14-th NATIONAL CONFERENCE
WITH INTERNATIONAL PARTICIPATION

ELECTRONICA 2023

PROGRAMME

1 – 3 June 2023
Sofia

National Science and Technical Centre
108 Rakovski Str.
&
Virtual room

14th NATIONAL CONFERENCE WITH INTERNATIONAL PARTICIPATION "ELECTRONICA 2023"

Organized by:

The Union of Electronics, Electrical Engineering and Telecommunications (CEEC),

Technical University of Sofia (TU-Sofia),

IEEE Bulgarian Section,

and Faculty of Electronic Engineering and Technologies (FEET)

"ELECTRONICA 2023" is technically co-sponsored by IEEE (Conference record # 58875)

and is part of the "Science Days of TU-Sofia" forum

In cooperation with:

Federation of the Scientific and Technical Unions in Bulgaria (FNTS),
Bulgarian Academy of Sciences (BAS),
University of Applied Sciences - Offenburg,
Riga Technical University,
VDE – Germany and
Leading Electronics Companies.

14th NATIONAL CONFERENCE WITH INTERNATIONAL PARTICIPATION ELECTRONICA 2023

Honorary chairmen:
Ivan Kralov – TU - Sofia
Ivan Yatchev – FNTS and CEEC
Conference chairmen:
Ivo Iliev - TU Sofia
Seferin Mirtchev – CEEC
Georgi Mihov – BAS and TU - Sofia
Scientific Secretary:
Dimitar Arnaudov – TU - Sofia

Local Organizing Committee:

Nikolay Hinov – TU - Sofia
Oskars Krievs - RTU
Sanka Gateva - BAS
Georgi Stoyanov - IEEE Bul. Sec.
Kiril Aleksiev - IEEE Bul. Sec.
Katya Asparuhova - IEEE Bul. Sec.
Anatolii Aleksandrov - TU - Gabrovo
Ilia G. Iliev - TU-Sofia
Dimitar Yudov – BFU - Burgas
Rossitza Goleva - IEEE Bul. Sec.
Radi Romanski – CEEC
Rossen Radonov - ТУ - Sofia
Anna Stojnova - TU - Sofia
Peter Yakimov - TU - Sofia
Emil Manolov - TU - Sofia
George Angelov – TU - Sofia
Vencislav Valchev -TU -Varna
Nikolay Madzharov - TU - Gabrovo
Sotir Sotirov - University "Prof. As. Zlatarov" Bourgas
Lidia Galabova - TU - Sofia
Krassimir Paskalev – Kostal SofiaSoft Bulgaria
Kalin Dobrev - Festo production
Sylvain Collot -Melexis Bulgaria
Verka Alexieva - LEM Bulgaria
Ivan Mihaylov
Georgi Lilkovski - Visteon
Nikola Durchev - Balkantel

Program Committee:

Alden Dochshanov, Italy
Darius Andriukaitis, Lithuania
Davy Pissoort, Belgium
Dimitar Arnaudov, Bulgaria
George Angelov, Bulgaria
Gennady Zinoviev, Russia
Ivo Iliev, Bulgaria
Juraj Breza, Slovakia
Lykourgos Magafas, Greece
Leonids Ribickis, Latvia
Dorin Petreus, Romania
Marius Neag, Romania
Marin Marinov, Bulgaria
Marin Hristov, Bulgaria
Miglena Dontschewa, Austria
Nicolae Muntean, Romania
Nikolay Hinov, Bulgaria
Rossen Radonov, Bulgaria
Octavian Cornea, Romania
Reinhard Bauer, Germany
Stefan Hensel, Germany
Dorin Neacsu, Romania
Stefan Pachedjiev, Bulgaria
Stoyan Stoyanov, UK
Vladislav Skorpil, Czech Republic
Viera Stopjaková - Slovakia
Ritonja Jozef - Slovenia
Namyong Kim, Korea

Secretariat
Stefan Patchedjiev – CEEC

14-th NATIONAL CONFERENCE WITH INTERNATIONAL PARTICIPATION "ELECTRONICA 2023"

	Hour	Event
Wednesday 31 May	16.00-18.00	**Registration of participants & test the system** (Virtual room 1) Webex software
Thursday 1 June	9:00 – 10:00	**Registration of participants** Hall 4 & Virtual room 1
	10.00-10.30	**Opening Session** Hall 4 & Virtual room 1
	10.30-12.30	**Scientific Session 1** Hall 4 & Virtual room 1
	12.30-13.00	Lunch break
	13.00-14.00	**Workshop** Opportunities for cooperation within the framework of the European University of Technology (EUt+) and business needs **Presentation of projects (Part 1) & PhD students Workshop** Hall 4 & Virtual room 1
	14.00-14.30	Coffee break
	14.30-16.30	Education in Electronics and Business Needs. Discussion with leading companies in electronics. Hall 4 & Virtual room 1
	16.30-18.00	„Alumni meeting**"-** Informal discussion – **(welcome cocktail)** Hall 3
Friday 2 June	08.30 -11.30	**Scientific Session 2 (Part 1 & Part 2)** Hall 3 & Virtual room 1
	11.30 -11.45	Coffee break
	11.45 -12.30	**Keynote: Digital Healthcare and IoT Sri Krishnan, PhD, PEng, FCAE, Toronto Metropolitan University, Canada** Hall 3 & Virtual room 1
	12.30 -13.00	Lunch break
	13.00-15.45	**Scientific Session 3 (Part 1 & Part 2)** Hall 3 & Virtual room 1
	15.45-16.00	Coffee break
	16.00 -18.15	**Scientific Session 4 (Part 1 & Part 2)** Hall 3 & Virtual room 1
	18.15 -18.30	Coffee break
	18.30 -19.30	**Scientific Session 5** Hall 3 & Virtual room 1
	19:30 – 20:00	**Presentation of projects (Part 2)**
Saturday 3 June	9:00	**Presentation of projects (Part 3), Closing Session & Social program**

https://e-university.tu-sofia.bg/e-conf/?konf=199

Virtual room 1 - https://technicaluniversityofsofia.my.webex.com/technicaluniversityofsofia.my/j.php?MTID=m9ae998964419b2c79cab3531339df54a

<u>Opening Session</u> 10.00 - 10.30

Hall 4 & Virtual room 1**, Thursday 1 June 2023**

<u>Scientific Sessions 1</u> 10.30 -12.30

Hall 4 & Virtual room 1**, Thursday 1 June 2023**

<u>Workshop</u> 13.00 – 14.00

Hall 4 & Virtual room 1**, Thursday 1 June 2023**

Opportunities for cooperation within the framework of the European University of Technology (EUt+) and business needs

Moderators: Prof. George Angelov - Technical University of Sofia, Bulgaria
Assoc. Prof. Anna Litvinenko - Riga Technical University, Latvia

EUt+ partners will participate in the discussion:

- Technical University of Sofia, Bulgaria
- Riga Technical University, Latvia
- Technical University of Cluj-Napoca, Romania
- University of Technology of Troyes (UTT), Troyes, France

Presentation of projects (Part 1) & PhD students Workshop

- КП-06-ПН57/32 „Hybrid and Fusion Prediction of The Functionality of Energy Converting Elements“ Competition for financial support of basic research projects – 2021 Bulgarian National Scientific Fund.
- КП-06-Н57/7/ 16.11.2021“Artificial Intelligence-Based modeling, design, control, and operation of power electronic devices and systems“ - Bulgarian National Scientific Fund.
- КП-06-Н37/25/18.12.2019 „Optimal design and management of electrical energy storage systems“ Bulgarian National Scientific Fund.

<u>Discussion</u> 14.30-16.30

Hall 3 & Virtual room 1**, Thursday 1 June 2023**

Education in Electronics and business needs. Discussion with leading companies in electronics.

Increasing the Interest of High School Students to Scientific and Engineering Professions, Jordan Kolev, IEEE Bulgaria Section, LMAG Chair (Life Member Affinity Group)

<u>Scientific Sessions 2, 3, 4, and 5</u> 8.30-20.00

Hall 3 & Virtual room 1**, Friday 2 June 2023**

Discussion on scientific projects.

<u>Closing Session</u> 3 June 2023 9.00, Hall 3

Scientific Session 1

Circuit and systems

Hall 3 & Virtual room 1, **Thursday 1 June, 10.30 – 12.30**

Chairpersons: Ivo ILIEV, Ivo PANDIEV

1.1 Second Order Band-Pass Filter Structure Employing Dynamic Current Scaling OTA Based Gyrators

Georgi Georgiev

Abstract—This paper presents the realization of a filter based on a gyrator structure. The goal is to showcase an operational transcoductance amplifier (OTA) using the constant-gm dynamic current scaling (DCS) technique as a building block for a gyrator-based 2nd order band-pass filter.

Before exploring the design a brief analysis of filters in general and gyrator based filters in particular has been conducted. A showcase of the DCS based OTA has also been performed with emphasis put on the benefits it provides to the particular application discusses in this paper.

In order to prove the benefits of the designed second order band-pass filter DC and AC simulations are performed. The results are presented graphically and conclusions are made as well as potential methods for adjusting the frequency of the filters have been identified.

1.2 Method for Increasing Fast Response of the Operational Amplifiers with a Classical Input Differential Stage

Darya Denisenko, Nikolay Prokopenko, Vladislav Chumakov, Marsel Sergeenko

Abstract—The BJT circuit design of the high-speed operational amplifier (op-amp) is considered, in which a significant increase in the maximum slew rate (SR) is provided by introducing differentiating circuits for correcting the transient in the input stage of the op-amp. As a result of computer simulation, the limiting values of the SR (up to 2900 V/μs) are established, which are implemented in the op-amp with the ideal current mirrors and an ideal buffer amplifier.

1.3 Integer Division Algorithm for the Gaussian Filtering Module of FPGA Based Edge Detection

Dimitre Kromichev

Abstract—In the speed domain, integer division is a critical problem to FPGA based edge detection which uses Gaussian filtering. Solving this problem requires the design of an FPGA focused integer division algorithm that satisfies two major goals in terms of speed: 1) work at a frequency that vastly exceeds the upper limit of execution speed in FPGA based edge detection – the highest clock frequency of embedded memory; 2) guarantee mathematically accurate result within a single clock cycle. This is what the presented paper focuses on to investigate by involving ten Intel (Altera) FPGA families.

1.4 Edge detection: Exact Localization of Detected Contours

Dimitre Kromichev

Abstract — A detected edge which is as close as possible to the true object boundary is not a solution in demanding applications. This paper proposes a method focused on the exact localization of detected contours. The method implements a set of four optimality criteria. The criteria are defined and function in interdependence among one another. The tool Scilab is used to mathematically prove and experimentally investigate the propoposed method according to a specifically designed methodology. Tests are conducted and conclusions are drawn by employing both synthetic and real-life images.

1.5 Analysis of RMII Interface Design through Simulations and Measurements

Alelxander Todorov, Katya Asparuhova

Abstract — This paper presents the implementation and verification of an RMII interface as part of a multi-function device designed for the automotive industry. The principle scheme, the PCB design, impedance calculations, results of signal integrity simulations with a HyperLynx and results of measurements of the finished design are described. All measured parameters are within the tolerance set by the manufacturer, indicating that the RMII interface so designed and implemented should have no functional problems.

1.6 ARM and BLE-Enabled TPMS for Improved Safety in Automotive Applications

Dimitar Vrachkov

Abstract—This research provides some fresh aspects of the BLE ARM based integration in TPMS applications and also in automotive in general. The paper analyses the threads and possible mitigation of the risks in such a system improving it with the features provided from BLE.

1.7 Thermal Control of Active and Inductive Loads by Impedance Monitoring

Georgi Georgiev, Valentin Mateev, Iliana Marinova

Abstract— In this work, a method and device for measuring the temperature of an electric inductive winding and the stages of a method for measuring the temperature in an indirect way without having to disconnect the load from the power circuit or partially interrupting the supply voltage are considered. The considered design is for direct current and alternating current.
Temperature controller is prototyped and tested in laboratory environment.

1.8 IoT-Based Electronic System for Measuring Microclimatic Parameters in Cattle Farms

Snezhinka Zaharieva, Iordan Stoev, Teodora Petrova, Adriana Borodzhieva

Abstract— The object of the paper is an IoT-based electronic system developed to provide measurement and evaluation of microclimatic parameters in cattle farms. A combined sensor for measuring temperature, moisture and carbon dioxide, and a calibrated sensor for measuring ammonia concentration in the atmosphere are connected to the developed five electronic modules for measuring microclimatic parameters in cattle farms. The measured data is transmitted via a LoRa interface to the data acquisition system, and there is also the possibility to connect the module to a redefined WiFi network for data transmission via an MQTT broker. When using WiFi connectivity and MQTT broker, the visualization and collection of measured data can be done from a remote system that is not installed near the sensors.

1.9 Simulation Study of Integrated Transistor Circuits for CAD Training in Electronics Education

Katya Asparuhova, Georgi Georgiev, Stanislav Asenov

Scientific Session 2

Instrumentation and Measurement, IoT Biomedical Engineering

Hall 3 & Virtual room 1, **Friday 2 June, 8.30 - 11.30**

Chairpersons: Marin MARINOV, Georgi NIKOLOV

Part 1 8:30 – 9:50

2.1. Reliability Evaluation of MEMS Pressure Sensors
Dimitar Nikolov, Borislav Ganev, Marin Marinov

Abstract— An experimental setup is presented which allows the study and characterization of integrated optical sensors. The system consists of a small integrating sphere that can be illuminated by various sources such as white and colored LEDs, calibrated sources, or halogen lamp types. The design allows easy installation and configuration of measuring instruments (light meter, standard calibrated photodiode). The control of the parameters of the tested sensors, data collection, and processing is performed using a microcontroller ESP 32 in the LabVIEW programming environment. Preliminary studies of the characteristics of color sensors and calibrated sources are presented.

2.2. Vibration-based loose component detection in automotive application
Vergil Djamiykov, Vasil Galabov, Dimitre Trendafilov, Borislav Ganev

Abstract— Vibration-based loose component detection is a technique that can be used in production of automotive components to identify loose or defective element in a vehicle's mechanical and electromechanical systems. The idea behind this technique is to monitor the vibration patterns of the single device or complete vehicle and identify any changes in those patterns that may indicate the presence of loose or defective components.

2.3. Global Positioning of Optically Detected Objects with UAV
Stefan Hensel, Marin Marinov, Raphael Panter, Dimitre Trendafilov

Abstract— In recent years, the development of drones has advanced rapidly. Due to their versatility and efficiency, drones are applied in a variety of fields. They are used to monitor and map areas, to support search and rescue missions, and to deliver goods. This work deals with the design and implementation of a camera-based tracking system for drones. It aims to build a realtime object detection and localization system. The detection and determination of the positions of the objects are done only by the camera and sensors of the drone.

2.4. LSTM Algorithm and IoT Data on Power Flow Forecast
Arbër Perçuku, Daniela Minkovska

Abstract— LSTM algorithm is an advanced version of Recurrent Neural Network and handles more accurately the time series predictions. The growth of renewable energy sources and changing of consumption nowadays lead on challenges in power system. To ensure the reliability and security on the electricity grid, the forecast of power flow on day ahead is essential. This paper presents a method by using LSTM algorithm and IoT sensor's data to forecast the power flow on two high voltages overhead lines. The analysis of study results shows better outcomes compared with traditional method.

2.5. Ultimate Execution Speed of Gaussian Filtering in FPGA Based Gradient Edge Detection
Dimitre Kromichev

Abstract—This paper investigates the ultimate execution speed of Gaussian filtering module of FPGA based gradient edge detection by proposing an organization of computations which focuses on achieving the upper limit of clock frequency of Gaussian filtering and guaranteeing that a filtered pixel is available at the output of the Gaussian filter every single clock cycle under all test conditions. Ten Intel (Altera) FPGA families are used in conducting the experiments and analyzing the obtained results.

2.6. Autonomous human presence solar energy harvesting sensor node for IoT applications
Stanislav Asenov, Dimitar Tokmakov, Katya Asparuhova, Hristo Kanevski, Daniela Shehova

Abstract—This work presents the use of a solar energy powered LoRaWAN sensor node for the realization of autonomous smart LoRaWAN human presence sensor for enterprise internet of things applications. In particular, the paper presents the possibility of using LoRaWAN human presence

sensor node powered by solar harvester systems to manage the bus stop and count the bus passagers. The hardware design and software implementation of the sensor node are presented. The designed and implemented sensor node was actually tested under external atmospheric conditions to guarantee its autonomous operations.

2.7.
2.8.

Part 2 10:00 – 11:15

2.9. Novel Design for Torque Control of a Robotic Arm

Babak v, Alireza Savabkar, Ali Najari, Majid Serajchi, Mohammadjavad Haghighatseresht

Abstract— This article presents a novel approach to designing a continuously variable torque transmission mechanism (CVT) for a two-degree-of-freedom robotic arm. The proposed gearbox is designed to adjust the conversion ratio between the actuator and the joint in real-time based on the torque functions of the joints. By dynamically changing the conversion ratio without controlling the engine torque, the proposed CVT provides the required power for the arm's movement, which varies under different conditions. The CVT enables the arm to move at a lower speed and with high power at high torques and at high speed and low power at low torques, without requiring torque control. The proposed mechanism has the potential to improve the efficiency and performance of robotic arms by optimizing power consumption and reducing torque control requirements.

2.10. Human Presence Detection In Smart Homes Using Local Wireless Network

Khatereh Jabari, Saeed Izadi, Saeed Izadi, Mahnaz Izadi, Bagher Khadem Hamedani

Abstract— The proposed approach for detecting the location of residences in a smart home using the received signal strength of access points and its neighbors is optimized using a discrete reinforcement learning algorithm. The approach utilizes a one-class support vector machine and a moving window method to detect human presence, while the trained network resulting from the reinforcement learning algorithm optimizes the design parameters. The reinforcement learning algorithm has an impressive effect on reducing the effects of abnormal noise in the received signal strength of access points and identifying changes in signal transmitters to tune the design parameters. The simulation results demonstrate that the proposed approach has an accuracy of 98.8% for human presence detection and 96.4% for location detection with ±1 meter. Moreover, it has a sensitivity of 98.3% and only 5.6% false alarms about human existence, indicating its high effectiveness in detecting human presence accurately.

2.11. Coronary Heart Diseases Detection using Stacking Based Ensemble with Emperor Penguin Optimization Approach

Prince Rajor, Indu Singh, Prasoon Jha, Prateek Singh

Abstract—A buildup of plaque in coronary arteries, the blood veins that supply oxygen-rich blood to heart, results in Coronary Artery Disease, also known as CAD, coronary or atherosclerotic heart disease, which is a dangerous condition. Globally, it has an impact on millions of individuals. Currently doctors conduct a wide variety of tests and evaluate patients' medical history to diagnose the disease. Hence a method is needed to diagnose the disease automatically and help in the early treatment of the disease. As time progresses the disease becomes worse. At the moment, angiography is performed to assess the degree and location of cardiac vessel blockage. Several academics have been inspired to apply data mining for CAD diagnosis because it is costly and has a lot of adverse side effects. The literature has employed a variety of characteristics and methods. This study proposes a machine learning and bio inspired algorithm based approach, Stacking Based Ensemble with Emperor Penguin Optimization (SEEPO), which uses a two level stacking with level 1 serving as the base level and level 2 as the metalevel. The input for meta-level ML classifiers is

chosen from the predictions of base-level classifiers. The 303 cases in the Z-Alizadeh Sani CHD (Coronary Heart Diseases) dataset that we utilize have all been approved by CAG (Coronary Artery Angiography). Experimental findings show that the suggested model identifies CHD with 94.7% accuracy, 94.8% precision, 94.8% recall, and 94.7% f1-score, respectively.

2.12. Modeling and Identification of Biotechnological Systems Using Knowledge Processing Systems

Maria Nenova, Valeria Nenova, Anelia Tzanova, Marian Hristov

Abstract — The article analyzes and systematizes concrete theoretical studies and scientifically applied results on the modeling of biotechnological processes related to methods and algorithms, for working in conditions of uncertainty and in the presence of numerical information.

2.13. Rehabilitation device with rotary pneumatic actuator

Ivanka Veneva, Pavel Venev, Georgi Katsarov, Silvia Angelova

Abstract— The aim of this paper is to present the design and development of a low-cost rehabilitation device with rotary pneumatic actuator. The system includes pneumatic rotary actuator and two adjustable levers coupled to the rotor's shaft, a control unit and air pressure regulator with four direct operated 3-port solenoid valves, two pressure sensors and analogue rotary position sensor. A graphical interface with interactive communication has been created to adjust the parameters and duration of rehabilitation. The designed system provides real-time visualization, adjustment and feedback, guiding the operator in the steps of the therapeutic procedure, which makes rehabilitation therapy more adaptable to the patient's personal characteristics without creating inconvenience.

2.14. Combined High-Pass and Mains Interference Rejection Filter

Georgy Mihov, Dimiter Badarov

Abstract— The paper presents an alternative approach for high-pass filtering of ECG and simultaneous removal of mains interference. The approach is based on the summation of several filters having zeros for the mains and zero frequencies. A program is compiled that calculates the coefficients of the combined filter depending on the set cut-off frequency for the high-pass filtering, the sampling rate and the frequency of the mains interference. The mathematical basis for synthesizing the combined filter is presented. Tests performed with artificial and real ECG signals and disturbances prove the combined filter is able to remove very intense baseline drift and completely suppress mains interferences with minimal impact on the ECG signal shape.

Keynote: Hall 3 & & Virtual room 1**, Friday 2 June, 11.45 - 12.30**

Digital Healthcare and IoT

Sri Krishnan, PhD, PEng, FCAE, Toronto Metropolitan University, Canada

Scientific Session 3

Power and Industrial Electronics

Hall 3 & Virtual room 1**, Friday 2 June, 13.00 - 15.45**

Chairpersons: Tsvetana GRIGOROVA, Nikolai HINOV

Part 1 13:00 – 14:15

3.1. Basic Characteristics of an Optimal Trajectory Controlled LLC Resonant DC-DC Converter at Continuous Current Mode

Aleksandar Vuchev, Tsvetana Grigorova, Stoyan Vuchev

Abstract— In this paper, the application of optimal trajectory control for an LLC resonant DC-DC converter is investigated. The operating frequency is higher than that of the series resonant circuit and the rectifier input current is continuous. Based on the results of an existing state-space analysis, the output and control characteristics are obtained. Important properties of the LLC resonant DC-DC converter are discussed.

3.2. Modeling of an Optimal Trajectory Controlled LLC Resonant DC-DC Converter

Aleksandar Vuchev, Tsvetana Grigorova

Abstract— A method for optimal trajectory control of an LLC DC-DC converter operating at frequencies above the resonant frequency is considered. A functional model in the OrCAD PSpice environment is proposed to study the converter behavior. The investigation examines the operation of the converter in different scenarios through simulation, including steady-state conditions, when a control parameter suffers significant changes, and when a short-circuit occurs at the output of the circuit. The obtained results are compared with those from theoretical analysis.

3.3. Supercapacitor energy storage system discharge strategies considering discharge power levels and DC grid voltage drop

Ģirts Staņa, Kaspars Kroics

Abstract—This paper describes the calculation of the discharge parameters of supercapacitor energy storage systems on both sides of a DC/DC converter when both the DC grid and the energy storage system supply power to the consumer. In one discharge variant, the intensity of the discharged power of the energy storage system is regulated as a percentage of the full power of the consumer. In the second discharge variant, the voltage drop across the DC line is regulated by the discharging of the energy storage system. The case of an energy storage system connected to the DC grid very close to the consumer and the case where it is connected further away from the consumer are considered.

3.4. PMSM Servomotor Performance Improvement with GaN based Inverter and Sinusoidal Filter

Kaspars Kroics

Abstract—The motors have significant inductance, so the current ripples are quite low even if the switching frequency is below 20 kHz. From the other side wide band gap transistors can operate with much higher frequencies. The paper provides some ideas how to utilize higher switching frequency to improve performance of motor drive. The paper discusses development of sinusoidal output filter and experimental results. The paper shows improved waveform by reducing dead time to increase the dynamics of electrical drive.

3.5. Analytical Calculation of Differential Mode and Common Mode EMI Filters
Jānis Voitkāns, Kaspars Kroičs

Abstract—The paper discusses line impedance stabilization network simplified circuit and how based on noise measurements use analytical calculation to calculate filter attenuation. Obtained equations further can be used to select passive elements of the electromagnetic interference filter.

3.6. Modeling of a Photovoltaic Plant for a Charging Station for Electric Vehicles with the Possibility of Feeding Excess Energy into the Power Grid
Gergana Vacheva, Andrei Borisov, Nikolay Hinov

Abstract—The current development aims to investigate the production of electricity from renewable energy sources and, more specifically, a photovoltaic plant to provide power to a charging station for electric vehicles, and to optimize the processes, the energy that remains in excess is sold to the electricity transmission companies.

3.7. Study of the Influence of Parasitic Components in Inverter Drives
Gergana Vacheva, Plamen Stanchev, Nikolay Hinov

Abstract— In this paper, a simulation study of an inverter drive for a permanent magnet synchronous machine is realized. The model is described by differential equations. A cable model is also included in the overall model and the effects of parasitic components are accounted for. The model is implemented in the PSim programming environment. Simulation results without and with RC- filter are shown.

Part 2 14:15 – 15:45

3.8. Analytical, Simulation and Experimental Investigation of the Phase Inductance Profile of a Three-Phase 12/8 SRM
Dimitar Yankov, Ivan Maradzhiev

Abstract—The paper presents a comparison between methods for analytical and experimental investigation of the phase inductance profile of switched reluctance motors. Since this type of motors have highly nonlinear phase inductance characteristics and most often only the maximum and minimum inductance values are given in the specification, and in many cases the specification is missing, they must be measured very precisely for one electrical period. The obtained results are used to structure an accurate mathematical model for a simulation study of the performance of the SRM. For this reason, the purpose of this paper is to investigate and compare analytical and different experimental methods, using as a reference frame for comparison the simulation results obtained by the Finite Element Analysis method to determine the inductance profile, of a three-phase type 12/8 SRM (H55PWBKM-1844). From the analysis performed, the relative error between the individual methods was calculated and the most accurate one was proposed to be used to measure the static characteristics of the phase inductance of the SRM and guarantee the most reliable results.

3.9. Comparative analysis of control algorithms for a power source - power converter - switched reluctance motor system in generator mode
Dimitar Yankov, Ivan Maradzhiev

Abstract—The paper presents a study of motor and converter power losses, efficiency, and torque ripple in a power source- converter -switched reluctance motor system, in generator mode operation, using unipolar modulation and different types of control algorithms. In the MATLAB/Simulink environment, for each of the selected algorithms, the converter and motor power losses, efficiency, and torque ripple are investigated while varying different input

parameters. Based on the simulation results obtained, a comparison is made between the different control algorithms of the system, and the most efficient one is selected.

3.10. Laser surface texturing LST overview, future trends, advantages, and disadvantages

Elena Nikolova

Abstract— Laser technology has become a major tool in electronic manufacturing. The precision and flexibility of lasers is widely applicable, especially in key operations such as cutting, drilling, welding and marking of electronic components. Laser surface texturing (LST) is an advanced technique that has attracted attention in recent years and represents the modification of the topography of the surface of the material in order to achieve desired properties, such as improved functionality, performance or increased aesthetics of the product. Surface modification uses the precision and flexibility of lasers to create micro- or nanoscale patterns, textures or features on a material's surface. Understanding the various physical processes occurring during laser interaction with the material is essential to optimize laser texturing parameters, achieve desired surface characteristics, and improve process efficiency and effectiveness. This paper examines the physical processes involved in LST and their implications for surface modification. In it, we examine its applications, including surface wettability, tribology, biocompatibility, and energy conversion. We discuss the physical mechanisms governing the formation of surface textures, such as melting, ablation, and hydrodynamic instabilities. We provide a comprehensive review of recent research efforts in the field, highlighting the potential of LST to improve productivity in electronic manufacturing.

3.11. A Novel Bidirectional Flying Inductor Inverter Topology

Yovko Rakanov

Abstract—This paper presents a bidirectional transformerless inverter. It is designed on the base of a so-called flying inductor symmetric topology (FIST). In AC-DC mode, it can operate with a high power factor which is very suitable for many applications.

3.12. Fuzzy logic control of Buck converter

Hristiyan Kanchev, Kiril Genev, Nikolay Hinov

Abstract—In this paper is presented the modeling of a buck converter with fuzzy logic control in Matlab/Simulink environment. The system behaviour is simulated and the reults with a conventional PI regulator and fuzzy logic controller are compared.

3.13. New method of testing in electronics manufacturing

Roumen Bagalev, Lyudmila Taneva, Pavel Dzhunev

Abstract— The article describes a new method for adaptive testing in the production of large series of complex electronic products. On the base of statistical data and real-time information the probability of each test to pass or fail is assessed and decision, whether to perform it or not is made. This way the total test time could be reduced which leads to reduction of test cycle time, increase of the manufacturing resource usage efficiency and reduction of the product cost. The method is suitable for complex electronic products, which undergo large number of tests during production and its advantages could be fully used.

3.14. Reliability and fault-tolerance of PV modules on Northern Greece

Theodoros Petroglou

Abstract—The last few years more and more failures occur in old installed PV systems many of them could have been avoidant. The main problem studied in this paper is the unexpected reduction performance of PV panels after a few years of operation. Solar panel power degradation is one of the main reasons that in many photovoltaic parks the performance ratio (PR) has fallen below 80%

while normally it should be a little over 90%. This reduction in energy production leads to an increase in the payback period of investments. This paper will also demonstrate and analyze the he main causes that led to these failures. Research results are based on data collected and analyzed from photovoltaic installations that have been operating for almost a decade in the area of Northen Greece. This paper is part of the research carried out for the doctoral thesis on the topic: 'reliability and fault tolerance of photovoltaic systems' The data presented in this paper were collected by on-site visits to the photovoltaic installations during which measurements were taken, thermal and physical photographs are also taken. To verify events that had occurred in a previous time since the visits to facilities the service books were studied as well as the data from the inverter telemetry. From the collected data, questionnaires were answered on the current state of the facilities as well as on the problems they had presented in the past. An overall picture of the operation status was taken of the PV installations that they had since the beginning of the operation 10-12 years ago until today. The data as well as some conclusions concerning the fault-tolerance of PV modules are presented in the following paper. Keywords—PV systems performance, solar panel – PV modules failures, Solar energy.

3.15. Replacing the coefficient of the PID controller with a mathematical function

Goran Goranov, Petar Panayotov

Abstract – In some areas of the industry, synchronizing two or more rotating mechanisms is necessary. This article proposes a system for synchronizing the developing mechanism of a labeling machine, in relation to the submission of a label by PID regulation of an electromagnetic brake. A software unit for controlling the holding force of a developing mechanism has been developed and implemented on a programmable logic controller SIEMENS S7-1200.

3.16. Mathematical model for automatic calibration of nonlinear sensors

Petar Panayotov, Goran Goranov, Anatoliy Aleksandrov

Abstract— In many areas of the industry, it is necessary to measure various parameters by means of sensors and transducers. Often measuring devices work with more than one sensor. When changing the type of sensor, it is necessary to rewrite the program code with the parameters of the new sensor, so that the device can calculate the real value of the measured quantity. This article will not consider the ways to convert an analog signal to digital form, but the relationship between the measured value and the analog value, which can be linear or non-linear depending on the type of sensor or converter. One of the ways to establish the type of sensor is by automatically calibrating and saving the new functional dependence of the sensor in the controller's memory. This is required when changing the sensor in multi-sensor measuring devices. The approach used to calibrate the sensors is through a reference function to which the measured values are compared.

Scientific Session 4

Information and Communication Technology

Hall 3 & Virtual room 1**, Friday 2 June, 16.00 - 18.15**

Chairpersons: Nikolay ATANASOV, Dimitar ARNAUDOV

Part 1 16:00 – 17:00

4.1. A Service Based Approach to Machine Learning Workflow in O-RAN

Ivaylo Atanasov, Evelina Pencheva, Ventsislav Trifonov

Abstract—Open Radio Access Network (O-RAN) is a technology that drives the transition towards open, virtualized, programmable, self-optimizing, and interoperable network. ORAN introduces the concept of RAN Intelligent Controller which is responsible for the RAN function control and

optimization. It enables training, deployment, execution, and performance monitoring of machine learning (ML) models aimed to deliver personalized services and to reduce the operational costs. The paper presents a service-based approach to implementation of processes related to the ML model workflow. Functions related to data processing, model training, deployment, execution, validation, and selfoptimization are described as services and communication between them is based on the HTTP.

4.2. Notification mechanism for malware detected by Microsoft Defender for IoT in industrial networks

Marian Hristov, Maria Nenova, Viktoria Dimitrova, Zlatka Valkova Jarvis

Abstract — Nowadays, threats against industrial networks such as factories, plants, and laboratories are becoming more dangerous and carry severe consequences. Progressively, threat actors are targeting these industries, attempting to steal intellectual property and/or cause financial damage. Security vendors, such as Microsoft, constantly evolve their products in order to respond to emerging threats, however, in many cases the hackers are one step ahead. This paper aims to propose a notification mechanism for malware in industrial networks detected by Microsoft Defender for IoT (D4IoT). When applied, an analyst in a Cyber Threat Analytics Center (CTAC) can instantly detect malicious activity (e.g. outbound connection attempts toward a suspicious destination, or malformed Domain Name System (DNS) queries) and respond to it. Prompt responses and adequate measurements can save significant amounts of resources and, in some cases, even human lives. The proposed solution works on top of D4IoT implementation in an industrial network with Microsoft Sentinel integration.

4.3. Safe Guarding Social Network: An Exploration of Advance Cryptographic Algorithms for Ensuring Data Security and Integrity

Ramesh Kumar, S. P. Singh, Hitesh Singh, Vivek Kumar, Boncho Bonev

Abstract— In the era of the digital age, social networks have become an essential part of our lives, allowing us to connect, communicate, and share information with each other. However, the widespread use of social networks has also brought to light the issue of data security and privacy concerns. This paper explores the use of advanced cryptographic algorithms for safeguarding social networks and ensuring data security and integrity.

The paper highlights various cryptographic algorithms such as symmetric key cryptography, asymmetric key cryptography, and hash functions that can be used for secure communication and data storage. The paper also discusses the advantages and disadvantages of each cryptographic algorithm, their strengths, and limitations, and the various use cases where they can be applied to ensure data security and integrity. The paper concludes with the importance of using advanced cryptographic algorithms for safeguarding social networks and the need for continuous research and development in this field.

4.4. A Circular Polarized Flexible Antenna for Energy Harvesting from Sources in 2.4 GHz ISM Band

Gabriela Atanasova, Blagovest Atanasov, Nikolay Atanasov, Manol Avramov, Nikolay Hristov, Nikolay Dishovsky

Abstract— A new circular polarized flexible antenna for RF energy harvesting from sources in the 2.4 GHz ISM band which provides high radiation efficiency and is appropriate for integration into different IoT devices such as a 'smart' backpack has been proposed. The antenna is prototyped using flexible materials - fabric (conductive and polyester) and a composite based on natural rubber. The reflection coefficient and bandwidth for several cases (antenna in free space, antenna attached to a backpack, and bent antenna) have been studied and compared. In all cases, the antenna has stable characteristics. Also, an excellent agreement between simulated and measured results has been observed.

4.5. Implementation of Public Key Code System Based on Polar Codes on a Minicomputer

Nahid Izadi, Mohammad Jabari, Ali Najari, Masoud Izadi, Maryam Jabbari

Abstract— This paper discusses the need for post-quantum cryptosystems, as standard public key cryptosystems based on number theory will be vulnerable to attacks by quantum computers. A new public key cipher system based on polar codes (PC-PKC) has been presented, which relies on the difficulty of the general encryption operation of a polar code for security. The PC-PKC cipher system is implemented on Raspberry Zero hardware, and its efficiency is evaluated by measuring parameters such as execution time, energy consumption, and CPU consumption. The results show that the PC-PKC cipher system outperforms the McAleese public key code system implemented on Raspberry Pi Zero in terms of encryption and decryption execution time, as well as energy consumption.

4.6. Improved Gray Wolf Algorithm for Scheduling Workflow in Cloud Computing Environment

Masoud Izadi, Mohammad Jabari, Ali Najari, Nahid Izadi, Maryam Jabbari

Abstract — This article discusses a method for calculating the predicted output power of a wind turbine based on the received actual and predicted wind speed data from the Internet, using the exponential smoothing method to minimize the forecast error. Also presented is a method for storing the received data and displaying the prediction results on the screen for the convenience of the user.

4.7. Lightweight Portable Environment for Building Visual Studio Projects (Solutions) and C/C++ Sources without Visual Studio

Berik Tuleuov, Ademi Ospanova, Akzhol Tussipkhanov, Aizhan Shegetaeva

Abstract — We present time and efforts preserving way for quick installing Microsoft C/C++ compiler and tools for building Microsoft Visual Studio projects and solutions without installation of Microsoft Visual Studio. It is important to notice that no administrative privileges needed for doing it and low-powered computer can be used. This suite can be used directly from removable media such as flash sticks or USB HDD/SSD devices. Also, single-file C++ projects, as well as Microsoft Macro Assembler (MASM 32/64) source files can be handled. This is very convenient for users such as computer scientists who are not professional programmers, but nevertheless actively use computers in their work, and who cannot spend a lot of time installing and configuring complex software.

Part 1 17:15 – 18:15

4.8. Improving Credit Card Fraud Detection through a Hybridized Approach: Squirrel Search - Honey Badger Algorithm, Optimized Neural Network, and Weighted SMOTE

Indu Singh, Prashubh Atri , Pranav Goyal , Pranav Bhatnagar

Abstract—The problem of unbalanced datasets in credit card fraud detection can lead to inaccurate predictions when using machine learning algorithms. In this research, we propose a novel approach called hSS-HBA, which combines the Squirrel Search and Honey Badger Algorithms to optimize a neural network model. Additionally, we introduce Weighted SMOTE based on Cross-Validation Uncertainty to generate synthetic samples that better represent the minority class. Experimental results demonstrate that our method significantly improves the accuracy and F1-score of the model. With an impressive F1 Score of 0.9000 and an accuracy of 99.97%, our approach offers a promising solution to address the challenges posed by imbalanced datasets in credit card fraud detection.

4.9. Multi-Resource Inventory Management

Todor Stoilov

Abstract— A quantification approach is applied for optimization of the inventory management. The case of simultaneous delivery of different types of goods is considered. These supplies are strictly

related according to the production behavior of the final goods. An optimization problem is defined and solved. The costs for delivery are minimized for given production plan. The empirical results give advantages for the obtained solution of the optimization problem.

4.10. Magical Ordering of Cards with the use of Computers

Serafeim Triantafyllou

Abstract— This paper researches the magical ordering of cards problem by proposing two algorithm implementations in Pascal programming language that could be used in entry-level college informatics and mathematics classrooms. The study examines published research on the magical ordering of cards problem and reviews the pedagogical role of implicit and explicit instruction in informatics and mathematics curricula. Supposing an n number of cards, where each card is numbered according to the following arithmetic sequence 1, 2,…n, it is examined in detail, the right order the cards should be placed, in order to be removed according to the arithmetic sequence 1,2,...n. This study reveals the magic of Mathematics and Informatics by examining the beauty of the magical ordering of cards problem.

4.11. Investigating the feasibility of using infrared thermography as a research tool for the relationship between the temperature-humidity index and the surface temperature of the skin in the flank and udder area of dairy cows

Hristo Hristov, Kalin Dimitrov, Toncho Penev

Abstract— The aim of the study was to test the feasibility of using infrared thermography (IRT) as a research tool for the relationship between temperature-humidity index (THI) and skin surface temperature in the flank and udder area of dairy cows farmed in the Southeastern Bulgaria. The correlation between measured THI and udder surface temperatures was close to 0.75. The correlation between the reported THI and surface temperatures in the flank area was close to 0.96. These results indicate that IRT can be used as a tool for studying the relationship between THI and skin surface temperature in the studied body areas in dairy cows.

4.12. A Software Method for Short-Term Forecasting of the Output Power of a Wind Turbine for the City of Sofia

Alina Fazylova, Grigor Mihailov

Abstract — This article discusses a method for calculating the predicted output power of a wind turbine based on the received actual and predicted wind speed data from the Internet, using the exponential smoothing method to minimize the forecast error. Also presented is a method for storing the received data and displaying the prediction results on the screen for the convenience of the user.

4.13. A smart classroom model implemented with the Internet of Things

Emil Delinov, Daniela Orozova, Zhelyazko Terziyski, Nadezhda Angelova

Abstract—The article presents a conceptual model for developing a monitoring system that manages the microclimate in a classroom, analyzes the data accumulated during the educational processes, and considers the impact of the environment on the students' activities. The described activities can be regarded as a basic approach to designing a smart classroom. Some of the initial results of processing data collected to date for a sample of the observed parameters are presented.

4.14. Electrical circuit modelling of FBAR in Cadence Virtuoso

Milena Sirakova

Abstract — This paper presents an approach how to model film bulk acoustic wave resonator (FBAR) in Cadence Virtuoso. The equivalent modified Butterworth – Van Dyke circuit model (mBVD) of the FBAR is created in the software and AC analysis is performed in order to obtain the resonance frequencies of FBAR. Q-factors are also calculated. This is a prerequisite for including FBAR is different schematic applications.

Scientific Session 5

Advanced materials & Electromobility

Hall 3 & Virtual room 1**, Friday 20 May, 18.30 - 19.30**

Chairpersons: Valentin KAMBUROV, Alexander ZAHARIEV

5.1. Electrochemical investigation of the insulating properties of complex anodic layers

Stefani Borisova, Boriana Tzaneva, Alexander Zahariev

Abstract—In the presented work, the preparation of complex anodic layers on aluminium, comprising honeycomb-like nanoporous layer with a thickness of 10 micrometers and a thickened barrier layer (up to 500 nm) both at the aluminium/ porous oxide and porous oxide/electrolyte interfaces is investigated. This complex structure is characterized by improved dielectric properties and enables easy functionalization by incorporating different materials into the nanopores. The complex film growth technique, the s.c. called reanodization is carried out in a mixed galvanostatic-voltastatic mode, as in the first galvanostatic stage, thickening the barrier layer is performed at current densities from 1 to 5 mA/cm2, and in the second voltastatic stage compaction of the barrier layer structure is accomplished at 300 V. Furthermore, electrochemical impedance spectroscopy is used to obtain information on the resistive and capacitive properties of the anodic alumina complex layers. The results are compared to impedance spectra of samples before reanodization. The highest total impedance is recorded for layers reanodized with 5 and 10 mA/cm2.

5.2. Wet-Chemical Fabrication of MeOx/TiO2-based Sensors on a Glass via UV

Bozhidar Stefanov

Abstract—This work presents a wet-chemical procedure for the fabrication of functional impedimetric humidity sensing devices on a titania (TiO2) surface. Optically transparent 250 nm thick TiO2 films were deposited on a glass substrate via solgel dip coating and surface-functionalized with functional metal oxide (MeOx) layer of either cobalt or nickel oxide by ultraviolet (UV) photodeposition. Photodeposition was employed to form the interdigitated electrode pattern the TiO2 surface as well, through activation with a silver catalyst for electroless copper deposition. The relative humidity (RH) response of pristine and MeOx-functionalized TiO2 sensors was studied by impedance (Z) measurements in the 15 – 90 % RH range. It was found that while MeOx-functionalization significantly dampened the RH – Z functional dependence it improved its overall linearity and may successfully be employed for the purposeful design of titania-based sensing devices.

5.3. Determination of stress-strain relationships in three-point bending tests verified by simulation modelling

Valentin Kamburov, Antonio Nikolov, Rayna Dimitrova

Abstract — This article compares existing relationships for determining flexural stresses and flexural strains in three-point bending with small relative radiuses of wide rectangular test pieces. The process and analytical relationships are analyzed by simulation modelling and plotting the effective stress - true strain diagrams. New relationships are proposed and verified for the maximum flexural stresses and flexural strains in the external tensile layer, which take into account both the influence of the bending angle, i.e. the deflection, and the relative bending radius.

5.4. 3D-printed UV Exponator Setup with Arduino-based Automated Irradiation Dose Control

Pavel Venev, Bozhidar Stefanov

Abstract—Herein, we present the design, technical implementation, and evaluation of a low-cost ultraviolet (UV) exposure setup, that is based on 3D-printed components, Arduino microcontroller, and inexpensive Arduino-compatible UV intensity module. In this case, the setup is equipped with a high-power UVA (λ = 365 nm) light-emitting diode (LED), powered through an off-the-shelf current-controlled DC-DC convertor, which also allows for UV intensity control through pulse-width (PWM) modulation. The functional dependence of UV intensity at the illuminated surface vs. PWM duty cycle was calibrated with a dedicated optical power meter and found to be linear, and controllable in the 5 – 30 mW cm–2 range. Using it as feedback for the UV exposure process, we demonstrate that the device is capable of providing fully automated exposure process with purposeful control of both the UV intensity and overall UV exposure dose.

5.5. How to improve the cross-team collaboration in large scale agile organizations by using AI and ML algorithms

Nikola Gaydarov, Roumiana Ilieva, Atanas Tonchev

Abstract— The main goal of this paper is to provide an approach on how to improve the cross-team collaboration in the large-scale agile organizations. The most critical point that will be discussed is the timing synchronization between many different stakeholders to produce a deliverable. Time boxing is in the hearth of the agility so if something goes wrong there the whole value deliverable chain will be broken. Still as we can expect teams will be delayed and the timing will be broken. As an example, the SAFe organizational structure will be used to show how important is the timing alignment of all teams.

5.6. Conversing to Electrical Car

Dimitar Arnaudov, Valentin Mishev, Hristo Batchvarov

Abstract— The paper discusses problems in converting a classic car into an electric one. The peculiarities of the construction of the mechatronic system are discussed. Attention is paid to the power converters and the organization of the power system.

5.7. Study of a Multi-Port DC-DC Converter

Faruk Ahmeti, Dimitar Arnaudov

Abstract— In the paper, the performance of a specific multi-port DC-DC converter is investigated. The energy management under load variation is investigated. A simulation model of this specific multi-port converter is developed. By conducting parametric analysis, some of the properties of the circuit are demonstrated. This converter is part of an energy storage system. The principle of operation is demonstrated using an energy storage element, a supercapacitor. The operation in different energy transfer directions is demonstrated.

Presentation of projects (Part 2)

Hall 3 & Virtual room 1

Hall 3 & Virtual room 1**, Friday 2 June, 19.30**

Closing Session & Presentation of projects (Part 3)

Hall 3 & Virtual room 1

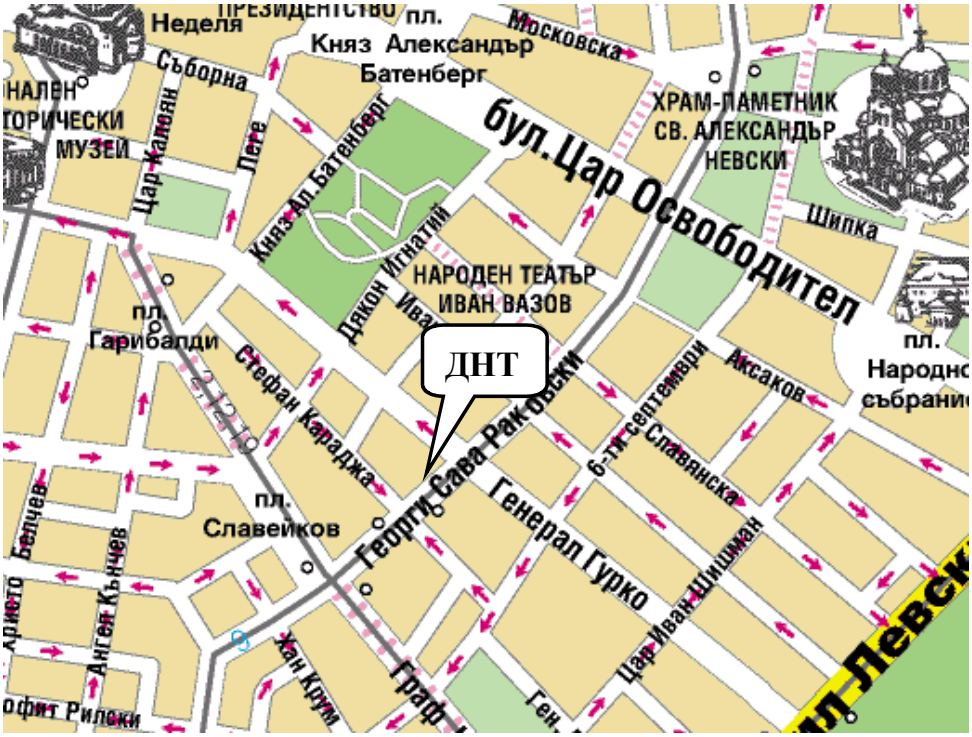
Hall 3 & Virtual room 1**, Saturday 3 June, 9.00**

INFORMATION

ELECTRONICA 2023 is technically Co-Sponsored by IEEE.

(IEEE Conference record # 58875)

The accepted and presented papers will be published in the conference Proceeding on USB and submitted to IEEE Xplore Digital Library, Scopus database.



Address for correspondence
Address:
CEEC (Union of electronics, electrical engineering and telecommunications),
1000 Sofia, 108 Rakovski Str.
Phones:
+359 2 987 97 67

e-mail:
electronica.ceec@gmail.com
ceec@mail.bg
Web site:
http://ceec.fnts.bg
https://e-university.tu-sofia.bg/e-conf/?r=199