall knowledge of power quality in ship power systems, ultimately facilitating the enhancement of reliability and efficiency in marine power generation.

SESSION B6 "ARTIFICIAL INTELLIGENCE 1"	**Stream 2**
Chairman: Valeri Mladenov	Technical University of Sofia, BG
Friday, October 7th 10:00 – 11:30	Online

Multivalued Network Logic with One Real and Two Imaginary Logic Structures

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

Abstract: This paper explores and proposes a multivalued network logic in which one real and two imaginary propositional logics are created. Each of the six states of this logic has a different degree of truth. Their arrangement in a chain in descending order is carried out by the relation. In this study it is shown that developed as such the multivalued network logic satisfies the axioms of Boolean algebra and is a propositional logic. It is also proven that network configuration is a general structure in which sequential and hierarchical configuration can be implemented in it. Two Kelly tables for truthfulness are proposed for disjunction, conjunction, and negation. Possibilities for further research on network multivalued logic and its applications are presented.

Unraveling the Elements of Effective Altruistic Appeals through Machine Learning and Natural Language Processing

Sourav Yadav *Illinois Institute of Technology, US*
Sankalp Arora *Vellore institute of technology, Vellore, IN*
Akash Kumar *SRM Institute of Science and Technology,Chennai, IN*
Kaveri Verma *Manipal University,Jaipur, IN*

Abstract: In today's world, online platforms such as social media, philanthropic communities, and Q&A websites provide opportunities for people to be altruistic by donating money or answering questions without expecting anything in return. The r/Random Acts Of Pizza subreddit on Reddit is one such online community where users can post requests for free pizza while explaining their current situation, and the outcome of each request is either successful or unsuccessful. This study seeks to explore the determinants that impact the outcome of such selfless appeals. To achieve this, we propose a new model architecture that combines two models, one that deals with sparse text vectors and the other that analyzes dense features from previous works to

predict the success of a request. The study reveals that the probability estimated from the first model and the number of comments on the request post is crucial in predicting the outcome of a request.

Comparative Analysis of Different Wavelet Transforms for Noise Reduction in CT Images

Miroslav Petrov *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Abstract: A method for noise suppression in CT images is proposed. It is based on comparing the gradient fields of a pair of X-ray images of a given anatomy with identical anatomical noise. The reduction of quantum and electronic noise is carried out by using wavelet transforms that have proved to be efficient in image contour segmentation tasks. The analyzing wavelet functions of these transformations are distributions, families of functions localized at a single point or built on the basis of lifting. The approach takes advantage of the possibility to identify the structures in this pair of mutually uncorrelated images. This allows for the relevant structural information, which is essential for the diagnostic value of the CT slice, to be retained. The experimental studies performed and the quality and structural similarity measures used show that the employed wavelet transforms achieve results comparable to those previously proposed or even better. The results of the comparative analysis obtained using phantom and clinical data show that the reported improvement in the mean values of these measures is about 10%.

SESSION A7 "AI-BASED PERSONALIZED EDUCATION" **Stream 1**

Chairman: Vladimir Jotsov University of Library Studies and Information Technologies, BG

Friday, October 6th 11:30 – 13:00 Hall 109TV

The use of mobile technologies in education with an emphasis on a student-centered approach

Vladimir Jotsov *University of Library Studies and Information Technologies, BG*
Gulnar Madyarova *Al-Farabi Kazakh National University, KZ*
Zhanat Umirzakova *Al-Farabi Kazakh National University, KZ*
Aliya Akramova *Al-Farabi Kazakh National University, KZ*
Galina Tkach *Al-Farabi Kazakh National University, KZ*
Nurassyl Kerimbayev *Al-Farabi Kazakh National University, KZ*
Nurbol Beisov *Al-Farabi Kazakh National University, KZ*

Abstract: The use of mobile technologies for implementing a student-centered approach has become increasingly relevant in modern education. This article explores the possibilities and benefits of integrating mobile technologies into the educational process, with a focus on addressing students' needs and interests. The advantages of individualization of education, improvement of

access to knowledge, stimulation of interaction and expansion of educational experience are considered. Additionally, the challenges related to the necessity of training teachers and creating appropriate resources for successful integration of mobile technologies into the learning process are addressed. This approach offers new opportunities for active and effective student engagement, stimulates their creative thinking and independence, and contributes to the development of modern skills required in today's information society. In conclusion, the importance of further research and practical implementation of the student-centered approach using mobile technologies in education is emphasized, aiming to enhance the quality of learning and students' development.

Recursive Estimation Library For Education

Ivan Grigorov — *Technical University of Varna, BG*
Nasko Atanasov — *Technical University of Varna, BG*
Nikola Nikolov — *Technical University of Varna, BG*

Abstract: Adaptive control encompasses an array of strategies dedicated to real-time automated control mechanisms. It's essential that identification algorithms are executed promptly, as the intake of fresh data and the application of updated control actions must occur within a specific discretization window. In this context, we also undertake a recursive estimation library presented in this paper.

Compact EEG Features for Person Identification

Firgan Feradov — *Technical University of Varna, BG*
Todor Ganchev — *Technical University of Varna, BG*

Abstract: In the present work, we consider the opportunity for person identification from multichannel EEG signals. Specifically, we propose a method for designing compressed characteristic features representing the aggregated EEG activity for a selected period. The features are obtained as the averaged values of the relations of activity between specific EEG electrodes, using different sizes of the aggregation window. Twelve sets of these features, designed through the proposed method, were evaluat-ed in a common experimental protocol based on the well-known DEAP database to assess the practical applicability when combined with typical classifiers. The experimental re-sults validate the practical significance of the proposed method for developing intelligent HMIs

SESSION B7 “ARTIFICIAL INTELLIGENCE 2”	**Stream 2**
Chairman: Valeri Mladenov	Technical University of Sofia, BG
Friday, October 6th 11:30 – 13:00	Online

Memristor-Based Neural Network Implementation with Adjustable Synaptic Weights in LTSPICE

Valeri Mladenov — *Technical University of Sofia, BG*
Georgi Tsenov — *Technical University of Sofia, BG*
Stoyan Kirilov — *Technical University of Sofia, BG*

Abstract: The memristors are innovative electronic elements with nano-sized structure and with very good memory and switching abilities. They have very low power consumption and a good compatibility to CMOS integrated chips, and they could be used in neural networks, memories, and many other schematics. In this paper an LTSPICE model of artificial neural network with memristor-based synapses is proposed. In this network, each synapse is realized with only one memristor, thus providing a higher reduction in circuit complexity and with main benefit of that individual memristor resistance value can be adjusted with external control voltage signals. The summing and scaling component implementations are based on op-amps and memristors. We use the most common logarithmic-sigmoidal activation function and it is realized by a voltage-controlled source. The operation of the proposed memristor neural network is analyzed and simulated in both LTSPICE and MATLAB, and the derived results are compared and verified successfully. The proposed memristor-based neural network is a significant step for engineering low power complex networks in very high-density integrated circuits and chips.

Network Intrusion Detection through Classification Methods and Machine Learning Techniques

Dimitrios Simeonidis — *University of Economics - Varna, BG*
Pavel Petrov — *University of Economics - Varna, BG*
Jordan Jordanov — *University of Economics - Varna, BG*

Abstract: The field of network attacks is rapidly evolving, which makes it particularly difficult to grasp a universal picture of the problem. Intrusion detection is one of the most important tools for securing and protecting computer systems from malicious attackers by enabling detection of attacks and reducing their impact. In this research, we study the problem of cyberattacks and approach the possibility of securing computer and network communications by proposing intrusion detection approaches based on classification and machine learning mechanisms. Considering that intrusion detection is not simply a matter of predicting the most likely classification (attack-"normal" behavior), since different types of errors incur different costs, we propose the implementation of a cost-sensitive approach to intrusion detection and apply it to some well-known and efficient classification algorithms for both wired and wireless networks.

Predicting High-Resolution Maps of Atmospheric Formaldehyde Concentration Using Vision Transformers

Ryan Rad *Northeastern University, CA*

Abstract: Formaldehyde (HCHO) is one of the most significant atmospheric trace gases and a precursor of tropospheric ozone. Modelling and monitoring HCHO is essential for protecting public health, mitigating environmental impacts, regulating industrial emissions, and advancing our understanding of atmospheric chemistry. In this paper, we utilize 15 bands from several satellites to produce next month prediction maps of HCHO concentration at a high resolution. In this study, we explore the suitability of Vision Transformer-based models for the task at hand and conduct a comparative analysis of their performance with deep convolutional neural networks (CNNs) and hybrid architectures.

SESSION A8 "ARTIFICIAL INTELLIGENCE 3" **Stream 1**

Chairman: George Mengov Sofia University St. Kliment Ohridski, BG

Friday, October 6th 14:00 – 15:30 Hall 109TV

Neural Model Forecasts Macroeconomic Indicators

Iliyan Nenov *Sofia University St. Kliment Ohridski, BG*
Ralitsa Simeonova-Ganeva *Sofia University St. Kliment Ohridski, BG*
Kaloyan Ganev *Sofia University St. Kliment Ohridski, BG*
George Mengov *Sofia University St. Kliment Ohridski, BG*

Abstract: A neuro-computational AI model, implementing insights into human and animal reactions in response to abrupt changes, is employed to forecast macroeconomic indicators. In turbulent years of pandemic and war, the model achieves good accuracy on GDP, Imports, and Exports. Using only a few previous data points, it outperforms the benchmark linear-fit models. It seems that knowledge of the neural mechanism, warning an organism about an imminent danger, can help to understand the economic effects of large shocks.

Agent Irrationality in Socio-Economic Choices

Anton Gerunov *Sofia University St. Kliment Ohridski, BG*
Ilia Atanasov *Sofia University St. Kliment Ohridski, BG*
George Mengov *Sofia University St. Kliment Ohridski, BG*

Abstract: National economies are complex systems inhabited by a large number of heterogenous agents, whose expectations and behavior crucially affect system dynamics. A variety of cognitive, cultural, and ideological factors contribute to making decisions, which can be systematically sub-optimal. Here we conduct an economic experiment about the currency change from lev to euro in Bulgaria, and find that consumers have different attitudes to the process, yet

all fail to discern small hikes in prices. This effect holds irrespective of age, education, occupation, or income.

Efficient Generative Adversarial DAG Learning with No-Curl

Hristo Petkov *University of Strathclyde, UK*
Feng Dong *University of Strathclyde, UK*

Abstract: Causal structure learning from data is a challenging task as the search space is typically huge. In recent years, a series of methods have been proposed to reformulate causality learning into an optimization problem with a continuous acyclicity constraint to allow problem-solving with continuous optimization techniques. This paper further improves on the causality learning results and efficiency of the continuous optimization approach through the use of generative adversarial neural network learning, which overcomes the limitations of using maximum likelihood estimation in the existing methods. In addition, we adapt the recently proposed DAG-NoCurl framework to the generative causal structure learning to improve speed performance. In particular, our adapted method does not constrain causal structure discovery to its initial estimation, hence allowing further improvement of the learning results. The proposed method has been tested on several benchmarks to compare against the state-of-the-art.

An Algorithm for Random Tessellation using a Steppe Fire Model

Ognyan Zhelezov *"Nikola Vaptsarov" Naval Academy, BG*
Valentina Petrova *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: This paper proposes an algorithm for obtaining a random mosaic in a discrete medium by implementing an autowave process, where the boundaries of the regions in the mosaic are obtained when the wave fronts are mutually quenched by a given number of active elements, with coordinates obtained by a random number generator. The extinguishing of wave fronts (as a Steppe Fire model) is used in known algorithms to obtain a skeletal description of objects. The proposed algorithm has the advantages of autowave processes - local connections between the elements of the discrete medium and the possibility of parallel execution of operations.

SESSION B8 "INTELLIGENT DIAGNOSIS IN HEALTH CARE" **Stream 2**

Chairman: Tania Pencheva — Institute of Biophysics and Biomedical Engineering, BAS (BG)

Friday, October 6th 14:00 – 15:30 — Online

Diagnosing diseases for Prostate Cancer Prediction Using Hybrid Learning

Sathesh Abraham Leo Ebi *Kings Engineering College, IN*

Abstract: In recent years, the prevalence of prostate cancer has increased worldwide. It has been established that prostate cancer is the most commonly diagnosed cancer in men and can be considered the leading cause of cancer-related mortality in men worldwide. Diagnosing diseases is one of the greatest hurdles in medicine. This research was critical because of the lack of precise standards for assessing prostate cancer symptoms as well as the low predictive accuracy of current diagnostic approaches. It is assumed that ML (Machine Learning)approaches can be used to solve situations where there are no specific and clear rules and where the aspects affecting the event can be predicted. Computer-aided systems use this knowledge to create a wide range of solutions. In this study, the performance of different supervised ML algorithms (LR, SVC, XG Boost (XGB), AdaBoost (Ada B), LGBM, KNC, GB, RF, and DT) are compared and discussed. In this research, we collected data from Kaggle consisting of hundred cases and ten traits. In our model, we first determined the maximum accuracy for XGB, RF,and LGBM at 93.33 percent. Finally, we used GridsearchCV to enhance the performance of the classifiers via hyperparameter optimization. This time, GB as a whole as well as these three were discovered to have the greatest accuracy, which was 96.67 percent. The most notable result of this research is the development in the accuracy and consistency of the predictions. As a result, if the computer is trained to utilize ML techniques utilizing patient data, it may be therapeutically useful in accurately detecting cancers. An unwanted patient biopsy may be prevented in this manner.

Autism Spectrum Disorder Detection through Facial Analysis and Deep Learning: Leveraging Domain-Specific Variations

Anupam Agrawal — *Indian Institute of Information Technology Allahabad, Prayagraj (UP), IN*

Krishna Sai Koppula — *Indian Institute of Information Technology Allahabad, Prayagraj (UP), IN*

Abstract: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with significant implications for both individuals and society. Early detection of ASD is crucial for effective intervention and support. This study focuses on detecting Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with significant implications for both individuals and society. Early detection of ASD is crucial for effective intervention and support. This study focuses on detecting ASD using facial analysis and deep learning techniques. The primary objective is to leverage domain-specific variations by employing four different Convolutional Neural Network (CNN) architectures, including VGG16, ResNet50, SE-ResNet50, and MobileNetv2. Unlike previous research that uses the ImageNet dataset, our models are pretrained on the specialized VGGFace2 dataset. This approach enables them to capture subtle facial variations and granular, face-specific features. We compared the performance of our models with their counterparts based on the same architectures. Experimental results

demonstrate that our models consistently outperform the existing methods in terms of various metrics, including test accuracy and the Area Under the Curve (AUC). Specifically, the VGG16 model achieved a test accuracy of 0.86 and an AUC of 0.86, surpassing the performance of other studies. Similarly, the ResNet50 and MobileNetv2 models demonstrated superior performance compared to their counterparts in previous research. These findings highlight the effectiveness of leveraging domain-specific variations in facial analysis for ASD detection.

A model of a two-stage classification system for glial tumors in magnetic resonance imaging

Miroslav Petrov *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Abstract: This paper proposes a system for classifying magnetic resonance images of the brain, but it does not provide the stages of preprocessing, segmentation, etc. Its aim is to find informative and discriminating features within this limited system design that provide acceptable classification accuracy. By means of a descriptor obtained by the method of principal components, the images are divided into normal and abnormal depending on the absence or presence of a glial tumor, respectively. By adding more wavelet energy and entropy signatures during the second stage of the system's operation, the content categorization of the abnormal images of low-grade and high-grade gliomas is performed. The quality measures: F1-score and the Matthew's correlation coefficient are used to evaluate the system's performance.

Robust Intelligent System for COVID-19 Detection using CT-Scan

Ahmad Al Smadi *Zayed University, AE*

Ahed Abugabah *Zayed University, AE*

Ahmad Mohammad Al-Smadi *Balqa Applied University, JO*

Abstract: In the beginning of 2020, the world witnessed the rapid spread of the new coronavirus, COVID-19, affecting millions of people globally. However, at the outset, the availability of corona test kits was scarce, leading researchers to explore alternative detection methods. Among these methods, the COVID-19 detection approach using CT-scans emerged, and artificial intelligence (AI)-based solutions proved to offer superior outcomes. Despite the potential of AI-based models, the issue of overfitting arose, significantly impacting model performance. In response to this challenge, we present a coherent and cohesive solution in this paper, utilizing a Convolutional Neural Network (CNN)-based approach for accurate classification of COVID-19 vs. non-COVID cases. To enhance the model's robustness, we incorporated data augmentation and batch normalization techniques for regularization. To evaluate the effectiveness of our proposed model, we conducted experiments with four different data

splitting ratios (50%-50; 70%-30; 75%-25; 80%-20) for training and testing. As a result, our suggested model achieved an impressive classification accuracy of 98.56% for distinguishing between COVID-19 and non-COVID cases. These promising results highlight the efficacy of our CNN-based approach with regularization techniques. Furthermore, we conducted a comparative analysis with other deep learning-based algorithms, and our model consistently outperformed them, demonstrating its superiority in COVID-19 detection. By providing such reliable and accurate results, our proposed model contributes significantly to the ongoing efforts in combating the COVID-19 pandemic and holds the potential to aid healthcare professionals in timely and precise diagnosis.

SESSION A9 "INTELLIGENT ROBOTICS" **Stream 1**

Chairman: Andon Topalov — Technical University Sofia Plovdiv Branch (BG), BG

Friday, October 6th 15:30 – 17:00 — Online

Longitudinal Stability of Wheeled Mobile Robots - Permissible Forces and Accelerations

Stoyan Lilov — *Institute of Robotics - BAS, BG*
Vanya Markova — *Institute of Robotics - BAS, BG*
Nickolay Popov — *Institute of Robotics - BAS, BG*
Ventseslav Shopov — *Institute of Robotics - BAS, BG*

Abstract: The paper investigates the longitudinal stability of a wheeled mobile robot depending on the size of its wheel base and the size of its mass. D'Alembert's principle is used for the calculations. The results represent the limit traction/braking force and limit acceleration/deceleration, at a given wheel base length for a given mass, before the robot loses stability.

Payload Stabilization in Multidirectional Robot Motion by Applying Trajectory Analysis Algorithm and Feedback Encoders

Tsvetelina Georgieva — *University of Ruse "Angel Kanchev", BG*
Aleksandar Ivanov — *University of Ruse "Angel Kanchev", BG*
Anton Anchev — *University of Ruse "Angel Kanchev", BG*

Abstract: The paper deals with the problem of stabilizing the payload while in motion when transporting it with a robotic transport system with 4 steerable omnidirectional wheels. The focus is on the analysis of the movement trajectory using artificial intelligence and the application of feedback to stabilize the robot. The robot is set in motion along a predetermined trajectory, the upcoming trajectory is analyzed, the performed motion is optimized to correct the motion trajectory, and the feedback data from the motor encoders is analyzed. The results

of experimental studies on a prototype of a multi-directional transport robot are presented.

An application of artificial potential functions method in the robotic formation control

Vanya Markova *Institute of Robotics - BAS, BG*

Ventseslav Shopov *Institute of Robotics - BAS, BG*

Abstract: In this article, APF and RPF are applied in the field of motion control of a group of robots in formation. The influence of the coefficients of attraction and repulsion in APF has been studied. It has been established through numerical experiments and simulations that the coefficients of attraction and repulsion are of different nature. While the coefficient of repulsion has a clear minimum, which can be found by numerical experiment, the coefficient of attraction decreases the total error with increasing.

Intelligence in Human-Robot Collaboration – Overview, Challenges and Directions

Katya Madzharova *Technical University of Sofia, branch Plovdiv, BG*

Nikola Shakev *Technical University of Sofia, branch Plovdiv, BG*

Abstract: This paper presents an overview of trends in the development of modern industrial robotics. The main challenges are outlined, both to the expected and necessary new functional capabilities of the robots, and to the implementation of new technologies. Special attention is paid to human-robot interaction and the potential that collaborative robots reveal. The possibilities that the development of artificial intelligence provides are also discussed.

SESSION B9 "ADVANCED MONITORING AND MODELING IN HEALTH" — Stream 2

Chairman: Gancho Vachkov — Baku Higher Oil School, AZ

Friday, October 6th 15:30 – 17:00 — Online

Monitoring heart rate and udder surface temperature in dairy cows under heat stress conditions by infrared thermography

Hristo Hristov *Trakia University, BG*

Toncho Penev *Trakia University, BG*

Abstract: The aim of this study was to investigate the dynamics of heart rate levels and udder surface temperature in dairy cows under conditions of heat stress. Heart rate, temperature-humidity index and thermographic images were periodically measured. Surface temperatures were obtained using software. Cow data were divided into groups according to the level of heat stress. Correlation coefficients between temperature-humidity index and heart rate and between temperature-humidity index and udder surface temperatures were calculated. After that, the coefficients of determination and the rates of change of the tracked parameters

were calculated depending on the temperature-humidity index for each of the groups into which the measurement data were divided. Results show that the correlation coefficients and the rates of change of the monitored parameters increase with increasing values of the temperature-humidity index or, respectively, with increasing the heat stress. We can conclude that the surface temperature of the mammary gland of cows increases smoothly with increasing temperature-humidity index values, compared to the measured heart rate values for cows, which start to increase noticeably after the temperature-humidity index increases above 79.

Towards Enhanced Well-being: Monitoring Stress and Health with Smart Sensor Systems Muhammad Moazam Shahid

Georgina Enuwa Agada *Nottingham Trent University, UK*

Mohammed Kayyali *Nottingham Trent University, UK*

Isibor Kennedy Ihianle *Nottingham Trent University, UK*

Pedro Machado *Nottingham Trent University, UK*

Abstract: Human well-being is significantly impacted by stress, which can be caused by physical or psychological triggers. To address this, the integration of body-worn and environmental sensors can be used to monitor physiological biomarkers and predict health outcomes, especially for vulnerable persons and the elderly living independently. This paper proposes a personalized smart system that is designed to monitor and visually represent health status in order to enhance health and mental wellbeing. The proposed cloud-based system uses physiological and environmental data to detect and monitor stress in real time. The results are displayed on a dashboard, indicating stress levels. These continuous insights facilitate ongoing health monitoring and personalised thermal comfort provision for elderly individuals, enabling timely interventions in abnormal situations and ultimately improving their quality of life.

Model-free based neural network time delay estimation control for a 3-DOF ankle exoskeleton

Hao Gu *Nanjing University of Science and Technology, CN*

Yang Tian *Nanjing University of Science and Technology, CN*

Haoping Wang *Nanjing University of Science and Technology, CN*

Abstract: In order to better help the rehabilitation of patients with ankle injury, this paper proposes a 3-DOF ankle exoskeleton robot named 3DAnEn and a model-free iPDTDRN controller. 3DAnEn is easier to wear and has a larger activity angle, which can better adapt to the whole process of ankle rehabilitation. The controller integrates intelligent PD (iPD) controller, time-delay estimation (TDE) and RBF neural network. Based on the concept of hyperlocal model, the exoskeleton dynamics model and uncertainty perturbation are concentrated, and the error caused by time-delay estimation is compensated by RBF neural network,

which greatly improves the accuracy and performance of the controller. The proposed controller was co-simulated by using SolidWorks and Matlab, and compared with iPD controller and iPD-TDE controller, it was verified that the proposed controller had higher stability, faster response speed and smaller error than the traditional controller.

Intelligent Triage: Integrating Artificial Intelligence, Queuing Theory and Game Theory for Automated Patient Prioritization in Infectious Disease Wards

Angel Ivanov *Institute of Information and Communication Technologies - BAS, BG*

Abstract: The dynamic and complex nature of patient care in infectious disease wards needs innovative approaches to assessment and prioritization. This paper presents a novel method that combines Queuing Theory, Game Theory and Artificial Intelligence (AI) to address this challenge. By modeling patient interactions and resource allocation as a strategic game, and employing Deep Learning, the proposed approach automates the evaluation of patient severity and optimizes treatment prioritization. The integration of these advanced computational methods offers a robust and responsive system that enhances the accuracy, efficiency, and fairness of patient care in infectious disease departments. Extensive experiments validate the effectiveness of the approach, demonstrating significant improvements over traditional methods and paving the way for future applications in healthcare delivery.

SESSION A10 "ADVANCED ROBOTIC APPLICATION" **Stream 1**

Chairman: Nikola Shakev Technical University Sofia Branch Plovdiv, BG

Friday, October 6th 17:30 – 19:00 Online

Use of KUKA KR300 Industrial Robot in Electric Arc Furnace Operation

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

Nikolay Todorov *Stomana Engineering S. A., BG*

Alexandra Grancharova *University of Chemical Technologies and Metallurgy, BG*

Abstract: The electric arc furnace is the most important scrap recycling process. By use of electric power, the furnace melts the scrap to produce liquid steel. The furnace area has various risks for the operator's safety and using robots to automatically perform the operations is very appropriate. The main reasons for robots being widely used in many industries are the high efficiency and precision of their operations, continuity of their work process, flexibility and the possibility to function in hazardous environment. This study considers the practical implementation of an automated system for temperature sampling in an electric arc furnace by using the industrial KUKA KR 300 robot. The architecture of the KUKA robot is described as well as its four operating modes and different types

of movements of the end effector. By using the KUKA Robot Language, the robot is programmed to make temperature sampling by taking a new thermocouple from a storage system and bringing it to the electric arc furnace. Details about the hardware and the software of the robot control system are given. Practical studies show that the KUKA robot successfully performs the task for temperature measurement thus increasing the safety of the furnace operating personnel.

An Object Detection And Tracking Approach To Control Of a Mobile Agriculture Robot

Vladimir Kotev — *Institute of Mechanics - BAS, BG*
Ivan Ivanov — *University of National and World, BG*
Georgi Komitov — *Agricultural University, BG*
Georgi Stanchev — *Agricultural University, BG*
Kostadin Kostadinov — *Institute of Information and Communication Technologies - BAS, BG*

Abstract: The application of machine learning, IoT, and robotics in agriculture increases rapidly during the last years. In this paper we present a research on training of YOLOv5 algorithm for object detection in order to develop a control system of an agriculture robot for mechanical destruction of weeds. First a dataset of a cabbage and weed has been created. The dataset is consisting of three annotated sets of images: training, test and validation. Second a model is trained and evaluated. Next, bounding boxes with coordinates of weed and cabbage are obtained. Finally, we are developing an object tracker, it will assign ID to the target cabbage and weeds. In order to control the robot and its end-effector properly both are required the coordinates and ID of the each weed and cabbage.

Comparative analysis of algorithms for wheat weed recognition

Asya Toskova — *University of Plovdiv "Paisii Hilendarski", BG*
Borislav Toskov — *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: The article presents a research and comparative analysis of the performance and accuracy of several state-of-the-art Deep Convolutional Networks tasked with recognizing common weeds in the wheat field. Twelve plant species were classified using images from the publicly available V2 Plant Seedlings Dataset. Two types of networks were created and four were used for transfer learning. During the study, numerous experiments were conducted with different combinations of hyperparameters of the networks and database processing and balancing techniques were applied. The best performance was obtained with a new small CNN 18 (96%) and with a large pre-trained Inception ResNet V2 (98%).

Studying the influence of working fluid temperature on the performance of an electrohydraulic servo system in dynamic mode

Stanimir Yordanov — *Technical University of Gabrovo, BG*

Krasimir Ormandzhiev — *Technical University of Gabrovo, BG*
Georgi Mihalev — *Technical University of Gabrovo, BG*
Krasen Kostov — *Technical University of Gabrovo, BG*
Veselin Mitev — *Technical University of Gabrovo, BG*

Abstract: The paper examines the influence of the working fluid temperature on power losses in an electro-hydraulic servo system. The behavior of the system has been investigated under Proportional-Integral (PI) control at different working fluid temperatures and various control setpoints. An Adaptive PID controller has been synthesized, utilizing feedback from sensors to measure various system parameters (such as temperature, pressure, and RPM), and then adapting the parameters of the P, I, and D components of the controller based on this data to achieve optimal regulation.

SESSION B10 "ADVANCED MEASUREMENT APPLICATION 1" **Stream 2**

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

Friday, October 6th 17:30 – 19:00 — Online

Impact Evaluation of the Optical Devices for Obtaining Soil Color Characteristics

Antonina Mihaylova — *University of Ruse "Angel Kanchev", BG*
Tsvetelina Georgieva — *University of Ruse "Angel Kanchev", BG*
Plamen Daskalov — *University of Ruse "Angel Kanchev", BG*

Abstract: The color characteristics and indices of soils obtained from images by four optical devices: a camera, a document camera, a mobile phone and a colorimeter are evaluated in the paper using statistical analysis techniques. The relationships between the color characteristics are investigated and an assessment of their influence on the measured parameters of the soil - humus, pH, nitrogen, phosphorus, potassium is made. Multicollinearity of the color characteristics and indices obtained from the optical devices is avoided by choosing an independent controllable factor R'-normalized value of color characteristic R, which has a sufficiently large influence and power of the weighting coefficients and was determined as an optimally informative factor. Through correlation and variance analysis ANOVA, it was found that the optical device factor significantly affects the measurement of the color of the soil samples.

Cultivator-based soil density measurement sensor

Asparuh Atanasov — *Technical University of Varna, BG*
Svilen Stoyanov — *Technical University of Varna, BG*
Desislava Mihaylova — *Technical University of Varna, BG*

Abstract: Soil compaction is the main factor that limits the development of agricultural crops. The measurement of this density can be accomplished by

various methods. The method considered in this study is carried out together with the planned agrarian technical measures. The measurement can be carried out with a cultivator or a plow to which a strain gauge is mounted. By mounting a strain gauge on each working body, the soil cutting resistance is measured for each individual blade, resulting in a density map of the treated area. The method requires calibration of readings after installation, but is applicable to all types of tillage bodies. The results obtained give a good dependence.

An Expert System for the Diagnosis of Livestock Poisoning, Veneta Tabakova-Komsalova

Veneta Tabakova-Komsalova *University of Plovdiv "Paisii Hilendarski", BG*
Stanimir Stoyanov *University of Plovdiv "Paisii Hilendarski", BG*
Asya Stoyanova-Doycheva *University of Plovdiv "Paisii Hilendarski", BG*
Ivan Stoyanov *Institute of Information and Communication Technologies, BAS, BG*
Lyubka Doukovska *Institute of Information and Communication Technologies, BAS, BG*
Atanas Dukovski *Institute of Information and Communication Technologies, BAS, BG*

Abstract: In recent years, artificial intelligence systems have become increasingly attractive for use in agriculture. Diagnostic expert systems are designed to determine the nature of various deviations from the usual course of biological or technical processes based on a set of symptoms. Although the first diagnostic expert systems appeared in the late 60s and early 70s of the 20th century, diagnostics remains an interesting domain for artificial intelligence. In this paper, we present an expert system that aims to assist veterinarians and farmers in the diagnosis of livestock poisoning. Our preliminary studies show that due to the wide variety of poisonings and their symptoms, the diagnosis of poisonings is a particularly difficult task, and providing such a system would be useful. Furthermore, the system architecture is presented and its use is demonstrated by an example in this paper. The system is implemented by Flex and VisiRule development tools.

Simple conditioning interfaces for strain measurement

Desislava Mihaylova *Technical University of Varna, BG*
Svilen Stoyanov *Technical University of Varna, BG*
Asparuh Atanasov *Technical University of Varna, BG*
Svetlozar Zahariev *Technical University of Varna, BG*
Angel Marinov *Technical University of Varna, BG*
Kaloyan Solenkov *Technical University of Varna, BG*

Abstract: The current paper presents a review of some conventional designs of strain measuring converters including updated operational amplifiers. The use of analog components is put under revision facing issues of the needed renovation of obsolete components and system integrity according to different applications.

The sensor interfacing circuits are examined on the basis of simulation models and experimental testing. Conclusions regarding their structure and functionality are made.

SESSION A11 "INTELLIGENT COMMUNICATION"	**Stream 1**
Chairman: Ivan Garvanov	University of Library Studies and Information Technologies , BG
Saturday, October 7th 09:00 – 10:30	Online

Investigation of Underwater Packet Radio Communication at 433 MHz

Nikolai Kolev *"Nikola Vaptsarov" Naval Academy, BG*

Darin Peev *"Nikola Vaptsarov" Naval Academy, BG*

Neli Stoycheva *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: An investigation of underwater packet radio communication at 433 megahertz is carried out. A finite element method model is developed for simulation of antenna radiation in an ununiform lossy media and electromagnetic wave power levels are calculated in fresh and seawater. An experimental setup was developed, based on 433 MHz commercial radios. Power levels and radio communication packets loss in lossy water media were investigated and compared with simulation data.

Mobile application for creating and exporting geofences

Victoria Velkova *Technical University of Gabrovo, BG*

Rosen Ivanov *Technical University of Gabrovo, BG*

Abstract: This paper discusses the design and testing of a mobile application for the interactive creation of geofences in the form of polygons. The application allows the visualization of the user's position on GPS maps, the input of the polygon points used to describe each geofence, and the export at any time of the already created geofences to a MongoDB database in GeoJSON format. The Mapbox GL-JS library are used to visualize GPS maps with the user's position, as well as to enter, edit and delete geofences. By leveraging MongoDB's geospatial query capabilities, services can be developed whose logic requires checking for approaching a geofence, entering or leaving in/out of a geofence. The application is used by the authors of the paper to build a database of geofences that describe the contours of historic landmarks that are not visible on GPS street maps because only a portion of the building foundations have been preserved.

Geocodes in Geographic Information Systems

Pavel Petrov *University of Economics - Varna, BG*

Abstract: This paper examines the role of geocodes in geographic information systems. Geocoding is a technology that efficiently indexes spatial data by converting geographic coordinates into short string. Various formats are used in

geographic information systems and factors such as convenience, performance, and legacy used formats play a role in deciding which format to use. With this regard in this study, we overview the main geocoding systems and outlined their main characteristics. As a result, the geocoding systems are categorized into few categories to facilitate the process of choosing the proper geocoding systems to be used in the geographic information systems.

Drone Detection Approach Based on Radio Frequency Detector

Ivan Garvanov *University of Library Studies and Information Technologies, BG*
Denislav Kanev *University of Library Studies and Information Technologies, BG*
Magdalena Garvanova *University of Library Studies and Information Technologies, BG*
Vladimir Ivanov *Institute of Information and Communication Technologies, BAS, BG*

Abstract: The unauthorized widely used unmanned aerial vehicle UAV (drones) raises serious concerns about the security of infrastructure and people in the settlements. This expansion leads to the need for development of effective systems for their detection and classification. In this article, a drone detection approach based on the detection of the Radio Frequency (RF) emitted during the communication between the drone and its remote controller, is proposed.

SESSION B11 "AI TECHNOLOGIES BASED LEARNING 1" **Stream 2**

Chairman: Margarita Todorova — St. Cyril and St. Methodius University of Veliko Tarnovo, BG

Saturday, October 7th 09:00 – 10:30 — Online

Using Big Data and Hadoop in the Student Learning Process - Enhancing the Educational Process through Real Experience

Irena Valova *University of Ruse "Angel Kanchev", BG*

Abstract: In recent years, with the development of IoT technologies, digitization in all spheres of life, the generation of data of any nature in huge quantities, the organization, storage, processing and analysis of big data is becoming more and more relevant. Hadoop as an ecosystem provides very powerful tools for working with big data. The environment itself is free, and with the availability of appropriate hardware for its installation, familiarization with such frameworks is very useful for students. This report presents the advantages and disadvantages of using Hadoop in student education and how the use of these modern environments can improve the educational process, expand the practical skills of students and prepare them for their future professional challenges in the field of processing and analysis of big data.

Implementing Gamified Learning in University Environment

Milen Sotirov *"Nikola Vaptsarov" Naval Academy, BG*
Valentina Petrova *"Nikola Vaptsarov" Naval Academy, BG*

Donika Nikolova-Sotirova *Technical University of Varna, BG*

Abstract: This paper explores the integration of gamification in university education, driven by the rapid advancements in digital technology and the crucial need to enhance student motivation. Despite the recognized methods of gamification, its application is often perceived as complex. The study investigates the integration of game-like elements into Learning Management Systems (LMS) and their possibility to revise the academic learning experience. This study proposes a novel gamification framework to provide diverse learning styles, game elements, and student motivations. This work's contributions include the gamification framework, insights into game mechanics for education, and a comprehensive view of the opportunities and challenges of embedding gamification in LMS. The paper highlights the educational power of gamification transformation in modern academic contexts.

Prolog Education in Selected High Schools in Bulgaria

Veneta Tabakova-Komsalova *University of Plovdiv "Paisii Hilendarski", BG*

Ivan Stoyanov *Institute of Information and Communication Technologies, BAS, BG*

Laska Kostadinova-Tzankova *University of Plovdiv "Paisii Hilendarski", BG*

Atanas Dukovski *Institute of Information and Communication Technologies, BAS, BG*

Tsvetomira Ivanova *Academy of Music, Dance and Visual Arts, BG*

Abstract: 2022 marks the 50th anniversary of the logic programming language Prolog. In this regard, the authors will join the international initiative known as “Prolog Education and Thinking”. The initiative aims to acquaint students mainly with logical programming and Artificial Intelligence through the Prolog language. The article presents shortly the project called “Digital Bulgaria in Prolog”, with which we want to join the above-mentioned initiative. The main topic and the architecture of the supporting software are also presented. Furthermore, the beginning and the current state of the introduction of artificial intelligence education in two Bulgarian schools are briefly discussed.

STEM educational kit for assistance of individuals with special needs

Todor Todorov *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Pajtim Vela *University of Kadri Zeka, Gjilan, Kosovo*

Abstract: The paper presents a practical application of microcontrollers and sensors to enhance learning system and create equipment that can help individuals with special needs. Throughout this study, 26 high school students volunteered as research participants. To achieve satisfactory results, several interviews were conducted to identify some of the service needs for people with special needs. As a result, a prototype was created, in which several components were integrated to finish the equipment. Finally, is made an analysis of test results about the device performance and satisfaction of the students and teachers involved in the process.

SESSION A12 "ADVANCED PROCESS CONTROL"	**Stream 1**
Chairman: Mariela Alexandrova	Technical University of Varna, BG
Saturday, October 7th 10:30 – 12:00	Online

IEC/EN 62264 Energy-based Restriction Knapsack Optimization Scheduling for Wood Processing SME

Plamen Vasilev — *University of Chemical Technologies and Metallurgy, BG*
Tsvetelina Ivanova — *University of Chemical Technologies and Metallurgy, BG*
Yordan Belev — *University of Chemical Technologies and Metallurgy, BG*

Abstract: Modern manufacturing enterprises are constantly faced with challenges related to the imposition of international and national regulatory measures, a dynamic market for electricity and raw materials. In conditions of a liberalized electricity market and great dynamics in customer demand, it is necessary to look for solutions to optimize production planning, as a result of which to reduce extraordinary costs for electricity, surpassing the previously requested. This challenge is particularly relevant in industries with high peak loads in energy consumption, such as for example enterprises from the wood processing industry. This research represents an Advanced Planning and Scheduling solution for wood-processing SME with implemented optimization Knapsack algorithm, complying with the varying customer orders and electricity demand.

Pareto Optimal Solutions of the Minimal Cost Minimal Time Assignment Problem

Lasko Laskov — *New Bulgarian University, BG*
Marin Marinov — *New Bulgarian University, BG*

Abstract: We propose an exact algorithm for calculation of a list of all Pareto optimal solutions of a biobjective assignment problem (AP) with a linear objective function (representing a cost criterion) and a non-linear bottleneck objective function (representing a time criterion). The method, along with all needed helper functions for its implementation, is described in details.

Steady State Optimization and Model Predictive Control of a Tubular Reactor

Alexandra Grancharova — *University of Chemical Technologies and Metallurgy, BG*
Junhong Xie — *University of Chemical Technologies and Metallurgy, BG*
Jus Kocijan — *Jozef Stefan Institute, SI*

Abstract: In this paper, the steady state and dynamic optimization of a continuous non-isothermal tubular reactor is considered, where a first-order irreversible chemical reaction takes place. The reaction is exothermic and a coolant flow is continuously circulating through the reactor jacket. The control of

reactor is based on its analytical model in the spatiotemporal space. The steady state optimization of reactor aims at maximizing the product concentration at the reactor output for given inlet reagent concentration and temperature. Then, the optimal stabilization of the outlet reagent concentration and temperature at their optimal set-point values is achieved by the design of a model predictive controller. The performance of the predictive controller is studied in the presence of parametric model uncertainty (about the heat transfer coefficient) and in the presence of disturbances in the coolant temperature. The results show that the optimal control system guarantees an offset-free stabilization of the output variables despite of model uncertainty and leads to high quality transients in the presence of disturbances.

Technological Machines Diagnostics of Grain Processing Enterprises as the Object of Automation

Palvan Kalandarov — *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Shakhnoza Ubaydullayeva — *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Nikola Nikolov — *Technical University of Varna, BG*

Aziz Hayitov — *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Husen Sharifov — *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Abstract: The article gives the basic concepts of reliability, performance, durability, considers the issues of changing the technical state of the machine during operation. The models under consideration have the ability to introduce various perturbations in order to simulate physical defects, and numerical simulation on a computer made it possible to obtain solutions in the form of temporary realizations of oscillations for different states of the simulation object. The cooperative use of the full-scale method and mathematical modeling made it possible to reduce the volume of full-scale experiments and apply statistical methods of analysis in the problem of classifying the technical condition by constructing mathematical models of the probability of failure and uptime during their operating time. The content of the main types of machine states is revealed, considerable attention is paid to the issues of identifying and influencing failures and the causes of failures in the machine, the reasons for the loss of performance during operation.

SESSION B12 “AI TECHNOLOGIES BASED LEARNING 1” **Stream 2**

Chairman: Margarita Todorova — St. Cyril and St. Methodius University of Veliko Tarnovo, BG

Saturday, October 7th 10:30 – 12:00 — Online

System Tempura - a modern approach for describing and managing temporal processes in a virtual educational space

Mihail Petrov *University of Plovdiv "Paisii Hilendarski", BG*

Vladimir Valkanov *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: Temporal logic is a mathematical formalism for addressing problems related to logical constructions based on parallel and sequential processes distributed within a specific time interval. The main problem facing every mathematical theory is the approach related to the implementation and fundamental communication processes and the subsequent construction of appropriate tools to implement the logical apparatus. To date, several tools successfully deal with the described problem. Examples of such implementations are C-Tempura, Temporal Prolog, etc. The examples provide a complete implementation of temporal logic but do not provide a complete set of capabilities of modern software tools. In this article, we will present the aspects of a new software tool, System Tempura, which aims to provide a new approach to solving problems related to temporal aspects in digital information systems, addressing one of the most important aspects of modern software practices.

The Nine-Steps Gamification Process: Increasing Student Engagement in LMS

Milen Sotirov *"Nikola Vaptsarov" Naval Academy, BG*

Valentina Petrova *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: This paper explores the innovative approach of implementing gamification into Learning Management Systems to enhance student engagement and comprehension. The paper proposes the application of gamified digital learning design within the Nine-Steps Course Gamification Process to foster an immersive learning environment. The authors outline the development and deployment of a gamified learning structure within a Moodle LMS course, targeting the improvement of student involvement and educational results.

SESSION A13 "MODELING AND CONTROL OF POWER SYSTEMS" **Stream 1**

Chairman: Kamen Perev Technical University of Sofia, BG

Saturday, October 7th 13:00 – 14:30 Online

Model Predictive Control for a Single Machine Infinite Bus Power System of Full and Reduced Order

Andrey Yonchev *Technical University of Sofia, BG*

Kamen Perev *Technical University of Sofia, BG*

Abstract: In this paper we perform model predictive control for a single machine infinite bus power system of full and reduced order. The model reduction aims at facilitation of controller design and reduction of computational complexity in

investigating the considered system. The suggested method for model reduction is a two stage method where balanced realization and Legendre polynomials approximation is performed. Then model predictive control design for the considered system also is performed. A numerical experiment is presented showing that the computed responses for the single machine infinite bus power system of full and reduced order are practically the same. This fact reveals the good approximation properties of the proposed approach.

Modelling of grid-connected PV-systems using real meteorological data

Svetlozar Zahariev — *Technical University of Varna, BG*
Desislava Mihaylova — *Technical University of Varna, BG*
Angel Marinov — *Technical University of Varna, BG*
Kaloyan Solenkov — *Technical University of Varna, BG*

Abstract: This paper focuses on developing a PV-grid modelling approach accounting for the vast majority of activities and factors related to processing of raw meteorological data - estimation of GTI and internal cell temperature, creating, tuning grid connected PV power system and its MPPT control and last but not least automatic analysis of the simulated results. For verification purposes, 4 case study Matlab models were developed and simulated for 64 full days with real meteorological data- two Simulink power models accounting for size differences small(<5kWp) and medium (5-30kWp) and 2 configurations for systems with solar tracking and without. Then a third script for system energy performance analysis was created and presented.

Study of output mechanical energy, developed by a small permanent magnet direct current motor, using simulations of linear motor models

Nickolay Popov — *Institute of Robotics - BAS, BG*
Stoyan Lilov — *Institute of Robotics - BAS, BG*
Ventseslav Shopov — *Institute of Robotics - BAS, BG*
Vanya Markova — *Institute of Robotics - BAS, BG*

Abstract: Thematic is in the mechatronics and automation branches, applicable in the robotics. The article analyses: the output mechanical energy of direct-current motor at motion, as well as how it corresponds to the mechanical and electrical parameters, when they are used for a mechatronics system of a robot. The goal criterion is the maximum achievable output mechanical power. This research is applicable as a study of direct- current motor and simulative model in some experiments on mechatronics and automatics control systems.

Generation of Electricity Using Compression Piezoelectric Harvesters

Rumyana Stoyanova — *Technical University of Gabrovo, BG*
Velimira Todorova — *Technical University of Gabrovo, BG*

Dimo Kolev *Technical University of Gabrovo, BG*

Abstract: The article is discussing designs for compression piezoelectric harvesters. Experimental research is carried out to estimate the volume of the obtainable electric energy as well as the applicability of the harvester designs.

SESSION B13 "AI APPLICATION IN SOCIAL SYSTEMS" **Stream 2**

Chairman: Kamen Spasov Sofia University "St. Kliment Ohridski" (BG)

Saturday, October 7th 13:00 – 14:30 Online

A Deep Learning Wheat-Weed Dataset

Asya Toskova *University of Plovdiv "Paisii Hilendarski", BG*

Borislav Toskov *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: The article presents the Wheat-Weed Dataset - the first dataset on weeds in wheat grown on the territory of Bulgaria. The set contains 4647 unique images belonging to 7 plant species. The images are full color and annotated. To evaluate the effectiveness of the base, two deep networks with different characteristics were trained on it. The results obtained are excellent. Wheat-Weed Dataset is freely available. It is our aspiration that the provided dataset will facilitate computer vision researchers in their endeavors to train models with the capacity to discern weeds amidst common wheat crops.

Opportunities and Challenges of Using Artificial Intelligence in Energy Communities

Vitali Atias *University of Plovdiv "Paisii Hilendarski", BG*

Abstract: Energy communities are legal entities that produce, store, and sell renewable energy (RE) while also exchanging it inside the community via the public grid. They provide economic, environmental, and social advantages to the community, but they also confront enormous obstacles in anticipating, managing, and participating in energy markets. This paper explores the potential of artificial intelligence (AI) in addressing the challenges faced by energy communities. AI techniques, including machine learning (ML), deep learning (DL), fuzzy logic (FL), neural networks (NNs), and genetic algorithms (GAs), can enhance forecasting, optimization, and control of renewable energy sources (RES) and demand within energy communities. The paper discusses the concept of energy communities, the role of AI, and its applications in predicting energy generation, optimizing grid operations, managing energy storage, controlling devices, and facilitating energy trading. However, barriers such as data availability, costs, ethics, regulations, and skills gaps hinder AI adoption. Overcoming these barriers requires policy development, collaboration, data security, ethical AI use, and education. According to the research, AI could assist energy communities in developing a more sustainable and resilient energy system.

An Evaluation of Web3 Concepts and Technologies and Relation with Digital Forensics

Blerim Krasniq *Sofia University St. Kliment Ohridski, BG*

Eliza Stefanova *Sofia University St. Kliment Ohridski, BG*

Abstract: The World is experiencing a significant shift in how technology is being used and how new strategies are being developed to streamline and get around bureaucratic processes. Cannot continue without mentioning blockchain as a revolutionary decentralization concept that also serves as a foundational notion for Web3. One must admit that this is a struggle we are going through and that will continue into this new period as we add more approaches and technologies. In this study, the Web3 principles (like decentralization, trust and security, privacy and data protection), methodologies, and technologies are evaluated, along with their connections to digital forensics. Various viewpoints emphasizing the difficulties and current condition of these issues are offered. Authors discuss their viewpoints while highlighting their extensive background in digital forensics, keeping in mind that digital forensics is a relatively new profession. Based on their viewpoint's conclusions are being set. This work is currently being done by the authors as part of their research in the field of digital forensics and Web3.

SESSION A14 "ADVANCED MEASUREMENT APPLICATION 2" **Stream 1**

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

Saturday, October 7th 14:30 – 16:00 — Online

Research and Analysis of the Method for Measuring the Moisture Content of Cottonmaterials at Ultrahigh Frequencies

Palvan Kalandarov *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Khasan Turkmenov *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Shakhnoza Ubaydullayeva *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Nikola Nikolov *Technical University of Varna, BG*

Mariela Alexandrova *Technical University of Varna, BG*

Abstract: The article provides a theoretical analysis of the microwave method for measuring humidity, discusses the problems of instrumentation of the method under consideration, and proposes a scheme for an experimental setup. Loose cotton materials were chosen as objects of study. The emission of an electromagnetic wave during measurement and evaluation of the electrophysical characteristics of the materials under study in the established range is analyzed, which requires a study of functional dependence amplitude and phase shift from

the mass ratio of moisture, mathematical models for various bulk cotton materials are obtained, describing the combined effect of humidity, material density on attenuation and phase shift of the passing wave.

Automation of Technological Processes for Controlling Grain Moisture in the Flow

Palvan Kalandarov — *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Shakhnoza Ubaydullayeva — *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Rano Gaziyeva — *«Tashkent institute of irrigation and agricultural mechanization engineers» National Research University, UZ*

Nikola Nikolov — *Technical University of Varna, BG*

Mariela Alexandrova — *Technical University of Varna, BG*

Abstract: The paper deals with the problems of grain wounding requires large energy costs, requiring a multi-stage process of grain processing, installation and perfect and reliable automation systems for the storage and processing of raw materials, theoretical and experimental studies and the results of the use of the microwave method in measuring the moisture content of grain and grain materials. The method under consideration is based on the principle of selective absorption of microwave radiation energy by water in materials and its derivatives. By the degree of absorption of radiation, the concentration of moisture is judged. The paper investigates the amplitude and phase methods of the passing wave in free space. The influence of the elastic properties of the material under study on the electrical characteristics of the microwave wave, suggesting fundamentally new ways of measuring the attenuation and phase shift of the electromagnetic wave, including discrete conversion of the signal of the primary converter, which does not require rigid metrological support and the use of a phase shift, is substantiated. Information on the values of the thickness of the material is analyzed in order to correct the influence of this value, consisting of two parameters: the signal of the passing wave, the attenuation and phase shift which characterizes the humidity and the additional signal - the phase wave reflected from the front surface of the materials and carrying information about its thickness.

Compensation of the Temperature Impact on the Characteristics of a Titania-Silica Thin Film Humidity Sensor element

Stefan Ivanov — *Technical University of Gabrovo, BG*

Nedyu Nedev — *Technical University of Gabrovo, BG*

Zvezditsa Nenova — *Technical University of Gabrovo, BG*

Abstract: In the present work is investigated the influence of ambient temperature in the range of 20ºC to 50ºC under a change in relative humidity RH

of 20% up to 92% on the characteristics of a highly sensitive TiO2-SiO2-based thin-film impedance humidity sensor element prepared by the sol-gel method. The variation of sensor impedance changes in a very wide range - about 4 orders of magnitude. The sensor element is included in a measurement circuit based on an AC bridge, a variable gain amplifier, a precision rectifier, and a microcontroller with an analog-to-digital converter at its input. The use of artificial neural networks with monitoring of the ambient temperature and the measured voltage and control of the switching of the measurement ranges is proposed for the realization of the temperature compensation of the characteristics. The proposed approach allows compensating the influence of temperature and performing measurements when including humidity sensing elements with a very wide dynamic range of impedance change.

Multisensor Sunflower Oil Quality Assessment System Based on "Electronic Nose"

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*

Abstract: The current paper demonstrates the application of artificial neural networks for accurately classifying sunflower oil based on gas sensor responses. Through a cost-effective, custom-designed electronic nose with a gas sensor module, experimental data is gathered. The trained classification neural network exhibits very good precision in recognizing different classes of sunflower oil. The developed device can be used as a basis for the creation of a mobile device for recognizing the quality of food products, using gas sensors.

Letter codes of the countries

where ICAI 2023 participants are from:

AE - United Arab Emirates
AZ - Azerbaijan
BE - Belgium
BG - Bulgaria
CA - Canada
CN - China
DE - Germany
IN - India
JO - Jordan
Kosovo - Kosovo
KZ - Kazakhstan
PL - Poland
RU - Russia
SI - Slovenia
UK - United Kingdom
US - United States of America
UZ - Uzbekistan

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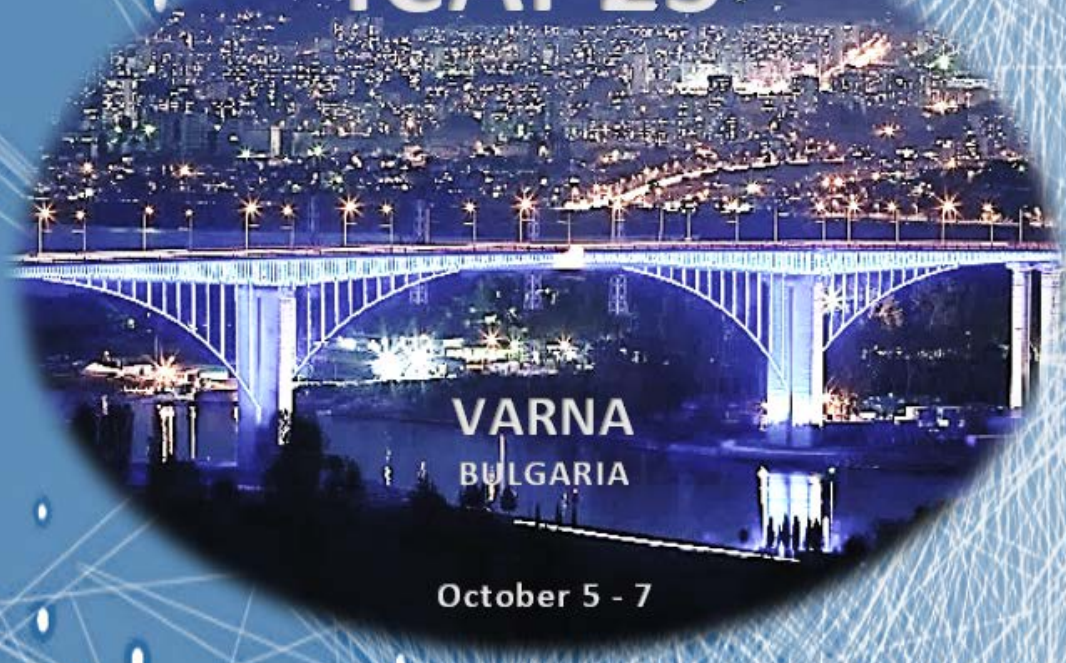

October 5 - 7

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