IEEE

@

TECHNICAL UNIVERSITY OF VARNA

John Atanasoff days

SAI

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 2022

Welcome to ICAI'2022

Dear participants,

It is a great honor and pleasure to welcome you to the International Conference Automatics and Informatics`2022 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 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'2022

CONTENTS

International program committee

Honorary Chairs:
Acad. Janusz Kacprzyk, Polish Academy of Science (PL)
Acad. Vassil Sgurev, Bulgarian Academy of Sciences (BG)
Acad. Kiril Boyanov, Bulgarian Academy of Sciences (BG)
Chair: Acad. Mincho Hadjiski, Bulgarian Academy of Sciences (BG)
Vice Chairs:
Prof. Vencislav Valchev, Technical University of Varna (BG)
Prof. Kosta Boshnakov, University of Chemical Technology and Metallurgy(BG)
Prof. Gancho Vachkov, Baku Higher Oil School (AZ)
Vice Chair for Publications: Prof. Alexander Gegov, University of Portsmouth (UK)
Vice Chair for Industry: Valeri Andreev, Systems,Automation, Technologies Ltd (BG)
Members:
Aldeniz Rashidov, Technical University of Gabrovo (BG)
Alexander Gegov, University of Portsmouth (UK)
Alexandra Grancharova, University of Chemical Technology and Metallurgy (BG)
Andon Topalov, Technical University Sofia Plovdiv Branch (BG)
Asya Stoyanova-Doycheva, University of Plovdiv (BG)
Atanas Atanassov, University of Chemical Technology and Metallurgy-Sofia (BG)
Boris Evstatiev, University of Ruse (BG)
Chrysostomos Stylios, University of Ioannina (GR)
Dessislava Petrova-Antonova, Sofia University (BG)
Dimitar Pilev, University of Chemical Technology and Metallurgy-Sofia (BG)
Emil Marinov, Technical University of Varna (BG)
Ercan Buluş, Namık Kemal Üniversitesi (TR)
Erol Uyar, Üniversitesi Elektrik Elektronik Müh. Bölümü (TR)
George Mengov, Sofia University (BG)
Georgi Ganev, Technical University of Sofia (BG)
Georgi Todorov, Veliko Turnovo University (BG)
Gergely Eugen, The University of Library Studies and Information Technologies (RO)
Grisha Spasov, Technical University Sofia Plovdiv Branch (BG)
Hristo Valchanov, Technical University of Varna (BG)
Idilia Batchkova, University of Chemical Technology and Metallurgy (BG)
Ivan Kurtev, University of Telecommunications and Posts (BG)
Javanshir Mammadov, Sumgait State University (AZ)
Jus Kocijan, Jozef Stefan Institute (SI)
Kamen Ishtev, Technical University of Sofia (BG)
Kamen Perev, Technical University of Sofia (BG)
Kamen Spassov, Sofia University (BG)
Kiril Alexiev, IICT-BAS (BG)
Kiril Tenekedjiev, University of Tasmania, Australia (AU)
Liping Fan, Shenyang University of Chemical Technology, Shenyang (CN)
Lyudmila Mihaylova, The University of Sheffield (UK)
Margarita Todorova, Veliko Turnovo University (BG)
Markos Papageorgiou, Technical University of Crete (GR)
Michail Petrov, Technical University Sofia, branch in Plovdiv (BG)
Milko Marinov, University of Ruse (BG)
Milena Lazarova, Technical University of Sofia (BG)
Natalia Nikolova, University of Tasmania, Australia (AU)
Nencho Deliiski, University of Forestry (BG)

Nicolai Christov, Université de Lille (FR)
Nikola Nikolov, Technical University of Varna (BG)
Nikola Shakev, Technical University Sofia Branch Plovdiv (BG)
Nikolay Kostov, Technical University of Varna (BG)
Olga Georgieva, Sofia University "St. Kliment Ohridski" (BG)
Petia Georgieva, University of Aveiro (PT)
Petia Koprinkova-Hristova, Bulgarian Academy of Sciences (BG)
Petko Ruskov, The University of Sofia (BG)
Petrica Vizureanu, Technical University of Iasi (RO)
Plamen Angelov, SRTI-BAS (BG)
Plamen Zahariev, University of Ruse "Angel Kanchev" (BG)
Qing-Shan Jia, Tsinghua University (CN)
Radoslav Yoshinov, Laboratory of Telematics – BAS (BG)
Radovan Madlenak, University of Zilina (SK)
Radu-Emil Precup, Politehnica University of Timisoara (RO)
Rosen Ivanov, Technical University of Gabrovo (BG)
Roumen Trifonov, Technical University of Sofia (BG)
Sevil Ahmed, Technical University of Sofia, Plovdiv Branch (BG)
Snejana Yordanova, Technical University of Sofia (BG)
Stanimir Stoyanov, University of Plovdiv "Paisii Hilendarski" (BG)
Stanimir Yordanov, Technical University of Gabrovo (BG)
Tania Pencheva, Institute of Biophysics and Biomedical Engineering, BAS (BG)
Teofana Puleva, Technical University of Sofia (BG)
Tanya Titova, University of Food Technologies-Plodiv (BG)
Teodor Iliev, University of Ruse (BG)
Todor Ganchev, Technical University of Varna (BG)
Todor Stoilov, Institute of computer and communication systems (BG)
Todorka Glushkova, Plovdiv University "Paisii Hilendarski" (BG)
Toshko Nenov, Technical University of Gabrovo (BG)
Tsonyo Slavov, Technical University of Sofia (BG)
Valeri Mladenov, Technical University of Sofia (BG)
Veselin Nachev, University of Food Technologies-Plodiv (BG)
Vladimir Hristov, Technical University of Sofia (BG)
Vladimir Jotsov, UniBit (BG)
Willian Dimitrov, University of Library Studies and Information Technologies (BG)

National organizing committee

Chair: Assoc. Prof. Nikola Nikolov, Technical University of Varna (BG)
Vice Chairs:
Prof. Valentina Markova, Technical University of Varna (BG)
Assoc. Prof. Hristo Valchanov, Technical University of Varna (BG)
Assoc. Prof. Mariela Alexandrova, Technical University of Varna (BG)
Assoc. Prof. Stanimir Yordanov, Technical University of Gabrovo (BG)
Coordinator: Dr. Zhivko Zhekov, Technical University of Varna (BG)
Members:
Assoc. Prof. Vesko Uzunov, Technical University of Varna (BG)
Assoc. Prof. Ivaylo Penev, Technical University of Varna (BG)
Dr. Dian Djibarov, Technical University of Varna (BG)
Ivan Grigorov, Technical University of Varna (BG)
Secretary: Evgenia Dimitrova, John Atanasoff Society of Automatics and Informatics (BG)

IEEE INTERNATIONAL CONFERENCE AUTOMATICS AND INFORMATICS'2022 (ICAI'22),

6 - 8 October 2022, VARNA (Technical University – Varna) (Hybrid)

http://icai-conf.org

CONFERENCE PROGRAM

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

Thursday, October 6th

Stream 1 (Auditory Hall 114M)
10.00 - 10.15 WELCOME AND OPENING CEREMONY

Stream 1 (Auditory Hall 114M)
10.15 - 10:50 PLENARY SESSION (PS)

Chairman: Kosta Boshnakov

Integration of Decision Making and Control Systems

> **Mincho Hadjiski**
> Bulgarian Academy of Sciences

10.50 - 11:00 DISCUSSION

Stream 1 (In attendance) (Track A – Hall 109TB)		Stream 2 (Online) (Track B)	Stream 3 (Online) (Track C)
11:00 – 12:30 SESSION A1 "ARTIFICIAL INTELLIGENCE 1" Chairman: Ivaylo Penev		**11:00 – 12:30 SESSION B1 "ARTIFICIAL INTELLIGENCE 2" Chairman: Gancho Vachkov**	**11:00 – 12:30 SESSION C1 "COMPUTER SCIENCE 1" Chairman: Petko Ruskov**
1. Novel Model for Hospitalization Tracking based on Smart Contracts and IoT, Hristo Valchanov and Veneta Aleksieva (1250)		**1. Intelligent Logistics at Harvest Time in Grain Production**, Vassil Sgurev, Lyubka Doukovska and Stanislav Drangajov (157)	**1. A framework of blockchain/IPFS-based platform for smart crop production,** Ivan Popchev, Doukovska Lyubka and Irina Radeva (5204)
2. Resilient Architecture Framework for Robotic Systems, Anton Hristozov, Eric Matson, John Gallagher, Marcus Rogers and Eric Dietz (4264)		**2. Using ontologies to support development of adaptive learning content**, Tatyana Ivanova (5030)	**2. An Algorithm for Generating All Subsets in Lexicographic Order**, Valentin Bakoev (7540)
3. Comparative study of two on-line learnable neural approximators of a robot inverse kinematics, Zhivko Zhekov (9195)		**3. Compositional Machine Learning Method for Computer Security Incidents Response Taxonomy Classification**, Veneta Yosifova (8609)	**3. Auditing blockchain smart contracts,** Ivan Popchev, Irina Radeva and Veneta Velichkova (9644)
4. A Methodology for Estimation of Software Architectural Complexity in Publish-Subscribe Systems, Anton Hristozov and Eric Matson (1483)		**4. Digital Twin Software Overview with Text Mining Techniques,** Georgi Kolev, Viktoria Lozeva and Elena Koleva (6459)	**4. Study of Received Signal Strength Indicator values of Bluetooth Low Energy in Test Environment and Simulation**, Aydan Haka, Yordan Yordanov, Veneta Aleksieva and Hristo Valchanov (1394)
12.30 - 14.00 LUNCH			

14:00 – 15:30 SESSION A2 "CONTROL SYSTEMS 1" Chairman: Nikola Nikolov	14:00 – 15:30 SESSION B2 "ARTIFICIAL INTELLIGENCE BASED TECHNOLOGIES 1" Chairman: Atanas Atanassov	14:00 – 15:30 SESSION C2 "COMPUTER SCIENCE 2" Chairman: Veneta Aleksieva
1. State Controller with Improved Response Speed for Linear Discrete SISO Systems, Nikola Nikolov, Mariela Alexandrova, Rano Gaziyeva and Shakhnoza Ubaydullayeva (5392)	**1. Bimodal System for Facial Emotion Recognition Based on Deep Learning Neural Networks,** Dimitar Pilev, Atanas Atanassov and Fani Tomova (7384)	**1. An improved approach of using data storage services in ASP.NET Core**, Daniel Damyanov, Zlatko Varbanov and Silviya Varbanova (7930)
2. A model-free method based on Laguerre series expansion for dynamic measurement improvement, Tsonyo Slavov, Miroslava Baraharska and Ivan Markovsky (270)	**2. Intelligent Real-Time Face Mask and Temperature Recognition Using Deep Learning on Raspberry Pi,** Oliver Simonoski, Izabela Mitreska and Ile Dimitrievski (2665)	**2. Repository Platform for RESTful Web Services,** Alexander Nikolov and Dessislava Petrova-Antonova (1565)
3. Application of a modulus and symmetrical optimum tuning methods for a cascade control system of a 2-joint planar robot, Zhivko Zhekov (5461)	**3. Validation and evaluation of models in the study of characteristic descriptors based on patients' gender,** Ginka Marinova and Maya Todorova (4525)	**3. Internet of Things–based pregnancy tracking and monitoring service,** Rosen Ivanov, Stanimir Yordanov and Dinko Dinev (2293)
4. Combined local system for joint purification of drinking water from iron and arsenic with limitation of the harmful substances level in rinse water, Gancho Ganchev and Nikola Nikolov (2164)	**4. An Overview of some popular devices and technologies designed for blind and visually impaired people,** Tihomir Stefanov, Silvia Varbanova and Milena Stefanova (3537)	**4. AutoCAD application for selecting the required materials for manufacturing machines and equipment from sheet material,** Aleksandrina Bankova, Stefan Tenev and Ismail Mehmedov Mehmedov (4131)
15.30 - 16.00 COFFEE BREAK		

16:00 – 18:00 SESSION A3 "COMPUTER TECHNOLOGIES 1" Chairman: Hristo Valchanov	16:00 – 18:00 SESSION B3 "ARTIFICIAL INTELLIGENCE BASED TECHNOLOGIES 2" Chairman: Gancho Vachkov	16:00 – 18:00 SESSION C3 "DATA PROCESSING 1" Chairman: Radoslav Yoshinov
1. Comparison of compiler efficiency with SSE and AVX instructions, Maria Pashinska-Gadzheva (2663) **2. Performance Study of MySQL and MongoDB for IoT Data Processing and Storage,** Tsvetelina Mladenova and Irena Valova (4011) **3. Android Application Prototype to Study Text Reading Speed and Comprehension,** Tsvetozar Georgiev (1847) **4. Bitcoin Price Prediction using Long Short Term Memory Neural Networks,** Soudeh Javadimasoudian, Nisha Gowda, Paras M. Kathuria and Talha Ali Khan (6292) **5. Measuring the effectiveness of blockchain smart contracts,** Alexander Panayotov and Petko Ruskov (2794)	**1. Recycling Rate in Europe: Econometric Modeling and dART Clustering Analysis,** Reni Pantcheva and George Mengov (6294) **2. Bot Development for Intelligent Automation in ERP Systems,** Radoslav Hrischev and Stela Stoykova (9309) **3. Personal Assistant Supporting Diagnosis of Livestock Poisoning,** Veneta Komsalova, Stanimir Stoyanov, Lyubka Doukovska, Ivan Stoyanov and Stoyan Cherecharov (6521) **4. Automated Music Generation using Deep Learning,** Shikhar Bhardwaj, Shalmiya Mundeth Salim, Talha Ali Khan and Soudeh Javadi Masoudian (4655) **5. Study of the characteristics, capabilities and efficiency of a system for intelligent management of the power supply of a resort complex,** Desislava Delcheva (9191)	**1. Increasing the Accuracy of Pulsar's Period Measurement by Chinese Remainder Theorem,** Vladimir Ivanov, Ivan Garvanov, Nikolay Ivanov, Magdalena Garvanova, Genka Torres and Nikola Petrov (9711) **2. A Survey of Data Quality and Processing of Information in Innovative Smart Devices,** Daniel Denev and Tsvetoslav Tsankov (7129) **3. Statistical analysis of data using LabVIEW,** Vladimira Ganchovska and Ivanka Krasteva (6738) **4. Converting color to grayscale image using LabVIEW,** Vladimira Ganchovska and Ivanka Krasteva (9186)
18.30 COCKTAIL - НУК gallery		

Friday, October 7th

Stream 1 (In attendance) (Track A– Hall 109TB)		Stream 2 (Online) (Track B)	Stream 3 (Online) (Track C)
10:30 – 12:00 SESSION A4 "ARTIFICIAL INTELLIGENCE 3" Chairman: Ventsislav Nikolov		**10:30 – 12:00 SESSION B4 "CONTROL THEORY" Chairman: Alexandra Grancharova**	**10:30 – 12:00 SESSION C4 "DATA PROCESSING 2" Chairman: Valeri Mladenov**
1. Using Machine Learning Algorithms to Improve Education Process, Vladimir Jotsov, Zukhra Abdiakhmetova, Nurassyl Kerimbayev, Aidana Berdaly and Laura Zhumakhan (4490)		**1. Distributed Model Predictive Control of Time-Delay Systems: Application to a Series of Chemical Reactors,** Alexandra Grancharova, Sorin Olaru and Ivana Valkova (9943)	**1. Biosignal measurements for Neurophysiological tests aimed to determine new beverage responses,** Stilyan Georgiev, Stanimir Andonov, Georgi Tsenov and Valeri Mladenov (1647)
2. Using the innovative I-learning platform in the education system, Nurassyl Kerimbayev, Gulnar Madyarova**,** Madina Bolyskhanova, Galina Tkach, Ivan Garvanov and Zhanat Umirzakova (4154)		**2. Adaptive Metaheuristic Moth-Flame Optimized Droop Control Method for DC Microgrids,** Elvin Yusubov and Lala Bekirova (6587)	**2. Complete Experimental Set with a Period Meter,** Desislava Mihaylova, Svilen Stoyanov and Asparuh Atanasov (2277)
3. Evaluation of cost-sensitive machine learning methods for default credit prediction, Yanka Aleksandrova and Mariya Armyanova (7040)		**3. Industrial Bound Design and Application of Fuzzy Logic PID Controller for Liquid level in Carbonisation Column,** Snejana Yordanova, Milen Slavov, Georgi Prokopiev and Desislava Delicheva (5449)	**3. Network Design for Gathering Data in Manufacturing Process,** Antoniy Petrov and Albena Taneva (6904)
4. State Of Charge Estimation in Lithium-Ion Batteries via Machine Learning, Viktor Mashkov, Milena Karova and Ivaylo Penev (5349)		**4. Robust Control of Electro-Hydraulic Servo System,** Stanimir Yordanov, Georgi Mihalev and Krasimir Ormandzhiev (4137)	**4. Process Inspection and Data Collection for Manufacturing,** Antoniy Petrov and Albena Taneva (2973)

12.00 - 13.30 LUNCH

13:30 – 15:00 SESSION A5 "SYGNAL PROCESSING" Chairman: Nikolay Kostov	13:30 – 15:00 SESSION B5 "CONTROL SYSTEMS 2" Chairman: Nikola Shakev	13:30 – 15:00 SESSION C5 "OPTIMIZATION" Chairman: Idilia Bachkova
1. List of Selected Number of Optimal Solutions of the Assignment Problem by Time Criterion, Lasko Laskov and Marin Marinov (7510)	**1. Intelligent Robotic Process Automation for Small and Medium-sized Enterprises,** Radoslav Hrischev, Stela Stoykova and Nikola Shakev (2280)	**1. Multi-Objective Optimisation of Urban Design Using a Genetic Algorithm,** Stoyan Boyukliyski, Dessislava Petrova-Antonova, Emil Hristov and Kristiyan Hristov (1312)
2. SONG Adaptive Delta Modulation Processing of PPG Signals with Motion Artifacts, Nikolay Kostov, Hristo Zhivomirov, Boris Nikolov and Stela Kostadinova (920)	**2. Overview of Industrial Communcation in Process Automation,** Nikola Petkov and Anton Naumov (1159)	**2. An Efficiency of Third Party Genetic Algorithms Software Libraries in Mobile Distributed Computing for Financial Time Series Forecasting,** Gergana Mateeva, Dimitar Parvanov, Ioan Dimitrov, Iliyan Iliev and Todor Balabanov (1930)
3. Quadcopter's telemetry parameters and their recursive estimates, Ivan Grigorov, Dian Dzhibarov and Nasko Atanasov (8861)	**3. Use of Elements and Algorithms of Intelligent Support in the Automation of Technologies for Control and Quality Management of Bulk Materials**, Polvon Kalandarov, Shakhnoza Ubaydulayeva, Rano Gaziyeva, Nikola Nikolov and Mariela Alexsandrova (3182)	**3. Metaheuristic Maximum Power Point Tracking for PV systems under Partial Shading Conditions**, Elvin Yusubov and Lala Bekirova (760)
4. Investigating the possibility of monitoring the drying in the upper soil layer by means of a drone in the Dobruja region, Asparuh Atanasov, Radko Mihaylov and Gallina Mihova (1941)	**4. IEC/EN 62264 multi-dimensional scheduling approach using ISO 22400 Key Performance Indicators,** Plamen Vasilev (5472)	**4 Finding the minimum number of disks of fixed radius needed to cover a set of points in the plane by MaxiMinMax approach,** Stefan Panov, Svetlana Panova and Atanas Garbev (8798)

15.00 - 15.30 COFFEE BREAK		
15:30 – 16:10 SESSION A6 "ADVANCED ELECTRICAL DRIVE" Chairman: Nikolay Djagarov	**15:30 – 17:00 SESSION B6 "CONTROL SYSTEMS 3" Chairman: Kosta Boshnakov**	**15:30 – 16:30 SESSION C6 "COMPUTER TECHNOLOGIES 2" Chairman: Ivan Kurtev**
1. Synchronous Reference Frame Theory Control for Current Harmonics Suppression in Ship Power System Using Shunt Active Power Filter, Dimitar Tsvetanov, Nikolay Djagarov, Zhivko Grozdev and Julia Djagarova (8100) **2. Comparative Analysis of Conventional Methods for Braking a Three-phase Induction Motor and Research on Efficient Combinations of Methods for Efficient Braking Process,** Plamen Bahov and Mariela Alexandrova (2210)	**1. Towards Achieving Thermal Comfort through Physiologically Cloud based controlled HVAC System,** Isibor Kennedy Ihianle, Pedro Machado, Kayode Owa and David Ada Adama (745) **2. Model for determining of optimal ultrasonic sensors measurement zone,** Hristo Kilifarev and Delyan Genkov (4554) **3. Energy management system based on wireless sensor networks and power line communications,** Azhar-Husain Omar, Reza Malekian and Dijana Capeska Bogatinoska (1808) **4. Design, Manufacture and Control of the Prosthetic Hand with 3D Printer,** Arbnor Pajaziti, Genta Rexha, Xhevahir Bajrami, Edvin Rustemi, Jozef Kola and Mehmet Zeqiraj (2547)	**1. Possibilities for visual programming in robotics via node-red**, Atanas Garbev (7868) **2. Video lectures management system**, Delyan Genkov, Tsvetan Raykov and Hristo Kilifarev (6152) **3. Educational technology integrating the project and problem-based approach in technical disciplines for the formation of creativity and creative thinking in engineering students,** Maya Stoeva, Petko Stoev and Denis Chikurtev (6183)

		16:30 – 18:00 SESSION C7 "APPLICATIONS" **Chairman: Nencho Deliiski**
		1. An Approach for Computing the Average Moisture Content in Batches of Wood Materials Subjected to Thermal Treatment, Mincho Hadjiski, Nencho Deliiski, Pavlin Vitchev and Dimitar Angelski (1539)
		2. Parallel Distributed Compensation for the Control of Processes in Anaerobic Organic Wastewater Treatment, Desislava Stoitseva-Delicheva and Snejana Yordanova (1292)
		3. LoRa Application for Food Monitoring – LYUTENITSA, Krassimir Kolbe, Rositsa Maksimova and Atanas Kostadinov (2039)
		4. Positioning intermodal terminals optimally along a railway line using the train differential equation of motion, Stoyo Todorov, Vladimir Popov and Matey Iliev (8250)
18.15 - 18.30 CLOSING CEREMONY - Stream 1		

SESSION A1 "ARTIFICIAL INTELLIGENCE 1"	**Stream 1**
Chairman: Ivaylo Penev	Technical University of Varna, BG
Thursday, October 6th 11.00 - 12.30	Hall 109TB

Novel Model for Hospitalization Tracking based on Smart Contracts and IoT

Hristo Valchanov   *Technical University of Varna, BG*
Veneta Aleksieva   *Technical University of Varna, BG*

Abstract: In recent years, fraud and abuse of false health care hospitalizations have become a serious problem, requiring monitoring of hospital bed occupancy. Control will increase the social, health and economic efficiency of health care costs, which in turn will improve the quality of health services. This paper proposes a new model, based on a blockchain. In this model data from sensors located in hospital beds and a fitness tracker for each patient are chronologically recorded. At the same time there are both monitoring the location of the tracker and monitoring the patient's vital signs. The smart contract sends timely signals to stakeholders when the parameters of the sensors exceed the set norms. An experimental implementation of the model on Hyperledger Fabric is presented, which proves the applicability of the model.

Resilient Architecture Framework for Robotic Systems

Anton Hristozov   *Purdue University, USA*
Eric Matson   *Purdue University, USA*
John Gallagher   *University of Cincinnati, USA*
Marcus Rogers   *Purdue University, USA*
Eric Dietz   *Purdue University, USA*

Abstract: Robotic architectures in use today provide some mechanisms for evolution but fall short of their capabilities for dynamic reconfiguration and adaptation during run-time. Adding new modes of operation, components, and connections allows for supporting the evolution of a product throughout long periods. We analyze and discuss the possibilities of performing architecture modifications on the fly without rebooting the systems since a reboot may be undesirable or impossible. For this, we rely on strict component interfaces and a component manager subsystem that can make the transition from one architecture to another while the robot is operating. Our study focuses on modern systems such as ROS2 and PX4 and assumes a publish-subscribe mechanism for communication. The ability to modify the software architecture allows for adaptive solutions that work in different environments and are less susceptible to specific attacks. Switching to a safer architecture can limit some functionality but can increase security. Working with structurally defined interfaces, we set the possibility of using COTS components that comply with our requirements to build new architectures. This can make reuse and composition easier and improve time-to-market while guaranteeing reliability and safety.

Comparative study of two on-line learnable neural approximators of a robot inverse kinematics

Zhivko Zhekov   *Technical University of Varna, BG*

Abstract: In this article are proposed two on-line learnable neural approximators of a robot inverse kinematics. Simulation research is conducted of the neural approximators working separately and simulation research is conducted of the control system working with these neural approximators. For that purpose is used a two-link planar robot.

A Methodology for Estimation of Software Architectural Complexity in Publish-Subscribe Systems

Anton Hristozov   *Purdue University, USA*
Eric Matson   *Purdue University, USA*

Abstract: Software systems are growing in complexity, and the trend is accelerating due to several forces in the industry. One of them is using more complex components that perform higher-level functions and use AI algorithms. The other is the fact that architectures are expected to be universal and versatile and to support different types of hardware platforms. Reusing third-party components makes some of the tasks more manageable, but there is not always a complete understanding of how to estimate the complexity of an architecture, especially one based on diverse components from different sources. It is not a straightforward route to come up with an objective and quantitative measure that can estimate the complexity of a particular software architecture, but it can be instrumental. Such a methodology is developed in this paper to be applied to a class of architectures for comparison, planning, and maintenance. The trend to be able to modify some architectures dynamically at runtime requires the user to have an idea of how the complexity can change when an architecture is modified. Our study focuses on publish-subscribe style architectures used mainly in the robotics industry, but the approach can be applied to any architecture with similar message delivery mechanisms and distributed components or subsystems.

SESSION B1 "ARTIFICIAL INTELLIGENCE 2"	Stream 2
Chairman: Gancho Vachkov Baku Higher Oil School (AZ)	
Thursday, October 6th 11.00 - 12.30 Online	

Intelligent Logistics at Harvest Time in Grain Production

Vassil Sgurev   *IICT Bulgarian Academy of Sciences, BG*

Lyubka Doukovska   *IICT Bulgarian Academy of Sciences, BG*

Stanislav Drangajov   *IICT Bulgarian Academy of Sciences, BG*

Abstract: This work presents an approach to optimization of the grain transportation at harvest time – an issue, which turns out to be crucial nowadays, even in global aspect. This is of great importance to big grain producers as this saves a large amount of labor force, fuel, maintenance expenses for machines etc. Here an approach is proposed for the optimization of the land transportation of many millions of tons of grain, based on solving network flow problems. The main issue in the paper is the circulation of the haulage vehicles and other machines and the optimization of the routing, i.e. minimization of the transport expenses while observing the other requirements of the process – types and quality of grain from different fields and its transportation to the respective warehouses, location of the different storehouses. A formal network flow model with constraints is presented, in which the optimization is reduced to solving a linear programming problem and the applicability of the model is demonstrated. Some directions are given in the conclusion for future research.

Using ontologies to support development of adaptive learning content

Tatyana Ivanova   *TU, TCS, BG*

Abstract: Personalization of e-learning becomes more and more valuable in the context of increasing usage of e-learning during pandemic situation. Many studies proposed adaptive learning approaches, methods, tools and systems. Adaptive learning process can be organized only when adaptive educational content have been developed. Increasing needs of development of adaptive e-learning content is important trend in e-learning resource development. In this paper we analyze adaptive e-learning content specifics and ways of development of adaptive e-learning resources. We propose a general methodology for adaptive e-learning content development making special attention to the usefulness of ontologies in this process.

Compositional Machine Learning Method for Computer Security Incidents Response Taxonomy Classification

Veneta Yosifova   *Technical University of Sofia, BG*

Abstract: Incidents handling follows developed methodologies for dealing with incidents such as: cyber-attacks, breaches in the organization's security or remediation of vulnerabilities. The number of discovered vulnerabilities increases every year requiring automation of their processing and classification. Assigning an incident automatically to an element of a classification scheme (taxonomy) will improve the response time and reduce the harmful consequences of the incident. To address these challenges, we propose a compositional ML method called CoMLCSIRT for finding adequate reflection of the classification status of an incident or vulnerability. Our model supports Triaging phase in handling security incidents, outperforms the baseline classification models and performs as well as classification made by human experts but in real-time and without delay.

Digital Twin Software Overview with Text Mining Techniques

Georgi Kolev	*University of Chemical Technology and Metallurgy, BG*
Viktoria Lozeva	*University of National and World Economy, BG*
Elena Koleva	*University of Chemical Technology and Metallurgy, BG*

Abstract: Manufacturing processes, products or services can be represented digitally by Digital Twins (DT) aiming to monitor, simulate, study, analyze and control the process, to improve the product quality, to reduce the process setting time, to improve supply chain, risk and maintenance management, the production process flexibility and reconfigurability, to shorten the product design and testing stages, to optimize the total process real-time monitoring, performance and management. In this paper an approach for making an overview of available specialized DT software by implementation of text mining tools is proposed and implemented.

SESSION C1 "COMPUTER SCIENCE 1"	**Stream 3**
Chairman: Petko Ruskov	Sofia University "St. Kliment Ohridski", BG
Thursday, October 6th 11.00 - 12.30	Online

A framework of blockchain/IPFS-based platform for smart crop production

Ivan Popchev	*Bulgarian Academy of Sciences, BG*
Lyubka Doukovska	*IICT Bulgarian Academy of Sciences, BG*
Irina Radeva	*IICT Bulgarian Academy of Sciences, BG*

Abstract: The paper presents a framework of platform SCPDx (Smart Crop Production Data Exchange) for facilitation of data provision and information sharing between parties involved in research and development of smart crop production. The framework integrates - blockchain and distributed file system technologies and is based on a private eos.io-based blockchain and private Interplanetary File System networks (IPFS). The main concepts and capabilities of the used blockchain platform and the IPFS technology are presented. There are defined the main building stages, the general infrastructures and the elements of the platform architecture. As a part of implementation are described the deployed blockchain and IPFS networks, the automated blockchain installation procedure, the developed test application with embedded file upload/download algorithm along, and a smart contract. The source code and the script files are provided on GitHub repository.

An Algorithm for Generating All Subsets in Lexicographic Order

Valentin Bakoev	*"St. Cyril and St. Methodius" University of Veliko Tarnovo, BG*

Abstract: The algorithms for generating all subsets of a given set, like many other generating algorithms, are of two main types: for generating in lexicographic order or in Gray code order. Many of them use binary representation of integers (i.e., binary vectors) as characteristic vectors of the subsets. Here we consider the set Un of n elements that are ordered according to a given total order relation. We propose the ordering of characteristic vectors and their serial numbers (i.e., their corresponding integers) such that the characteristic vectors define a lexicographic ordering of subsets of Un. To get this, we define and study the properties of three sequences: (1) pn—of all subsets in lexicographic order, (2) cn—of characteristic vectors corresponding to pn, and (3) sn—of integers representing the vectors of cn. We then propose a simple, straightforward, and fast algorithm that, for a given n, $1 \le n \le 64$, generates the sequence sn. This algorithm only performs integer additions. Its time and space complexity is of the type $\Theta(2n)$—exponential with respect to the size of the input n but linear with respect to the size of the output $2n$. The algorithm was used in the creation of sequence A356120 in the OEIS [1]. Finally, the general case where n is a positive natural number and the generation of the subsets themselves, i.e., the sequence pn, are discussed

Auditing blockchain smart contracts

Ivan Popchev — *Bulgarian Academy of Sciences, BG*

Irina Radeva — *IICT Bulgarian Academy of Sciences, BG*

Veneta Velichkova — *IICT Bulgarian Academy of Sciences, BG*

Abstract: The purpose of this paper is to present the main focus areas in smart contracts securing and to propose a procedure and a sample audit plan of an upload/download files smart contract on a blockchain-based platform designed for data and information sharing. Smart contracts and blockchain oracles definition and types are discussed and summarized. The smart contracts and blockchains securing issues and activities are systemized in four directions: code writing, security and penetration testing, blockchain security testing and vulnerability scanning tools. A five-step smart contract audit plan is suggested, adopted to the smart contract's current functional specifications and program code complexity. The audit plan is illustrated by example.

Study of Received Signal Strength Indicator values of Bluetooth Low Energy in Test Environment and Simulation

Aydan Haka — *Technical University of Varna, BG*

Yordan Yordanov — *Technical University of Varna, BG*

Hristo Valchanov — *Technical University of Varna, BG*

Veneta Aleksieva — *Technical University of Varna, BG*

Abstract: Internet of Things (IoT) technologies are actively growing and finding ever wider application in various areas of life. One of the most common and used

IoT technology in various small-sized devices is Bluetooth Low Energy (BLE). The technology has various applications, one of which is determining the location of nodes in the network based on the Received Signal Strength Indicator (RSSI) values. This paper presents an investigation of RSSI values in a real BLE network with Texas Instruments and Arduino end nodes, as well as in simulation. Based on the experiments, a comparison was made between the reported RSSI values and recommendations were formulated describing the cases in which to use the considered end nodes in a real network and the simulator.

SESSION A2 "CONTROL SYSTEMS 1"	**Stream 1**
Chairman: Nikola Nikolov	Technical University of Varna, BG
Thursday, October 6th 14.00 - 15.30	Hall 109TB

State Controller with Improved Response Speed for Linear Discrete SISO Systems

Nikola Nikolov	*Technical University of Varna, BG*
Mariela Alexandrova	*Technical University of Varna, BG*
Rano Gaziyeva	*Tashkent institute of irrigation and agricultural mechanization engineers, UZ*
Shakhnoza Ubaydullayeva	*Tashkent institute of irrigation and agricultural mechanization engineers, UZ*

Abstract: This paper presents an opportunity to create a linear discrete system (LDS) with a modal state controller for SISO objects control. The modal controller has a built-in integral component and direct connection to the system set point implemented by an equivalent object inverse model. The proposed system guarantees handling of the disturbances and providing an improvement in the system performance as in PID-controller systems. In structure proposed, an LQR state controller could be used instead of the MSC.

A model - free method based on Laguerre series expansion for dynamic measurement improvement

Tsonyo Slavov	*Technical University of Sofia, BG*
Miroslava Baraharska	*Technical University of Sofia, BG*
Ivan Markovsky	*CIMNE and ICREA Pg. Lluis Companys 23, ES*

Abstract: In this paper, a model-free method for the improvement of time-varying dynamic measurements, based on an orthogonal Laguerre model is proposed. It is appropriate in the case of well-damped measurement process. The main difference with the standard model-free method is that for modelling of measurement process instead of a specific type of FIR model an orthogonal Laguerre model is used. In this manner, the proposed method combines the advantages of model-free method and orthogonal models. As a result, the obtained measurement model is of lower order than estimated one with conventional model-free method. The online estimation of time-varying

measurement model is performed by modified linear regression model and a recursive least squares algorithm with constant trace of covariation matrix. The workability of the suggested method is confirmed by simulation of temperature estimation, which is a common problem in practice.

Application of a modulus and symmetrical optimum tuning methods for a cascade control system of a 2-joint planar robot

Zhivko Zhekov   *Technical University of Varna, BG*

Abstract: In this article is proposed 2-joint planar robot cascade control with controllers tuning by modulus and symmetrical optimum methods and feedforward component in the position loop. Accomplished simulation research confirms sufficient system performance with the tuning in this way and different operational conditions.

Combined local system for joint purification of drinking water from iron and arsenic with limitation of the harmful substances level in rinse water

Gancho Ganchev   *Technical University of Varna, BG*
Nikola Nikolov   *Technical University of Varna, BG*

Abstract: This publication addresses the problem of arsenic purification in drinking water. The damage that arsenic causes to the human body and what its maximum permissible concentration in water can be are described. A brief overview of methods for purifying drinking water from arsenic is presented. The advantages and disadvantages of different technological solutions are shown.

As a result of the analysis, an option of a combined local system for joint purification of drinking water from iron and arsenic is proposed. A technological scheme of the drinking water treatment plant is presented, the main ratios for determining the volume of water for the individual washes are derived, and an algorithm for managing the washes of the first stage of the installation is developed in order to avoid exceeding the waste water limits and to increase the life of the filter media. In conclusion, a prescription is made of which technical means the combined system can be implemented.

SESSION B2 "ARTIFICIAL INTELLIGENCE BASED TECHNOLOGIES 1"	Stream 2
Chairman: Atanas Atanassov	University of Chemical Technology and Metallurgy, BG
Thursday, October 6th 14.00 - 15.30	Online

Bimodal System for Facial Emotion Recognition Based on Deep Learning Neural Networks

Dimitar Pilev   *University of Chemical Technology and Metallurgy, BG*
Atanas Atanassov   *University of Chemical Technology and Metallurgy, BG*
Fani Tomova   *University of Chemical Technology and Metallurgy, BG*

Abstract: Current paper presents the development of bimodal system for facial emotions recognition. There are different modalities related to the human emotions. Some of them are related to the facial ones, other to the body positions and some are related to the surrounding scene or weather. Current bimodal system is based on two deep learning neural networks /DNN/. First DNN recognizes seven basic facial emotions and second DNN recognizes five weather conditions. The fusion of the results of both networks increases the accuracy of final emotions recognition. Selection of DNN for Facial Emotions Recognition /FER/ has been described in a paper [1] presented on ICAI 2020 and selection of weather condition DNN is based on the comparative analysis of existing weather condition systems, introduced in this paper. The improvement of the emotions recognition is based on possibility matrix combining the predictions of both DNNs.

Intelligent Real-Time Face Mask and Temperature Recognition Using Deep Learning on Raspberry Pi

Oliver Simonoski — *University of Information Science and Technology "St. Paul the Apostle", MK*

Izabela Mitreska — *University of Information Science and Technology "St. Paul the Apostle", MK*

Ile Dimitrievski — *University of Information Science and Technology "St. Paul the Apostle", MK*

Abstract: There has been a steady and significant growth of the advancement in computer vision systems for face masks and temperature tracking. The World Health Organization introduce strict measures to prevent the spread of the coronavirus disease. This paper attempts to create a highly accurate and real-time approach that can effectively detect non-mask trying to enforce to wear mask in order to contribute to community health. For the purpose of detecting face masks, a hybrid model combining deep and regular machine learning will be utilized. We will use OpenCV to recognize faces in real time from a live feed via the Camera module using a dataset that includes images with and without masks and send the data to the cloud for visualization and further analysis. As a main part of the solution, we proposed embedded system with tools utilizing Python, OpenCV, and Tensor Flow with using computer vision and deep learning. To make it cost efficient, quick, scalable, and effective the whole process for detection of face mask is carried out on Raspberry Pi. This project enables improved control over the information already provided and strongly points out the deployment of our method to stop the local transmission from spreading and decrease the possibility of human coronavirus disease carriers.

Validation and evaluation of models in the study of characteristic descriptors based on patients' gender

Ginka Marinova — *Technical University of Varna, BG*

Maya Todorova   *Technical University of Varna, BG*

Abstract: Cancer-related distress is the result of the psyche's reaction to the diagnosis given and to the various stressors in the development of the type of malignant disease. The spreading of the psychological distress and depression may change depending on the stage, gender, and age of the patient. Identifying gender-based distress is important for improving the work of health professionals. The results of the study of models of characteristic descriptors based on patients' sex evaluated distress by applying three methods of machine learning. This report evaluates the effectiveness of the metrics accuracy and classification error. It implemented validation of models of descriptors and the calculated correlation coefficients. The results obtained for the two metrics – accuracy and classification error – were high.

An Overview of some popular devices and technologies designed for blind and visually impaired people

Tihomir Stefanov   *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Silvia Varbanova   *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Milena Stefanova   *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Abstract: The paper describes some of the leading technologies and devices for blind people used in the past and today. Possible analogues of Braille print resources with existing electronic ones are presented. Significantly, today's users are mobile literate, leading to the design and implementation of devices that would not have been possible to use in the past. Based on research, advantages and disadvantages of technologies designed for the blind and visually impaired – in the process of using them – are summarized.

SESSION C2 "COMPUTER SCIENCE 2"	**Stream 3**
Chairman: Veneta Aleksieva Technical University of Varna, BG	
Thursday, October 6th 14.00 - 15.30 Online	

An improved approach of using data storage services in ASP.NET

Daniel Damyanov   *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Zlatko Varbanov   *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Silvia Varbanova   *St. Cyril and St. Methodius University of Veliko Tarnovo, BG*

Abstract: The work with a large number of repositories (program components used for a connection between the applications and databases) leads to a program code repetition for any separate repository. The opportunity to load them from overall repository container can reduce the code amount. In this work, we present an improved approach of using data storage services by Repository pattern and Unit of work in Entity Framework (ASP.NET Core).

Repository Platform for RESTful Web Services

Alexander Nikolov   *Paysafe Group, BG*

Dessislava Petrova-Antonova   *Sofia University "St. Kliment Ohridski", BG*

Abstract: With the growing usage of web services across the globe, a demand for advanced repositories has emerged that manage web service discovery and facilitate their use by different domains. The rapid development of mobile applications and the adoption of Internet of Things technologies and serverless computing have led to the popularity of the Representational State Transfer (REST) architecture, a preferable approach. Due to their lightweight nature, the RESTful web services area is preferable over Simple Object Access Protocol (SOAP) web services for the development of distributed applications. Thus, new approaches for the design and development of web service repositories are needed to overcome the limitations of the current web service discovery mechanisms and consider the advanced RESTful technologies. This paper addresses such a need by proposing a repository platform for RESTful web services. It supports the validation of web service definitions against OpenAPI specification, the generation of client SDKs and server stubs, the invocation of web service operations for testing purposes and the assessment of web service availability, customer support level and rating. The architecture, functionality and validation of the platform are presented, giving insight into its features, and proving its feasibility.

Internet of Things–based pregnancy tracking and monitoring service

Rosen Ivanov   *Technical University of Gabrovo, BG*

Stanimir Yordanov   *Technical University of Gabrovo, BG*

Dinko Dinev   *Technical University of Gabrovo, BG*

Abstract: This paper presents the architecture and implementation of a service for pregnancy tracking and monitoring. The main goal of the service is to analyze the behavior of pregnant women in order to proactively decide to notify medical staff when symptoms are detected that are risky for the normal pregnancy. This is achieved by (1) providing the necessary pregnancy-related information for each of the gestational weeks (nutrition, physical activity, normal and risk symptoms, necessary screening tests, etc.), (2) analysis of physical activity of pregnant women, (3) measurement and analysis of basic biological indicators using a wireless sensor network (pulse oximeter, human body temperature, biopotential channel to obtain electrocardiogram (ECG) and bioimpedance channel to measure respiration), and (4) receiving push notifications about important events related to the pregnancy; scheduled medical examinations; risk factors; and messages from the obstetrician under whose supervision the pregnant woman is. The service has a distributed architecture - it uses multiple microservices. The communication between clients (mobile app), wireless sensor network and microservices is realized through a message broker. Microservices use its own MongoDB databases

hosted in the Azure cluster. Experiments were conducted to prove the feasibility of the service on simulated wireless sensor network.

AutoCAD application for selecting the required materials for manufacturing machines and equipment from sheet material

Aleksandrina Bankova	*Technical University of Varna, BG*
Stefan Tenev	*Technical University of Varna, BG*
Ismail Mehmedov	*Technical University of Varna, BG*

Abstract: Design documentation proved to be insufficient in determining the areas of sheet metal element unfolds as well as that of machines and equipment with a predominant number of sheet metal elements. Therefore, the present study proposes an approach for determining the percentage of technological waste which can be used to increase the amount of sheet material needed in the machine detail manufacturing. Using the AutoCAD product operational characteristics, it is possible to significantly reduce a large percentage of technological waste.

SESSION A3 "COMPUTER TECHNOLOGIES 1"	**Stream 1**
Chairman: Hristo Valchanov	Technical University of Varna, BG
Thursday, October 6th 16.00 - 18.00	Hall 109TB

Comparison of compiler efficiency with SSE and AVX instructions

Maria Pashinska-Gadzheva   *Bulgarian Academy of Sciences, BG*

Abstract: In this paper, we present a comparison between the execution times of code generated by three widely used compilers for C/C++ for specific class of problems connected to our research. We juxtapose the execution time of the software compiled by clang, gcc, and msvc on Windows OS and Ubuntu OS. The software has explicit use of the SSE4.1 and AVX2 instruction sets and calculates the weight spectrum of a linear [n,k] code over the finite field GF(2). The build platform used for the projects is CMake which allows us to easily control the compilation parameters. The conclusions are made based on efficiency of the compiler.

Performance Study of MySQL and MongoDB for IoT Data Processing and Storage

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

Abstract: One of the most important moments in the development of software development is the emergence and use of databases. With the emergence of the Internet and web applications, as well as with the entry of IoT devices into literally all spheres of our lives, the amount of data that is generated and processed increases many times. The popular SQL databases cannot meet the requirements of the new volumes of data, and this necessitates the search for other solutions and the emergence of NoSQL databases. It is challenging to

compare and evaluate the two types when designing and developing software applications.

This paper presents a study and performance comparison of the two types (SQL and NoSQL) databases for data from IoT devices and sensors. Two basic operations - Insert and Select - have been tested, in different technical variants. The results show that MySQL is a suitable choice when there is a need for multiple select queries and MongoDB is suitable when there are numerous insert queries that have to be processed by the DBMS. The experiments show that a combination of both databases is an optimal solution.

Android Application Prototype to Study Text Reading Speed and Comprehension

Tsvetozar Georgiev   *University of Ruse "Angel Kanchev", BG*

Abstract: The paper examines a prototype Android application to investigate text reading speed and comprehension. The two types of reading - informative reading and reading with comprehension, the different metrics for measuring reading speed, as well as the factors affecting this speed are examined. Based on the literature analysis and analysis of existing applications, the functional requirements for such applications have been determined. The development and basic steps in working with the prototype are described. The results of two tests are shown and corresponding conclusions are drawn.

Bitcoin Price Prediction using Long Short Term Memory Neural Networks

Soudeh Javadimasoudian   *University of Europe of Applied Sciences, DE*
Nisha Gowda   *University of Europe of Applied Sciences, DE*
Paras M. Kathuria   *University of Europe of Applied Sciences, DE*
Talha Ali Khan   *University of Europe of Applied Sciences, DE*

Abstract: Cryptocurrency investment has been on trend for the last many years. Many studies have been done on cryptocurrency price prediction based on their parameters and factors. In this research, we concentrate on bitcoin as one of the well-known cryptocurrencies. In this regard, some machine learning approaches predicate the bitcoin price. Neural Networks and Recurrent Neural Networks seem great in bitcoin price prediction and relatively accurate because of their ability to work on timeseries data. In this paper, the survey on the performance of LSTM (Long Short-Term Memory), which is one of the Recurrent Neural Networks and is suitable for time-series problems, has proven it can be used for bitcoin price prediction investigation. In this paper, to fulfil this measurement task, a model has been implemented to train and test the dataset; the last year's data was only used because of the fluctuation of the price in recent years. The result shows that LSTM can predict the price remarkably with acceptable accuracy.

Measuring the effectiveness of blockchain smart contracts

Alexander Panayotov   *Sofia University "St. Kliment Ohridski", BG*
Petko Ruskov   *Sofia University "St. Kliment Ohridski", BG*

Abstract: Blockchain smart contracts have quickly become a focal point of research and development. Their autonomous, decentralized, transparent and secure nature allows for the enforcement of an agreement between multiple parties, with no need for trust as a prerequisite and no intermediaries to facilitate the relationship. However, this shift in paradigm, the significant difference with conventional software, and a variety of decentralization specifics have made the development of reliable and effective smart contracts extremely difficult. The tendency has been shown by the short, yet the turbulent history of smart contracts, full of numerous attacks, exploits, thefts, and failures. In this paper, the authors address this by proposing a formal way to evaluate the effectiveness of smart contracts. They specify the factors that impact effectiveness. First, parameters that serve as the input to a specially constructed evaluation model are identified. Then, the algorithm used by the model to calculate the effectiveness is shown. The result of this process is a special output metric called the Smart Contract Index of Effectiveness, which quantifies the level of the potential risk to the effectiveness of a smart contract. Lastly, the authors validate the model by applying it to popular smart contracts and show that it correctly classifies them as effective or not. Direction for future development of the model and further specification of its scope and accuracy is also provided.

SESSION B3	"ARTIFICIAL INTELLIGENCE BASED TECHNOLOGIES 2"	**Stream 2**
Chairman: Gancho Vachkov	Baku Higher Oil School (AZ)	
Thursday, October 6th 16.00 - 18.00	Online	

Recycling Rate in Europe: Econometric Modeling and dART Clustering Analysis

Reni Pantcheva   *Sofia University "St. Kliment Ohridski", BG*
George Mengov   *Sofia University "St. Kliment Ohridski", BG*

Abstract: In its effort to stop environmental damage, humankind has undertaken a series of steps, among which the development of circular economy is central. This practice is based on keeping resources in economic circulation as long as possible through reuse and recycling. The relatively broad scope and interpretations of the concept have led to the creation of numerous metrics to evaluate the advancement of the process. One of them, the recycling rate of solid municipal waste, has emerged as a most useful and straightforward indicator of circular performance. In this study, we conduct an econometric analysis of the circular economy in the European Union in the period 2013–2020. We find that the larger share of investment in research and development, higher resource productivity, GDP per capita, and the adoption of a landfill ban are essential factors leading to higher recycling rate. A dART clustering analysis offers additional insight into the types of circular economy in Europe.

Bot Development for Intelligent Automation in ERP Systems

Radoslav Hrischev   *Technical University of Sofia, Plovdiv branch, BG*
Stela Stoykova   *Technical University of Sofia, Plovdiv branch, BG*

Abstract: The paper presents software bot development approaches for automating the tasks of business document extraction and information extraction in a selected cloud ERP system – SAP Business Technology Platform. Three types of bots are developed: document extraction bot, document information extraction bot and conversation information extraction bot. The document extraction bot is built using an existing bot template, which is further extended to support logging of bot operations and transfer of logs by an email service. The information extraction bots are originally developed. The document extraction and document information extraction bots are connected in a bot chain for intelligent automation of business document processing. The conversation information extraction bot is deployed as a part of customer interaction service.

Personal Assistant Supporting Diagnosis of Livestock Poisoning

Veneta Komsalova   *University of Plovdiv, BG*

Stanimir Stoyanov   *University of Plovdiv, BG*

Lyubka Doukovska   *IICT Bulgarian Academy of Sciences, BG*

Ivan Stoyanov   *IICT Bulgarian Academy of Sciences, BG*

Stoyan Cherecharov   *University of Plovdiv, BG*

Abstract: This paper presents a personal assistant that is able to support veterinarians in diagnosing livestock poisoning. The assistant is implemented as an intelligent agent on top of ZEMELA platform. ZEMELA provides an infrastructure for integration of the physical and virtual worlds that can be used for development of smart agriculture applications. The architecture of the assistant is also presented in the paper. Furthermore, the assistant's operation is demonstrated by a small example.

Automated Music Generation using Deep Learning

Shikhar Bhardwaj   *University of Europe of Applied Sciences, DE*
Shalmiya Mundeth Salim   *University of Europe of Applied Sciences, DE*
Talha Ali Khan   *University of Europe of Applied Sciences, DE*
Soudeh Javadi Masoudian   *University of Europe of Applied Sciences, DE*

Abstract: Generating Music using Deep Neural Networks has been an active field of study for the past few decades. This paper discusses how to create computer-based monophonic musical content using a Recurrent Neural Network with the extension of Long Short-Term Memory. The objective of this study is to generate music that has a melodic nature to it and can be played by humans using sheet notation. In order to do so, the neural network is fed with input from the video game series: Final Fantasy. The selection of instrument is piano, which will be same for the input as well as output. The main focus of this paper is on constrained music differentiating notes from chords to help the

architecture learn to distinguish one from the other and generate music with a mix of both, thus creating a pleasant listening experience.

Study of the characteristics, capabilities and efficiency of a system for intelligent management of the power supply of a resort complex

Desislava Delcheva   *University of Mining and Geology "St. Ivan Rilski", BG*

Abstract: In this research, a comprehensive study of the system for intelligent control of the power supply system of Sunny Beach Resort was conducted. The structure, principles of management, technical possibilities and the overall concept of the system for intelligent control were analysed. Based on this, the main functions of the system for intelligent management of the power supply system of Sunny Beach Resort, such as improving the control and flexibility of the ECM of the complex, increasing the reliability, efficiency and safety of EE supplies to end users, reducing the cost of maintaining the ECM of the complex, have been determined. Various electrotechnical indicators related to the energy efficiency of the power supply system of the complex have been determined. Based on these indicators, the possibilities for streamlining the operating modes and reducing the electricity losses in the power supply system of the complex have been determined.

SESSION C3 "DATA PROCESSING 1"	**Stream 3**
Chairman: Radoslav Yoshinov	Laboratory of Telematics - BAS, BG
Thursday, October 6th 16.00 - 18.00	Online

Increasing the Accuracy of Pulsar's Period Measurement by Chinese Remainder Theorem

Vladimir Ivanov	*IICT Bulgarian Academy of Sciences, BG*
Ivan Garvanov	*IICT Bulgarian Academy of Sciences, BG*
Nikolay Ivanov	*IICT Bulgarian Academy of Sciences, BG*
Magdalena Garvanova	*IICT Bulgarian Academy of Sciences, BG*
Genka Torres	*IICT Bulgarian Academy of Sciences, BG*
Nikola Petrov	*IICT Bulgarian Academy of Sciences, BG*

Abstract: The paper addresses the problem of increasing the accuracy of determining the repetition period of a pulsar signal using the Chinese Remainder Theorem (CRT). The proposed approach can be applied in various systems that are using pulsar signals.

A Survey of Data Quality and Processing of Information in Innovative Smart Devices

Daniel Denev	*Konstantin Preslavsky University of Shumen, BG*
Tsvetoslav Tsankov	*Konstantin Preslavsky University of Shumen, BG*

Abstract: Smart devices are entering people's daily lives with full force and are aiming to largely displace laptops and PCs. At the moment, more and more

smart devices offer powerful processing, good entertainment options and work with the Internet. This article highlights data processing by the microprocessor representatives of the companies Qualcomm and Kirin. These companies are major microprocessor manufacturers and share the same perspective on microarchitecture. The First manufacturer often bets on increasing physical cores, while the other one bets more on logical cores. In this article, we discuss and compare the differences in the workflow of the selected processors.

Statistical analysis of data using LabVIEW

Vladimira Ganchovska	*University of Food technologies, Plovdiv, BG*
Ivanka Krasteva	*University of Food technologies, Plovdiv, BG*

Abstract: This article presents the implementation of statistical analysis with NI LabVIEW. Virtual instruments Standard Deviation and Variance VI and T Test VI for statistical data processing were used. A program has been created for automatic calculation of standard deviation, variance, mean/dispersion, T-test. The T-test is implemented with significance levels 0.05, 0.01 and 0.1. The created program has been tested with different numbers and values of inputs data.

Converting color to grayscale image using LabVIEW

Vladimira Ganchovska	*University of Food technologies, Plovdiv, BG*
Ivanka Krasteva	*University of Food technologies, Plovdiv, BG*

Abstract: In recent years, scientists and researchers have been working in the field of converting color images to grayscale. This color conversion is dictated by the capabilities of certain hardware or software, as well as the need to distinguish and separate certain objects in the image. This article describes the ability to convert a color image to grayscale based on extracting one of the components of an RGB, HSI, HSV, or HSL color space in LabVIEW. Image processing in LabVIEW requires converting a color (32-bit) image to a gray (8-bit) image before using certain functions.

SESSION A4 "ARTIFICIAL INTELLIGENCE 3"	**Stream 1**
Chairman: Ventsislav Nikolov Technical University of Varna, BG	
Friday, October 7th 10.30 - 12.00 Hall 109TB	

Using Machine Learning Algorithms to Improve Education Process

Vladimir Jotsov	*University of Library Studies and Information Technologies, BG*
Zukhra Abdiakhmetova	*Al-Farabi Kazakh National University, KZ*
Nurassyl Kerimbayev	*Al-Farabi Kazakh National University, KZ*
Aidana Berdaly	*Al-Farabi Kazakh National University, KZ*
Laura Zhumakhan	*Al-Farabi Kazakh National University, KZ*

Abstract: One of the main goals of any educational institution is high quality education, taking into account the shortcomings of the education system. Currently, in the field of education, one of the urgent problems is the identification of signs that affect student performance. Machine learning

algorithms are used to determine these features. Machine learning algorithms are being implemented in various spheres of society today. Giants from all over the world, such as Amazon, Google, Apple, identify customer-related problems using machine learning algorithms. In addition, a number of machine learning methods in eco- nomics, banking and medicine, manufacturing and industry can improve the work of specialists. Aiming at better performance and better understanding of the obtained results, binding models had been applied at the data selection and integration stages. The article discusses the collection of databases, learning algorithms, analysis of algorithms and the definition of features. In the research work, a database is created that includes the physiological and psychological characteristics of students. The program is executed in the Python programming environment. Predictions are based on databases with machine learning algorithms. Lin- ear regression methods, the Support Vector Machine method and Random Forest are used, and work is devoted to determine the best algorithm. Algorithms are evaluated using regression evaluation metrics. The results of the study provide the best algorithm and the necessary marks for individual academic performance.

Using the innovative I-learning platform in the education system

Nurassyl Kerimbayev	*Al-Farabi Kazakh National University, KZ*
Gulnar Madyarova	*Al-Farabi Kazakh National University, KZ*
Madina Bolyskhanova	*Al-Farabi Kazakh National University, KZ*
Galina Tkach	*Al-Farabi Kazakh National University, KZ*
Ivan Garvanov	*University of Library Studies and Information Technologies, BG*
Zhanat Umirzakova	*Al-Farabi Kazakh National University, KZ*

Abstract: Today, due to the rapid development of digital technology, every teacher has the opportunity to competently form their own educational resources. The number of platforms, services, sites, special courses, allowing to offer educational resources is growing in the market. Creation of competitive educational resources and their wide distribution is one of the urgent problems of today. In this article we will analyze open educational resources offered for mass use, identify the most widely used topics and demand for them, and explore directions for development. To this end, search services and open educational resources of the Internet will be available. The results of the study identified two main areas: first, the fact that teachers need proper training and professional development in relation to online learning to successfully meet the requirements for learning in an online environment. The results of this study showed that the main goal of the innovation process is the renewal of education, the optimal use of new technologies, the study of Innovative Learning gave relatively new results. Secondly, to determine the impact of educational resources to improve the quality of learning, it is necessary to introduce a form of assessment of student achievement according to their cognitive level in order to measure learning outcomes. It is also very important for the teacher to use a common assessment

form to track progress in the virtual environment. The results confirm the idea of the theory of conceptual self-improvement, for effective organization of innovative learning teachers need appropriate professional development. The results of this study can improve the experience of using the educational environment on the Internet with the help of an innovative platform I-learning.

Evaluation of cost-sensitive machine learning methods for default credit prediction

Yanka Aleksandrova   *University of Economics - Varna, BG*

Mariya Armyanova   *University of Economics - Varna, BG*

Abstract: Peer-to-Peer lending market has grown rapidly during the recent years. This alternative finance business model gives many advantages for all participants - investors, borrowers, and internet-based Peer-to-Peer lending platforms. However, the risk arising from defaulted credits should not be underestimated as this is one of the main concerns for investors and platforms. Machine learning algorithms are successfully used to predict the credit risk in the process of credit approval, but for better decision making they should consider the highly imbalanced nature of the data and misclassification costs associated with wrong predictions. The purpose of this research paper is to explore different techniques for dealing with imbalanced datasets and different misclassification costs related to the target classes. We propose a set of measures to evaluate model's performance both in term of accuracy and profit optimization. Our approach is implemented on real dataset from the Lending Club company. We use case-based data about the profit and loss for every loan and calculate more precisely the misclassification costs. Cost-sensitive models are trained using extremely gradient boosted decision trees (XGBoost) with hyperparameters optimization. Empirical results show that cost sensitive XGBoost model with weights derived from the cost matrix gives and threshold adjustment best results both in terms of accuracy and profit optimization.

State Of Charge Estimation in Lithium-Ion Batteries via Machine Learning

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

Abstract: Accurate State of Charge estimation is crucial for rationing the energy usage of lithium-ion batteries. The goal of this paper is to showcase different machine learning techniques for State of Charge modeling. Different Support Vector Machine (SVM) and Deep Neural Network (DNN) models were trained and tested on the NASA Battery dataset. Our models take into account battery voltage, load voltage and battery temperature and can be applied for online State of Charge estimation.

SESSION B4 "CONTROL THEORY"	**Stream 2**

Chairman: Alexandra Grancharova	University of Chemical Technology and Metallurgy, BG
Friday, October 7th 10.30 - 12.00	Online

Distributed Model Predictive Control of Time-Delay Systems: Application to a Series of Chemical Reactors

Alexandra Grancharova	University of Chemical Technology and Metallurgy, BG
Sorin Olaru	Centrale Supélec-CNRS-Université Paris-Sud, Université Paris-Saclay, FR
Ivana Valkova	University of Chemical Technology and Metallurgy, BG

Abstract: In this paper, an approach to distributed model predictive control (MPC) of linear interconnected time-delay systems is proposed. The particular case of distributed control of a series of chemical reactors is considered. The distributed MPC design includes representation of the interconnected time-delay dynamics in the augmented state space and finding a suboptimal solution of the Quadratic Programming problem resulting from the centralized MPC formulation. The proposed approach would be appropriate for embedded distributed MPC of time-delay systems and is illustrated on a simulation example of series of two chemical reactors with recycles.

Adaptive Metaheuristic Moth-Flame Optimized Droop Control Method for DC Microgrids

Elvin Yusubov	Azerbaijan State Oil and Industry University, AZ
Lala Bekirova	Azerbaijan State Oil and Industry University, AZ

Abstract: This paper presents an adaptive droop control strategy by using the metaheuristic moth-flame optimization technique to achieve near-optimal power and current sharing with minimal voltage deviation between DC-DC converters in a DC microgrid. One of the major control problems present in DC microgrids is unequal load current sharing due to the non-ideal converter properties and parasitic resistances which increases the stress levels on DC-DC converters thereby reducing their efficient lifetime. Conventional, non-adaptive droop control methods are employed to balance the load currents between the converters by changing the voltage reference proportionally. Another major issue with these strategies is the cause of voltage deviation to balance the load currents. Although these conventional methods are quite popular and simple to implement, their robustness reduces under dynamic voltage and load current changes. To confront these issues, a droop control method whose droop gains are adaptively adjusted to balance the output currents while maintaining the voltage within acceptable ranges. Simulation results demonstrate the superiority of the proposed approach over the traditional strategies.

Industrial Bound Design and Application of Fuzzy Logic PID Controller for Liquid level in Carbonisation Column

Snejana Yordanova	Technical University of Sofia, BG
Milen Slavov	"Solvay Sodi" SA, BG

Georgi Prokopiev   *"Solvay Sodi" SA, BG*
Desislava Delicheva   *Technical University of Sofia, BG*

Abstract: A novel approach for the design of a fuzzy logic controller (FLC) is suggested in order to improve the control of the liquid level in a carbonisation column for soda ash production. It considers the impact of the industrial environment and the signals, equipment, programmable logic controller (PLC) and real time control restrictions. A PID FLC is designed with inputs the system error and the rate of level computed via sliding average to smooth the reference step response and reduce disturbances and noise impact. The defuzzyfication is simplified and the control effort decreased assigning proper output singletons. The pre- and PI post-processing parameters are tuned in an off-line genetic algorithms based minimization of a novel fitness function of the system error and the control variance for prolonging actuator's and valve's lifetime. The FLC is implemented in a general purpose PLC. The real time level control shows an improved system performance.

Robust Control of Electro-Hydraulic Servo System

Stanimir Yordanov   *Technical University of Gabrovo, BG*

Georgi Mihalev   *Technical University of Gabrovo, BG*

Krasimir Ormandzhiev   *Technical University of Gabrovo, BG*

Abstract: An attempt to synthesize a robust control of an electro-hydraulic tracking system is discussed in the paper. Object nonlinearity is represented by an equivalent linear model in a state space with unstructured uncertainty. Some of the imprecisely known parameters are introduced as sources of structured uncertainty. An H∞ synthesis of a regulator has been attempted and simulation experiments have been carried out with the nonlinear model. The results of the simulation of the system with the proposed robust controller are compared with the data obtained when controlling the real system with a built-in PI controller. Transient analysis shows improved performance and stability in the operation of the electro-hydraulic system compared to that with PI control under the same operating conditions.

SESSION C4 "DATA PROCESSING 2"	**Stream 3**
Chairman: Valeri Mladenov	Technical University of Sofia, BG
Friday, October 7th 10.30 - 12.00	Online

Biosignal measurements for Neurophysiological tests aimed to determine new beverage responses

Stilyan Georgiev   *Visteon Electronics Bulgaria, BG*
Stanimir Andonov   *Technical University of Sofia, BG*
Georgi Tsenov   *Technical University of Sofia, BG*
Valeri Mladenov   *Technical University of Sofia, BG*

Abstract: The main aim of this work is to present a test methodology framework for neuromarketing evaluation of drinks and tastes by obtaining statistically significant conclusions from test focus groups neurophysical reaction. In the past decade there was high rise of affordable and easy to use sensors for biosignal measurements, that provide data in real time at any place. This is the case for electroencephalographic signals (EEG) that can be measured from the human skull and galvanic skin response (GSR) and pulse, that can be measured from a finger. The human brain activity and neurophysiological reaction to external stimuli can be measured and represented to some extent with EEG, GSR and pulse. With feature extraction from the raw signals and detection of informative features that are user independent, we can perform simple classifications process and apply the measured brainwaves in variety of applications. In this paper we present the application of EEG brainwaves, paired with GSR and pulse for recognition of the degree of response variation in a test group in order to determine the test group preferences.

Complete Experimental Set with a Period Meter

Desislava Mihaylova   *Technical University of Varna, BG*

Svilen Stoyanov   *Technical University of Varna, BG*

Asparuh Atanasov   *Technical University of Varna, BG*

Abstract: The study describes a multitask platform composed for measuring purposes. The elaborated system is applied for observation and control of time-dependent parameters obtained from a strain gauge transducer. It consists of hardware and software components intended, on one side, to transfer effectively the primary information from the sensor with a period meter as transducer, and on the other hand, to demonstrate the methods used by microcontrollers in accessing the important parameters of a type of pulse-width-modulated signal. The software part is based on time-interrupt handles and Graphical User Interface. In this way, the constructed experimental set represents the contemporary techniques of processing sensor data.

Network Design for Gathering Data in Manufacturing Process

Antoniy Petrov   *Technical University of Sofia, Plovdiv branch, BG*

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

Abstract: Many network specifications are open and vendor independent of industrial communication systems. The goal of this work is to design and present industrial network for gathering predefined data of manufacturing process. The new here is the network structure and its application in industrial area, gathering data and its representation. In this way the process can be observed, the optimized control strategy can be found and the maintenance of the equipment can be done. The key elements in industrial network designing are: the choice of proper communication protocol or set of protocols depending

on selected equipment; the proper physical connection depending on the protocol and infrastructure requirements. Industrial network creation allows not only to collect all necessary data but further usage of it for calculation, presentation and reflects to it robustness. Hence the article is useful for the upcoming Industry 4.0, which needs and proceeds of such solutions.

Process Inspection and Data Collection for Manufacturing

Antoniy Petrov   *Technical University of Sofia, Plovdiv branch, BG*

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

Abstract: Manufacturing systems of the future will be characterized by the individualization of products, early detection, diagnosis of faults, forecast of equipment damage, loss of performance and profits and even more. Nowadays, based on informatics evolution and its application in industrial area, the so-called Smart Manufacturing (SM) has promised to ensure self-optimizing manufacturing in industry by its potential such as maintaining reliability of equipment. For this purpose, in this article the benefits and challenges of self-optimizing manufacturing concept regarding its capability and responsibility are presented describing the adaptation to changing manufacturing environment. The idea of the work is to obtain data, needed for Key Performance Indicators (KPIs) calculation, then to apply IIoT solutions for collecting, visualizing and store the information for further analysis. The major and desired effects are: the time decrease for decision taking, product quality improvement, delivery on time and product cost.

SESSION A5 "SYGNAL PROCESSING"	**Stream 1**
Chairman: Nikolay Kostov Technical University of Varna, BG	
Friday, October 7th 13.30 - 15.00 Hall 109TB	

List of Selected Number of Optimal Solutions of the Assignment Problem by Time Criterion

Lasko Laskov   *New Bulgarian University, BG*

Marin Marinov   *New Bulgarian University, BG*

Abstract: In this paper we present a solution of the assignment problem with an algorithm with complexity $O(n^{9/2})$. The discussed algorithm allows an effective approach for generation of a list of selected number of optimal solutions of this problem. If it is predefined that the list does not contain more than n_0 number of optimal solutions, then the proposed algorithm has complexity $\tilde{n}O(n^{9/2})$, where $\tilde{n} = \min\{n_0, n_1\}$ with n_1 being the number of perfect matchings in the graph. The method is based on the Hopcroft-Karp algorithm for maximum matching in a bipartite graphs.

SONG Adaptive Delta Modulation Processing of PPG Signals with Motion Artifacts

Nikolay Kostov	*Technical University of Varna, BG*
Hristo Zhivomirov	*Technical University of Varna, BG*
Boris Nikolov	*Technical University of Varna, BG*
Stela Kostadinova	*Technical University of Varna, BG*

Abstract: In the present paper, we study the performance of a signal compression algorithm via SONG adaptive delta modulation (SADM) applied on photoplethysmogram (PPG) signals affected by disturbances in terms of motion artifacts (MA) with different intensity. The study is a logical extension to a previously published paper by the authors where the SADM is tested on regular PPG signals. For the current study, the PPG signals with MA are taken from a freely accessible database so all experiments are fully reproducible. The quality of the SADM applied on the PPG signals with different intensity of MA and sampling rates is evaluated in terms of signal-to-noise ratio and percentage root-mean-square difference. In the end, the achieved compression is assessed and conclusions are made regarding the ratio and quality of the compression.

Quadcopter's telemetry parameters and their recursive estimates

Ivan Grigorov	*Technical University of Varna, BG*
Dian Dzhibarov	*Technical University of Varna, BG*
Nasko Atanasov	*Technical University of Varna, BG*

Abstract: Real-time automated control often is handled by a group of methods collectively referred to as adaptive control. Many identification criteria must be met in real time. This is because new data must be submitted and new control measures implemented during a single discretization period. A real time recursive estimation of quadcopter telemetry parameters is performed in this paper.

Investigating the possibility of monitoring the drying in the upper soil layer by means of a drone in the Dobruja region

Asparuh Atanasov	*Technical University of Varna, BG*
Radko Mihaylov	*Technical University of Varna, BG*
Gallina Mihova	*Dobrudhza Agriculture Institute, BG*

Abstract: The possibility of monitoring the moisture in the upper soil layer by means of an unmanned aerial vehicle (UAV) was investigated. The dynamics of change of NDWI index according to data from terrestrial weather stations was determined. The dependencies between the various factors were analyzed. The moisture content of the topsoil shows a good correlation with the data obtained from the NDWI index. Through regression analysis, the tendency of the dependence of the NDWI index on meteorological data has been proven, as well as which of the factors have significance in the regression model.

| SESSION B5 "CONTROL SYSTEMS 2" | **Stream 2** |

Chairman: Nikola Shakev   Technical University of Sofia, Plovdiv branch, BG

Intelligent Robotic Process Automation for Small and Medium-sized Enterprises

Radoslav Hrischev   *Technical University of Sofia, Plovdiv branch, BG*

Stela Stoykova   *Technical University of Sofia, Plovdiv branch, BG*

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

Abstract: The paper presents two bot chains for integrating intelligent robotic process automation in purchase order processing and sales order creation, realized in SAP Business Technology Platform. The activities involved in purchase order processing and sales order creation are automated by deploying software bots in the existing ERP system of the enterprise. A comparison is made between a predefined software bot chain and an original bot chain solution. A use case scenario quantifying the business value of integrating intelligent robotic process automation in small and medium-sized enterprises is developed.

Overview of Industrial Communcation in Process Automation

Nikola Petkov   *Technical University of Sofia, BG*

Anton Naumov   *Technical University of Varna, BG*

Abstract: The industrial world is facing a dramatic challenge environment with the respect of more and more limited resources. Digital transformation (DT) is a key process for all industries and markets these days. It comprises the complete processes starting from planning of products and production process till the actual production of the products and its export to the end customers. Innovations available behind Industry 4.0 bring us to a new level of products and solutions developments in the industries. Some of the key benefits of digitalization process are increased efficiency and productivity, faster "time-to-market", better utilization of resources, increased business flexibility and agility. In addition, a new set of opportunities appears as greater innovations, new business models, better customer experience, data driven customer insights, etc. In the bases of all processes is the real time data collection and data exploration. That is why data infrastructure is essential for DT. This paper gives an overview of industrial communication used in Process Automation systems, challenges, practical automation network topologies and technology outlook. Topics like redundant topologies for process automation systems, typical network protocols and industrial security and are also addressed in the paper.

Use of Elements and Algorithms of Intelligent Support in the Automation of Technologies for Control and Quality Management of Bulk Materials

Polvon Kalandarov   *Tashkent institute of irrigation and agricultural mechanization engineers, UZ*

Shakhnoza Ubaydulayeva   *Tashkent institute of irrigation and agricultural mechanization engineers, UZ*

Rano Gaziyeva	*Tashkent institute of irrigation and agricultural mechanization engineers, UZ*
Nikola Nikolov	*Technical University of Varna, BG*
Mariela Alexandrova	*Technical University of Varna, BG*

Abstract: The article deals with the choice of criteria for efficiency, applicability in measuring technology, analytical and construction, on the basis of which a methodology for assessing the quality of structures of measuring devices of moisture of materials of the agro-industrial complex is proposed. The standard deviation of the random error characterizing the accuracy of measurements is shown. A complex efficiency criterion is discussed, including the dominant particular parameters: accuracy, reliability, cost, allowing to solve the problem of optimal design of humidity control devices for the materials under consideration. As an optimal option, a differential measuring device is analyzed, which practically eliminates random and systematic errors and makes it possible to design a multiparameter measurement method that considers the features of a heterogeneous environment, such as bulk grain materials of the agro-industrial complex.

IEC/EN 62264 multi-dimensional scheduling approach using ISO 22400 Key Performance Indicators

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

Abstract: The task of reliable planning of operations in a manufacturing enterprise is crucial for the competitiveness of the enterprise in the market. The elaboration of schedules, depending on the workload and in coordination with all activities is part of the activities of operational management and is defined in the IEC/EN 62264 standard. The approach of how it may be realized in a MES/MOM system with advanced planning and scheduling functions, what is the impact of scheduling and data collection in the performance analysis. A simplification and interpretation of some important Key Performance Indicators like Overall Equipment Effectiveness (OEE) and Net Equipment Effectiveness (NEE) indexes, are a matter of this work.

SESSION C5 "OPTIMIZATION"	**Stream 3**
Chairman: Idilia Bachkova	University of Chemical Technology and Metallurgy, BG
Friday, October 7th 13.30 - 15.00	Online

Multi-Objective Optimisation of Urban Design Using a Genetic Algorithm

Stoyan Boyukliyski	*Sofia University, GATE Institute, BG*
Dessislava Petrova-Antonova	*Sofia University, GATE Institute, BG*
Emil Hristov	*Sofia University, GATE Institute, BG*
Kristiyan Hristov	*Sofia University, GATE Institute, BG*

Abstract: In the current fast-growing cities, urban planners are continually required to optimize city designs to improve the urban environment whilst meeting ever more stringent regulations. Thus, the demand for optimization is increased continuously. However, real-world optimization problems often have a large search space and have objective functions with many conflicting objectives that are expensive to evaluate. The decision-making process to select a solution is equally demanding. These difficulties could be relieved by tools supporting the urban planners and decision-makers throughout the entire process of urban planning. This paper aims to show the potential and share insight gained using a genetic algorithm in such a problem area. It proposes an approach for parametric urban design at a neighbourhood level that optimizes the buildings' ground floor area (GFA) and green area in relation to the demography of the population. The approach is based on dynamic parameters such as demography, and urban morphology, which are linked to people's needs rather than fixed rules. It is automated in a tool implemented using a nondominated sorting genetic algorithm (NSGA-II). The tool proves to be useful for urban planning when decisions influencing the development of the city for a long time are taken.

An Efficiency of Third Party Genetic Algorithms Software Libraries in Mobile Distributed Computing for Financial Time Series Forecasting

Gergana Mateeva *IICT Bulgarian Academy of Sciences, BG*

Dimitar Parvanov *IICT Bulgarian Academy of Sciences, BG*

Ioan Dimitrov *Technical University of Sofia, BG*

Iliyan Iliev *IICT Bulgarian Academy of Sciences, BG*

Todor Balabanov *IICT Bulgarian Academy of Sciences, BG*

Abstract: Genetic algorithms are very well-known optimization meta-heuristics. They are very well presented in mathematical applications like Matlab, R, and others. Such specific implementations are not proper for industrial software development. Because of its popularity, genetic algorithms have become implemented as third-party software libraries. The popularity of Android OS with its capabilities for running Java source code attracted the usage of external software libraries for achieving mobile distributed computing tasks. Training of artificial neural networks and curve fitting by the usage of genetic algorithms brought financial time series forecasting to the mobile world. In this study, two of the most popular genetic algorithm software libraries are compared in order to be used in mobile distributed computing application.

Metaheuristic Maximum Power Point Tracking for PV systems under Partial Shading Conditions

Elvin Yusubov *Azerbaijan State Oil and Industry University, AZ*

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

Abstract: In this research paper, maximum power point tracking (MPPT) using

the moth-flame optimization (MFO) algorithm for photovoltaic (PV) modules is proposed. Extracting the maximum power from the PV modules is of paramount importance to achieve higher efficiency. Conventional MPPT techniques offer satisfactory results under uniform solar irradiation distribution in the PV modules since there is only one peak in the output power-voltage characteristics of the PV modules. However, these methods are inefficient under partial shading circumstances resulting in several peaks in the output characteristics. The conventional techniques can fall into local maxima entrapment. To solve this issue, a moth-flame optimization is proposed to track the global maximum of the MPPT output curve. Simulations are carried out to illustrate the efficiency of the proposed approach compared with the traditional Perturb and Observe (PandO) and metaheuristic particle swarm optimization (PSO) methods. The results of the simulations support the superiority of the MFO-based MPPT control technique.

Finding the minimum number of circles of fixed radius needed to cover n points in the plane by MaxiMinMax approach

Stefan Panov	*University of Chemical Technologies and Metallurgy, BG*
Svetlana Panova	*University of Chemical Technologies and Metallurgy, BG*
Atanas Garbev	*University of Chemical Technologies and Metallurgy, BG*

Abstract: This work evaluates the problem of finding the minimum number of disks of fixed radius needed to cover a given set of points in the plane. Two main algorithms are considered. The first of these always searches for a disk location in the plane that covers as many as possible of the currently uncovered points. It is expected such approach will lead to a minimum number of disks. For a plane defined by Cartesian coordinates, we can use computational techniques to decide how good candidate for a disk center each its point is. When searching for the best solution, critical is the sequence in which we find the covering disks. The second algorithm iteratively looks for a location that covers the maximum number of special input points not covered so far. For the latter algorithm a variation of the MaxiMin rule is applied. Both approaches are comprehensively tested for different number of input points as well as different radii. For the overwhelming majority of tests, the second method shows better or equal results compared to the first one.

SESSION A6 "ADVANCED ELECTRICAL DRIVE"	Stream 1
Chairman: Nikolay Djagarov "Nikola Vaptsarov" Naval Academy, BG	
Friday, October 7th 15.30 - 16.10	Hall 109TB

Synchronous Reference Frame Theory Control for Current Harmonics Suppression in Ship Power System Using Shunt Active Power Filter

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

Zhivko Grozdev   *"Nikola Vaptsarov" Naval Academy, BG*

Julia Djagarova   *"Nikola Vaptsarov" Naval Academy, BG*

Abstract: Today, the challenge of enhancing and maintaining the electrical power quality is growing along with the expansion of non-linear loads employed in ship power systems. The resulting deterioration may cause problems with electrical equipment operation and overall system instability. Different strategies, such as the use of active filters, passive filters, or other methods, can be used to avoid these effects. The goal of the current study is to reduce total harmonic distortion (THD) at the PCC (point of common coupling) of non-linear loads by implementing a shunt active power filter (SAPF) with a synchronous reference frame theory based control system used. The disruption in the system with and without the use of SAPF is analyzed and quantified through the proposal of a mathematical model of the ship's electrical power system and simulation of various case studies.

Comparative Analysis of Conventional Methods for Braking a Three-phase Induction Motor and Research on Efficient Combinations of Methods for Efficient Braking Process

Plamen Bahov   *Technical University of Varna, BG*

Mariela Alexandrova   *Technical University of Varna, BG*

Abstract: This document discusses the errors in braking an electric motor in different conventional operating modes for positioning with a screw lead mechanism. The focus of this document is on the error caused by the duration of the braking process. First, three electric braking modes are considered, namely self-excited braking using capacitors, magnetic braking and DC injection braking, and classical connection schemes are suggested. There are three combinations of the modes, mentioned above to increase the accuracy of the system. Research has been carried out to determine which stopping mode is the most accurate. Simulations were then performed in Simulink by using models with the same parameters to establish the truth of the research by analysing the value of the errors. Finally, a conclusion was made about the effectiveness of the used methods and applications of classical regimes in positioning systems.

SESSION B6 "CONTROL SYSTEMS 3"	**Stream 2**
Chairman: Kosta Boshnakov	University of Chemical Technologies and Metallurgy, BG
Friday, October 7th 15.30 - 17.00	Online

Towards Achieving Thermal Comfort through Physiologically Cloud based controlled HVAC System

Isibor Kennedy Ihianle   *Nottingham Trent University, UK*

Pedro Machado   *Nottingham Trent University, UK*

Kayode Owa   *Nottingham Trent University, UK*

David Ada Adama   *Nottingham Trent University, UK*

Abstract: Thermal comfort in shared spaces is essential to occupants' well-being and necessary in the management of energy consumption. Existing thermal control systems for indoor shared spaces adjust temperature set points mechanically, making it difficult to intelligently achieve thermal comfort for all. Recent studies have shown that thermal comfort in a shared space is difficult to achieve due to individual preferences and the inability of occupants to reach a thermal compromise on temperature set points. This paper proposes a thermal comfort system to automatically adjust the temperature set-points in a shared space whilst recognising individual preferences. The control strategy of the proposed system is based on an algorithm to adjust the temperature set point of the shared space using the individual thermal preferences and predicted thermal comfort value of the occupants. The thermal preferences of the occupants are determined first and used as part of the occupant's profile, which is mapped to thermal comfort values predicted from the occupants' measured physiological data and environmental data. A consensus is reached by the algorithm to find the optimal temperature set-point, which takes into account individual thermal preferences and their physiological responses.

Model for determining of optimal ultrasonic sensors measurement zone

Hristo Kilifarev   *Technical University of Gabrovo, BG*

Delyan Genkov   *Technical University of Gabrovo, BG*

Abstract: One of the most common ways the ultrasonic waves propagates in gases is in the form of narrow beam of rays and their distribution can be examined by the methods of geometrical optics. In the present paper is proposed a model for determining of the boundary distances of the working zone of parallel placed ultrasonic sensors when for the research purposes are used the reflected waves from the surface of an object. The model can be used for calculation and simulation of optimal distance to the researched object and for correct placement of ultrasonic sensors in a measuring device.

Energy management system based on wireless sensor networks and power line communications

Azhar-Husain Omar   *University of Pretoria, ZAF*

Reza Malekian   *Malmö University, Sweden, SWE*

Dijana Capeska Bogatinoska   *UIST "St Paul the Apostle" Ohrid, MK*

Abstract: In this paper, we developed a power line communication (PLC) system design, power measurement sensor design, light sensor design, temperature sensor design, and the integration of these components into an advanced sensor network to allow for energy metering and environment monitoring. A power measurement sensor was implemented through a current and voltage sensing circuitry was interfaced multi-plug power adapter to allow for non-invasive

measurement of power usage of appliances. The sensors produce signals corresponding to the drawn voltage and current, which are then sampled and processed to estimate power usage. The PLC communications operated at an average accuracy of 95%. The power measurement sensor had an accuracy of 92%, which made it appropriate for home user estimations. The light sensor had an accuracy of between 91-97%, which was suitable for home lighting measurement.

Design, Manufacture and Control of the Prosthetic Hand with 3D Printer

Arbnor Pajaziti	*University of Prishtina, KOSOVO*
Genta Rexha	*Albanian University Tirana, AL*
Xhevahir Bajrami	*University of Prishtina, KOSOVO*
Edvin Rustemi	*Albanian University Tirana, AL*
Jozef Kola	*Albanian University Tirana, AL*
Mehmet Zeqiraj	*University of Prishtina, KOSOVO*

Abstract: In this paper the design, fabrication, control and implementation of a low cost, 3D printed prototype of a prosthetic hand, customized for a specific patient, is presented. The prosthetic hand has been programmed to make some coordinated movements based on the commands from the patient. After testing, the prosthetic hand is given in use to the patient, who can use it in daily life. The control of the movement of the fingers has been done with Arduino board and the robotic hand is able to pick up different objects while controlling the pressure and temperature with sensors.

SESSION C6 "COMPUTER TECHNOLOGIES 2"	**Stream 3**
Chairman: Ivan Kurtev	John Atanassov Society of Automatics and Informatics, BG
Friday, October 7th 15.30 - 16.30	Online

Possibilities for visual programming in robotics via node-red

Atanas Garbev   *University of Chemical Technologies and Metallurgy, BG*

Abstract: This research was conducted to determine whether visual programming would be a successful means of creating programs for robotic systems that can operate both offline and online. The methods in this article show a way to create a program without writing any code or with minimal intervention due to the needs of the program. The results are quite good, namely by graphically arranging an algorithm that can be pre-written with code in it, and an executable program is created. The program was successfully tested in a virtual environment. In conclusion, it can be said that visual programming saves many hours of work if the environment for its use is first created by writing appropriate software.

Video lectures management system

Delyan Genkov   *Technical University of Gabrovo, BG*

Tsvetan Raykov	*Technical University of Gabrovo, BG*
Hristo Kilifarev	*Technical University of Gabrovo, BG*

Abstract: During the COVID crisis we had to perform distance learning. We used Microsoft Teams for remote teaching. Our students found as a very useful feature to make vireo recordings of the lectures, but we had some difficulties to rely on Teams to keep and regulate the access to the videos. We created a specialized platform for management of the video recordings. The present paper presents the Hydra Educational Platform (HEP) – specially developed for teaching purposes in our university.

Educational technology integrating the project and problem-based approach in technical disciplines for the formation of creativity and creative thinking in engineering students

Maya Stoeva	*South- West University, BG*
Petko Stoev	*IICT Bulgarian Academy of Sciences, BG*
Denis Chikurtev	*IICT Bulgarian Academy of Sciences, BG*

Abstract: Dynamic changes nowadays make creativity the most important economic resource of the 21st century. Success in the modern world depends on the rapid generation of creative ideas and non-standard solutions. A business that cannot create innovative concepts and implement innovative solutions, constantly renew and modernize its productions is doomed to failure. In order to respond adequately to dynamic changes and challenges, it is necessary for people to develop radically new knowledge, skills and competences. Not long ago, logical thinking, precision, and organizational abilities were decisive for professional realization, but now the need for a new way of thinking that challenges and rejects the imposed models and creates new non-standard concepts comes to the fore. The new century increasingly needs creative thinking people. In the field of vocational education and training, European requirements and initiatives are aimed at overcoming the closed nature of educational systems and modeling vocational training in accordance with the real needs of the labor market. The development of creativity and innovation at all levels of education, including vocational technical education, are part of these initiatives. In the context of this understanding, the current paper presents an educational technology for the formation of creativity and creative thinking by integrating the project-based and problem-based approach in the learning process of technical disciplines in engineering students. The presented results of the successful verification of the technology in a real learning environment are grounds for its implementation in a developed online platform.

SESSION C7 "APPLICATIONS"	**Stream 3**
Chairman: Nencho Deliiski	University of Forestry, BG
Friday, October 7th 16.30 - 18.00	Online

An Approach for Computing the Average Moisture Content in Batches of Wood Materials Subjected to Thermal Treatment

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 average moisture content in batches of wood materials subjected to thermal treatment has been suggested. This value of the wood moisture content is needed for calculation and automatic realization of optimal energy saving regimes for such a treatment of the materials. The approach is based on the use of two own coupled mathematical models: one of the 2D temperature distributions in non-frozen prismatic wood materials during their thermal treatment and another – of the heat balance of the equipment. The calculated by the models increase of the processing medium temperature in the beginning of basic regime is compared with the real increase of that temperature, which is periodically measured with a sensor in the automatic control system. After proper processing of the obtained differences between measured and calculated temperatures with the software package Table Curve, an equation for calculating the average moisture content of the wood materials in the batch loaded in the equipment for thermal treatment is derived. The good accuracy of the suggested approach is proved for the cases of autoclave steaming of non-frozen beech prisms in the production of veneer.

Parallel Distributed Compensation for the Control of Processes in Anaerobic Organic Wastewater Treatment

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

Abstract: The aim of the present investigation is to develop a simple approach for the design of a fuzzy logic controller (FLC) based on a derived Takagi-Sugeno-Kang (TSK) plant model using the principle of parallel distributed compensation (PDC) in order to improve the control of the biogas production rate in the anaerobic organic wastewater treatment. A fifth order nonlinear model that fits the experimental data from a laboratory bioreactor is used to study via simulation the plant step responses for two boundary values of the main disturbance - the initial organic load. Two TSK plant models are obtained to approximate the step responses via genetic algorithms minimization of the modelling error. Each TSK model is built of a Sugeno model with plant output as input and three outputs – the membership functions of belonging of the plant output to three linearization zones. The local plant in each zone is modelled by time-lags. Then two PDC on the same Sugeno models are designed with local linear PI controllers tuned with respect to the corresponding local linear plant

model. Another Sugeno model with input the concentration of the initial organic waste distributes by weighted average the plant output to the inputs of the Sugeno models of the two PDC. The PDC based system shows via simulation a reduced dynamic error compared to a designed model-free Mamdani PI FLC.

LoRa Application for Food Monitoring – LYUTENITSA

Krassimir Kolbe	*University of Food Technologies, BG*
Rositsa Maksimova	*University of Food Technologies, BG*
Atanas Kostadinov	*Technical University of Sofia, BG*

Abstract: This paper is a development that presents a perspective solution with modern aspects for LoRa application implementation of web Food monitoring. The model of the hardware architecture of the system is presented. A microprocessor system with compatible modern controller and appropriate sensors for food analysis is proposed. A screenshot of a working web application for interactive monitoring and processing of collected technological food data has been given and developed by the Dash framework in pure Python with a custom user interface. Snippets of the system's source code and a block diagram of the entire process of working of our system are provided. A modern and flexible solution for the implementation of real-time food monitoring of lyutenitsa is proposed. Samples of lyutenitsa from different producers are analyzer by proposed systems.

Positioning intermodal terminals optimally along a railway line using the train differential equation of motion

Stoyo Todorov	*University of architecture, civil engineering and geodesy, BG*
Vladimir Popov	*University of architecture, civil engineering and geodesy, BG*
Matey Iliev	*University of architecture, civil engineering and geodesy, BG*

Abstract: Energy efficiency is a key sustainability factor in every mode of transport and railway transport poses no exception. As the share of intermodal freight is increasing, the investment interest in construction of new intermodal terminals is also high. The locations of newly built terminals are to be properly researched and justified prior to construction. This paper presents a method for determining an optimal location for the construction of new intermodal terminals along a given railway line with the block train running costs as the target function. The proposed method utilizes a numerical algorithm for solving the differential equation of motion of a block train with the total energy cost per run of the block train as the output. Adequate locations for the new terminals are then highlighted through an analysis of the algorithm's output space across the railway line length.