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ABSTRACTS

PhD Scientific Seminar

Faculty of Electronics and Automation
Technical University of Sofia, Plovdiv Branch

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Preface

The PhD Scientific Seminar of Faculty of Electronics and Automation is held annually since 2021. It has become an expected place for meetings between PhD students, young scientists and leading researchers at Technical University of Sofia, Plovdiv Branch. Over the years, the seminar gives the chance to the PhD students of the faculty to show and share their most interesting and significant results.

This book of abstracts presents the essence of progress which the PhD students of Faculty of Electronics and Automation gained in the period of March 2024 - March 2025. As a result it contains 14 resumes, which have been extended by presentations and demonstrations during the seminar.

We would like to thank all PhD students who have contributed to the seminar. To thank all those attendees who showed to the PhD students that they are important part of the scientific community of Technical University of Sofia, Plovdiv Branch.

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ALGORITHMS AND PROGRAMS DEVELOPMENT TO ENSURE PRODUCTION SYSTEM OPERATION WITH NETWORK COMMUNICATION

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The field of information and communication technologies is defined as one of the current areas of development of science and innovation in the world. Modern industrial automation is based on the integration of achievements in the fields of information, control, and communication technologies. In this meaning, the work is focused on developing solutions, algorithms, and programs to ensure the operation of intelligent production systems with network communication. The tasks are aimed at designing specialized modules for data collection and processing for diagnostics and notification in the maintenance and management of production processes. The research and analysis provided in the dissertation are focused on developing a comprehensive system for predictive support to help operators to make adequate decisions based on the accumulated, summarized and stored in a special database experience. It is planned to analyze in detail the existing methods for maintenance of technological facilities and sites, and their positive and negative sides will be analyzed. Existing software systems and standards for predictive diagnostics and maintenance will be thoroughly researched and analyzed. Based on the requirements for the predictive support system, the aim of this dissertation will be formulated. A widely used approach is based on data from previous developments and the current state of the forecasting process to determine how much time is left before failures occur. The time remaining until the failure occurs is called "Remaining Useful Life (RUL)", which means "remaining useful time". Predictive maintenance is based on the condition, performed as a result, of a prognosis obtained from the analysis and evaluation of significant parameters of degradation of an element of the facility. It is planned to develop a software module to support

decision-making on the condition, using intelligent methods for predictive diagnostics. The idea is to develop a module for analyzing production and reducing losses by using various algorithms and methods. The prognosis development for of the RUL, the ways of decision-making in the presence of alternatives and proposals for a model will be goal finding solutions and applying to the industrial system. The requirements for automated systems are becoming higher, and their performance is improved through the methods of self-optimization, self-configuration, self-organizing logistics, adaptive diagnostics.

So far the recent work is presented and published in four papers:

1) A. Petrov, A. Taneva, Network Design for Gathering Data in Manufacturing Process, International Conference AUTOMATICS AND INFORMATICS`2022, October 06 - 08, 2022, Varna, Bulgaria (ICAI'22) , DOI: 10.1109/ICAI55857.2022.9960027, 978-1-6654-7625-6/22/$31.00 ©2022 IEEE, Electronic ISBN:978-1-6654-7625-6, Print on Demand (PoD) ISBN:978-1-6654-7626-3

2) A. Petrov, A. Taneva, Process Inspection and Data Collection for Manufacturing, International Conference AUTOMATICS AND INFORMATICS`2022, October 06 - 08, 2022, Varna, Bulgaria (ICAI'22) **DOI:** 10.1109/ICAI55857.2022.9960000 , 978-1-6654-7625-6/22/$31.00 ©2022 IEEE,

3) A. Petrov, A. Taneva, Algorithm for Pneumatic actuator control and diagnostics, 2023 International Scientific Conference on Computer Science (COMSCI), Sep 18 - 20, 2023, Sozopol, Bulgaria **DOI:** 10.1109/COMSCI59259.2023.10315855 , 979-8-3503-2525-6/23/$31.00 ©2023 IEEE,

4) A.Taneva, A. Petrov, M. Petrov Fault Detection Algorithm for Pneumatic Measuring and Sorting Station, 18th IFAC CONFERENCE on PROGRAMMABLE DEVICES and EMBEDDED SYSTEMS - PDES 2024, https://www.ifac-control.org/conferences/programmable-devices-and-embedded-systems-18th-pdes, 2024

Velyo Vasilev is a fourth year PhD student at the Technical University Sofia branch Plovdiv, Department of Computer Systems and Technologies. He has a MSc and BSc degree in Computer Systems and Technology from Plovdiv branch of Technical University of Sofia. His PhD research interests and activities are in algorithms for virtual agents in high-risk environments.

New Algorithms And Models For The Work Of Intelligent Assistant Agents In a High-Risk Environment

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The goal of the dissertation work is to create and investigate innovative models and algorithms for the functioning of intelligent assistant agents in high-risk environments. The study emphasizes the development of a virtual 3D simulator and 3D intelligent agents designed to assist in electric substations or within the medium and/or high voltage segments of the electric power system.

Training agents in real-world hazardous environments presents significant challenges, including high costs, time demands, and safety risks, therefore the use of a virtual electric substation as a safe and efficient platform for training agents in obstacle avoidance and goal-reaching tasks has been explored. By leveraging the capabilities of various virtual environments and game engines, diverse weather conditions, terrains, and hazardous scenarios can be simulated to optimize agent performance. The behavior of an electrical engineer agent has been modelled and evaluated within this virtual substation, which is designed to mirror a real-world facility while incorporating dynamically occurring hazards. The training process utilizes the Unity Machine Learning Agents Toolkit (ML-Agents Toolkit) in conjunction with Python, PyTorch, and ONNX for neural network generation and employs Deep Reinforcement Learning algorithms, specifically Proximal Policy Optimization (PPO); Soft Actor-Critic (SAC);

Behavioral Cloning (BC) and Generative Adversarial Imitation Learning (GAIL), to develop a non-playable character (NPC), which autonomously navigates and interacts with its environment. The findings demonstrate the effectiveness of each of the machine learning algorithms in different scenarios as well as exploring virtual training environments in enhancing agent learning and performance in complex, hazardous settings.

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PARALLELIZING THE NEEEDLEMAN-WUNCH ALGORITHM USING GRAPHIC ACCELERATORS

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Bioinformatics represents a new field at the interface of the twentieth-century revolutions in molecular biology and computers. A focus of this new discipline is the use of computer databases and computer algorithms to analyze proteins, genes, and the complete collections of deoxyribonucleic acid (DNA) that comprises an organism (the genome). A major challenge in biology is to make sense of the enormous quantities of sequence data and structural data that are generated by genome-sequencing projects, proteomics, and other large-scale molecular biology efforts. The tools of bioinformatics include computer programs that help to reveal fundamental mechanisms underlying biological problems related to the structure and function of macromolecules, biochemical pathways, disease processes, and evolution. According to a National Institutes of Health (NIH) definition, bioinformatics is "research, development, or application of computational tools and approaches for expanding the use of biological, medical, behavioral or health data, including those to acquire, store, organize, analyze, or visualize such data." The related discipline of computational biology is "the development and application of data-analytical and theoretical methods, mathematical modeling and computational simulation techniques to the study of biological, behavioral, and social systems."

The Needleman–Wunsch algorithm is an algorithm used in bioinformatics to align protein

or nucleotide sequences. The algorithm was developed by Saul B. Needleman and Christian D. Wunsch and published in 1970.The algorithm essentially divides a large problem (e.g. the full sequence) into a series of smaller problems, than optimizes the results. The algorithm is widely used for optimal global alignment, especially when the quality of the global alignment is of the utmost importance. The algorithm assigns a score to every possible alignment and his purpose is to find all possible alignments having highest score.

The DNA sequences are available in FASTA format, which are stored in NCBI (The National Center for Biotechnology Information). The structure of one FASTA file is presented by a thousand rows – a nucleotid sequences. A large computing resource is required for comparing and searching for matches. The graphical accelerators are suitable for this problem. GPUs (Graphical Processing Units) have thousands of cores,which can be used for parallel comparison. In 2006 appears the CUDA (Compute Unified Device Architecture) architecture, which can be used for parallel programming, using languages like FORTRAN/C, ACC, C++.

Stefan Stoyanov is 4th year PhD student at the Technical University Sofia branch Plovdiv, Department of Computer Systems and Technologies. He has MSc degree in Computer Systems and Technology from Technical University of Sofia and BSc degree in Computer Systems and Technology from Plovdiv branch of Technical University of Sofia. His PhD research interests and activities are in Computer Architectures, Computer Security, RISC-V processors and Machine Learning

SECURE HETEROGENEOUS ARCHITECTURE

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Embedded processors are the core of smart and IoT devices. For the last two decades, they were primarily ARM instruction set based but since the RISC-V instruction set was introduced 15 years ago, things came to a state where RISC-V challenges ARM supremacy. Due to the open nature of this instruction set, it became popular for both industry and academic studies, as it enables freedom of design, implementation and scalability.

Along with the benefits, RISC-V becoming mainstream technology leads to an increased risk of cyber attacks, necessity for data protection and execution security. Many solutions to these challenges are ported from other platforms, new approaches were introduced and advanced researches are being conducted to handle the ever-existing security threads.

The latest technology and future development direction of RICS-V security research is still to be defined.

A common tendency in computer security especially implementing Root-of-Trust is isolation in terms of hardware resources and access to these resources. Best results can be achieved if there is a complete isolation, even between the execution flows of user programs, kernel and security targeted code, which naturally leads to the use of multi-processor systems. Based on the security level of each processor it might or might not have access to the other processor

resources thus defining one of the processors as a security core. These processors perform different computations and algorithms. To optimize the device means that these processor cores should not be identical but have the minimum functionality to perform their tasks. As RISC-V base instruction set includes just 47 instruction it means that we can have very small cores perform different tasks which minimizes chip size and power consumption.

Cyber-security faces constant attempts to exploit previously undiscovered security holes. While software can easily be patched and misbehavior detected by the user, hardware security issues can only be partially fixed by software resulting in performance degradation and can also go unnoticed by the user. Hardware implemented mechanisms can spot unauthorized code on very low level. Having a separate RISC-V RoT core which is able to identify security threads can significantly improve the reliability of a RISC-V base heterogeneous computer system.

Stefan Lishev is PhD student at the Technical university of Sofia - branch Plovdiv, Faculty of Electronics and Automation (FEA). He received B.Sc. degree in "Computer Systems and Technologies" in 2008 and a M.Sc. degree in 2010. The subject of his PhD is „Methods and means for remote measurements of atmospheric air parameters . He works now at the Department of Computer Systems and Technologies. His main interests are embedded systems, wireless sensor networks, digital signal processing,

METHODS AND MEANS FOR REMOTE MEASUREMENTS OF ATMOSPHERIC AIR PARAMETERS

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Measuring different parameters of atmospheric air is important for air pollution control, monitoring of CO2 in the light of global warming, weather forecasting, environment monitoring for public safety and etc. Air quality is one of the most important factors for human life. It is vital to monitor indoor and outdoor air parameters and to do appropriate measures. In the recent years the technology advances increasingly and that makes possible to produce many types of low-cost sensors and microcontrollers that have low power consumption.

Poor air quality is one of the key factors, that contribute to low quality of life and also to number of diseases, including cardiovascular and pulmonary. The pollutants that contribute to poor air quality in cities are mainly from on-road vehicles and can be classified in two groups – primary and secondary. The first group are produced directly by pollution sources like gases from combustion, some of which are Nitrogen Oxides NO2, Sulfur Dioxide SO2, CO and CO2, or particulate matter (PM) with various sizes, for example fine particles PM2.5. PM in atmosphere are complex mixtures of elemental carbon (EC), organic carbon (OC), mineral dust and water aerosols. Within this group are organic compounds, classified as Volatile Organic Compounds VOC. Some of them are benzene, toluene, ethylbenzene, and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and

polychlorinated dibenzo–p–dioxins and dibenzofurans (PCDD/Fs). They are mutagenic and possibly carcinogenic. The other group – secondary pollutants are produced not directly but as a reaction in the atmosphere from the primary contaminates. One example is Ozone O3, which is toxic. So, it's important to monitor outdoor as well as indoor air quality in order to take appropriate measures such as frequent ventilation, managing traffic in big cities or increasing green spaces in urban areas.

Sensors that are examined are different types from the low-cost air sensors class. While not so accurate as the certified stations for monitoring air parameters, they provide very good precision data in real time. The developed hybrid architecture of a system based on wireless sensor network and IoT has been tested with the open-source network simulator ns-3. The focus of the study is the consumption of end devices and the selection of optimal parameters of the radio link for usage in environment monitoring in real time. End devices with air sensors could be stationary, on mobile platforms such as bicycle or on a drone.

Tihomir Stoyanov is 3rd year PhD student at the Technical University Sofia branch Plovdiv, Department of Control Systems. He has MSc and BSc degrees in Automation, Information and Control Technology from Plovdiv branch of Technical University of Sofia. His PhD research interests and activities are in Robotics, Artificial Intelligence, and Machine Vision.

VISUAL SERVOING - OVERVIEW

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Vision guided robotics has been one of the major research issue for more than five decades. The more recent technological development facilitated the advancement in the area which has resulted in a number of successful and even commercial systems using off–the–shelf hardware. The applications of visually guided systems are many: from intelligent homes to automotive industry. The overview concentrates on different types of visual servoing: image based, position based and 2 1/2D visual servoing.

Using visual feedback to control a robot is commonly termed visual servoing. Visual (image based) features such as points, lines and regions can be used to, for example, enable the alignment of a manipulator / gripping mechanism with an object. Hence, vision is a part of a control system where it provides feedback about the state of the environment. Visual servoing has been studied in various forms for more than five decades starting from simple pick–and–place tasks to todays real-time, advanced manipulation of objects. In terms of manipulation, one of the main motivations for incorporating vision in the control loop was the demand for increased flexibility of robotic systems.

Radoslav Furnadzhiev is a PhD student at the Technical University Sofia branch Plovdiv, Faculty of Computer Systems and Technologies. He has hands-on experience in the development of data-intensive applications that involve processing, analyzing, and storing large volumes of data. His PhD research is focused on exploring orchestration and coordination architecture patterns aimed at achieving high scalability and availability in modern containerized applications. Radoslav also holds an MSc degree in Computer Science from the same institution.

SCHEDULING AND RESOURCE ALLOCATION OF CONTAINERIZED APPLICATIONS

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Cloud computing has become a cornerstone of modern IT infrastructure, offering on-demand access to computing resources and providing users with benefits such as automatic scaling, simplified management, and dynamic resource allocation. To fully exploit these advantages, various architectural paradigms have emerged, enabling the efficient development and deployment of complex software systems.

Among these, container-based microservice architectures have gained significant popularity. This approach involves packaging an application along with its dependencies into a lightweight container image that can run uniformly across different environments. The adoption of containerization technologies has been significantly accelerated by orchestration platforms like Kubernetes, which provide robust support for the deployment, scaling, and lifecycle management of containerized applications.

Scheduling applications in a Kubernetes cluster is a multifaceted and critical task that directly affects system performance and reliability. Efficient scheduling strategies are needed to ensure that workloads are placed on the right nodes, respecting resource requirements and constraints while minimizing disruption and maximizing throughput. These strategies often

incorporate advanced optimization algorithms to handle the dynamic nature of cloud-native environments.

In addition to traditional scheduling metrics such as CPU and memory utilization, modern Kubernetes clusters are increasingly considering energy and thermal-aware resource allocation. As data centers continue to grow in scale, energy efficiency has become a crucial concern. Scheduling decisions can now factor in power consumption, thermal limits, and environmental impact, enabling smarter placement of workloads to reduce energy waste and manage heat distribution. Another growing area of focus is network topology awareness, especially in large-scale and geo-distributed Kubernetes clusters. In such setups, scheduling decisions must account for latency, bandwidth availability, and data locality. Understanding the underlying network structure enables more efficient placement of interdependent services, minimizing cross-node and cross-region communication overheads.

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APPLICATION OF AI IN MANAGEMENT INFORMATION SYSTEMS AND BUSINESS ANALYTICS

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Management information systems (MIS) are information systems used for decision-making, and coordination, control, analysis, and visualization of information regarding the processes, people and technology employed within an organizational setting. The field of MIS increasingly often relies on the implementation and integration of AI tools to transform aggregated organizational and business data into insights for improving business decisions as well as for development of process automation solutions. Initially, research efforts were focused on preparing a comprehensive literature review on the topic of application of AI in MIS with the aim of identifying types of AI tools utilized in and developed for MIS, types of platforms for AI deployment, as well as business categories that most benefit from the introduction of AI in terms of value generated. The study recognized gaps in previous research efforts in the field as opportunities, identified challenges in the research field and offered future research directions that can bridge these gaps:

- Artificial Intelligence for Management Information Systems: Opportunities, Challenges, and Future Directions, Stoykova, S., Shakev, N., Algorithms 2023, 16, 357, **DOI:** 10.3390/a16080357

Three main categories of tasks, inherent to MIS, which can benefit from the introduction of AI-based methods and solutions were identified in the literature review:

- Intelligent Robotic Process Automation (iRPA)

- Cognitive interaction
- Operational analytics

Our previous research revolves around the implementation of (iRPA) for document extraction and information extraction within the most widely distributed ERP system SAP Business Technology Platform with the goal of reducing human workers' involvement in time-consuming low value tasks. A use case scenario quantifying the business value of integrating iRPA bot chains in small and medium-sized enterprises was developed:

- Intelligent Robotic Process Automation for Small and Medium-sized Enterprises, Stoykova, S., Hrischev, R., Shakev, N., **DOI:** 10.1109/ICAI55857.2022.9960077
- Bot Development for Intelligent Automation in ERP Systems, Stoykova, S., Hrischev, R., **DOI:** 10.1109/ICAI55857.2022.9959995

Furthermore, within the field of cognitive interaction a chatbot digital assistant solution was developed. A version of the solution was integrated as a cloud service within the SAP BTP platform. The aim of the chatbot is to contribute to the workforce on-boarding and training process as a human experience management (HXM) tool in the field of industrial robotics:

- Generative AI-Driven Personnel Training in Industrial Robotics through Intelligent HXM, Stoykova, S., Shakev, N., **DOI:** 10.1109/ICAI63388.2024.10851547

The digital assistant has been trained locally on manuals and technical documentation for a Mitsubishi industrial robot as well as a command database for the programming language MELFA Basic V. Some of the identified disadvantages to this solution were regarding data privacy, operational costs and downtime due to reliance on cloud infrastructure. Thus, a second version of the digital assistant platform was developed, which can be trained on user-provided content with all data and AI models stored locally on user machines. The new model provides privacy (no data is shared with model or cloud providers), which is ideal for implementation in research organizations, as well as significantly reducing operational costs, which makes it ideal for small and medium-sized enterprises.

Lastly, significant research efforts were dedicated to researching AI methods applicable to operational analytics in the context of CRM systems and related KPIs.

Mincho Velkov is a second-year PhD student at the Technical University of Sofia, Department of Power Supply and Electrical Equipment. He holds a Master's degree in Electrical Engineering from the Technical University of Sofia, Plovdiv Branch, and a Bachelor's degree in Power Supply and Electrical Equipment from the Technical University of Ruse. His PhD research interests and activities are in the field of …

RENEWABLE ENERGY GENERATION AND BALANCING

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Modern construction is evolving towards sustainability and energy efficiency, with renewable energy sources playing a key role in this process. The use of solar energy in buildings significantly reduces the carbon footprint and dependence on fossil fuels. Smart energy systems, integrated with modern construction technologies, enable efficient energy resource management and cost optimization. Additionally, renewable energy sources combined with innovative architectural solutions provide better energy efficiency, a modern aesthetic, and sustainability. This article explores innovations in construction related to renewable energy sources, as well as the challenges and prospects for their wider application. As the scale of infrastructure projects increases, so do the maintenance costs for the common areas of the facilities. In many cases, maintaining the common areas of an energy facility requires significant funds. The aim of this study is to provide a new solution for optimizing electricity costs for a specific site.

Ana Dimitrova is a first-year PhD student at the Technical University of Sofia, Department of Electrical Engineering. She holds a Bachelor's and Master's degree in Mechanical Engineering and Technologies, as well as a Master's degree in Electrical Engineering from the Plovdiv branch of the Technical University of Sofia. Her research interests and activities within the framework of her PhD studies are focused on Electrical Engineering materials and the impact of technological processes on their electrical properties.

"RESEARCH ON MODIFIED ALUMINUM FOR ELECTRICAL ENGINEERING APPLICATIONS"

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Electrical engineering materials constitute the basis of contemporary electrical systems and are imperative for the fabrication of components utilized in the energy sector. These materials play a pivotal role in the transmission and distribution of electrical energy, thereby ensuring the functionality of the modern world.

Among the most commonly used metallic conductors, aluminum (Al) and copper (Cu) are particularly noteworthy, along with their alloys containing zinc (Zn), manganese (Mn), silicon (Si), and other elements. These materials exhibit exceptional electrical and mechanical properties, rendering them indispensable for a wide range of applications. These materials are particularly useful in applications where weight reduction and mechanical performance are crucial factors.

Aluminum (Al) is one of the most frequently utilized materials in the field of electrical engineering. This is primarily due to its excellent electrical conductivity, low density, and comparatively lower cost when compared to copper (Cu). However, pure aluminum exhibits certain limitations that constrain its application in specific high-reliability electrical engineering systems. To address these limitations, aluminum is often alloyed with other metals, modified through chemical or physical processes, or exposed to thermal treatments. These modifications

aim to enhance its electrical and mechanical properties, making it a more versatile material for various engineering applications.

A diverse array of modifiers is employed to modify aluminum (Al) and its alloys. The most widely applied alloying elements include copper (Cu), which increases strength and electrical conductivity; manganese (Mn), which improves corrosion resistance and mechanical properties; silicon (Si), which reduces electrical resistance and enhances wear resistance and magnesium (Mg), which increases strength, hardness, and other mechanical characteristics. Thermal treatment through quenching and aging can further enhance the mechanical properties of aluminum alloys and electrical engineering materials with minimal loss of electrical conductivity, which is of critical importance.

Modified aluminum is most commonly applied in: (1) High-voltage power lines – due to its favorable strength-to-weight ratio; (2) Busbars and conductors – in industrial electrical installations; (3) Transformer windings – in applications requiring a balance between efficiency and cost; (4) Switchgear components – where reducing electrical contact losses and improving mechanical properties without degrading electrical parameters could lead to significant economic advantages, such as reducing material and production costs, improving energy efficiency, and extending the service life of components.

The utilization of diverse methodologies to augment the mechanical properties of aluminum and aluminum alloys, in conjunction with the incorporation of neutral refractory particles at the nano- and microscale, subsequent to plastic deformation processes, exerts a profound influence on the material's structure and properties. A phase analysis has been conducted, revealing that the particles are embedded within the melt. Research studies have demonstrated an enhancement in material hardness and a marginal improvement in strength. The ongoing pursuit of enhancing the mechanical properties of metals and alloys utilized in electrical engineering without compromising their electrical conductivity remains a subject of worldwide scientific investigation.

I am attaching my latest work related to my dissertation:

1. A. Dimitrova, I. Draganova-Zlateva, S, Stefanov. Influence of Technological Processes on the Electrical Properties of Electrical Engineering Materials, 16th Electrical Engineering Faculty Conference BulEF 2024, Varna, Bulgaria, IEEE, 2024. ISBN 979-8-3503-9167-1, ISSN: 2831-5782, DOI: 10.1109/BulEF63204.2024.10794901

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Methods and tools for implementing intelligent mobile systems in the field of personalized healthcare

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In the realm of modern medicine, the synergy between human expertise and artificial intelligence (AI) through collaborative decision-making promises to revolutionize healthcare by enabling highly effective, patient-centered outcomes. Machine learning (ML), a core pillar of AI within computer science, leverages a diverse array of methods and algorithms—spanning supervised learning, which relies on labeled datasets for predictive modeling; unsupervised learning, which uncovers hidden patterns in unlabeled data; and reinforcement learning, where systems optimize decisions through trial and error. These techniques underpin the development of intelligent systems that adjust and react to complex healthcare needs.

Historically, the application of ML in medicine was limited to standalone systems, disconnected from the rich, structured data of electronic health records (EHRs). In contrast, today's healthcare landscape is shifting toward a dynamic, learning health system. This paradigm integrates real-time insights obtained from EHRs, including digitized clinical data such as patient histories, diagnostic results, and treatment outcomes, into actionable care strategies. The widespread adoption of mobile health technologies further amplifies this transformation. Intelligent mobile systems, equipped with sensors and connectivity, collect continuous streams of data from clinical trials and remote monitoring in home environments, tracking vital signs like heart rate, glucose levels, or physical activity. The integration of these data sources generates an extraordinary abundance of information, enabling the customization of interventions for individual patients with enhanced precision.

However, these advancements also introduce significant challenges, including data privacy concerns, the need for robust interoperability between heterogeneous systems, and the computational complexity of processing large-scale, multi-modal datasets. My research focuses on developing methods and tools to address these hurdles, harnessing AI-driven approaches—such as deep learning for pattern recognition and natural language processing for extracting insights from unstructured clinical notes—and integrating them into mobile platforms. These intelligent systems aim to bridge the gap between data and delivery, empowering healthcare providers and patients alike to achieve personalized, high-efficacy care. Ultimately, this work contributes to the broader transition toward a future where healthcare is not only reactive but also predictive and preventive, driven by the seamless collaboration of human ingenuity and computational intelligence.

Georgi Bodurov is a 1st year PhD student at the Technical University of Sofia (Plovdiv branch) Department of Electronics, Faculty of Electronics and Automation (FEA). He holds an MSc in Electronics from the Technical University of Sofia, Plovdiv branch. The subject of his PhD thesis is "A study of the energy exchange in the power source-asymmetrical bridge converter-switched reluctance motor system in bidirectional operation under different control algorithms".

PERSPECTIVES AND FEATURES OF ENERGY CONVERSION IN ELECTRIC DRIVES WITH SWITCHED RELUCTANCE MOTOR

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The switched reluctance motor (SRM) has garnered significant interest for various industrial applications, including wind power systems and electric vehicles. This is largely due to its simple and robust design, high torque capacity, wide speed range, and outstanding energy efficiency.

A key area of research involves advancing and refining control algorithms for SRMs in both motoring and generating modes, particularly for energy recovery purposes. This topic is of considerable importance in both industrial and academic settings. The rapid development of electronic components and technologies provides a strong foundation for ongoing studies and research in this area.

It is essential to analyze the energy exchange processes within the power source—the asymmetrical bridge converter and switched reluctance motor system—during their operation in motoring and generating modes. Additionally, the effects of various control algorithms on load characteristics, torque ripples, and power loss distribution within the motor should be thoroughly examined.

The main part of the research focuses on the development, modeling, and implementation of a high-efficiency SRM converter based on SiC/GaN devices. This includes creating analytical and experimental methodologies to predict losses in a three-phase 12/8 SRM under normal operating conditions, including saturation. The study also investigates copper and iron losses in relation to the level and waveform of the exciting currents, the switching frequency, and the phase conduction period.

Konstantin Hristov is a 1st year PhD student at the Technical University of Sofia (Plovdiv branch) Department of Electronics, Faculty of Electronics and Automation (FEA). He holds a BSc in Business Economics from The University of Exeter, an MSc in Management from The London School of Economics and an MSc in Electronics Engineering from the Technical University of Sofia (Plovdiv branch). His PhD research interests are in the field of sensors, industrial automation and safety systems.

Enhancing Accuracy and Reliability in Industrial Fire and Gas Detection Systems: Hardware and Software Solutions to Minimize the Adverse Effects of Environmental Factors and Sensor Degradation

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Over the past 30 years, rapid advancements in industry have led to increased process efficiency and reliability, but this has come at the price of greater complexity and a heightened need for cohesive safety programs. Fire and gas detection systems have undergone significant evolution as a result. From more robust data transmission protocols and wider integration options, to self-testing and cloud-based analytics, advancements have emerged in every aspect of these technologies.

Due to application-specific limitations, the sensor layer has arguably received the least amount of attention from academics and practitioners. While this can partially be attributed to the available selection of mature, low-cost sensing technologies, it also points to optimization possibilities that could further improve the in-field performance of these systems.

More specifically, the development of hardware and software solutions which minimize the adverse impacts of environmental factors (temperature, humidity, the presence of contaminants) and allow for dynamic drift compensation, predictive maintenance and anomaly detection, could bridge the gap between existing sensor options and the emerging needs for adaptive control systems. Such solutions would allow practitioners to circumvent some of the limitations related to the use of these low-cost sensors and perhaps also offer some transferable principles to be applied in dealing with operational challenges in the use of micro-electro-mechanical (MEMS) sensors.

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Research on Methods and Techniques for Early Detection of Life-threatening Sudden Illnesses in Motor Vehicles Drivers

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Road accidents are a global issue. The increasing number of vehicles in our everyday life is rising the probability for a fatal car crash. Meanwhile the population of the developed countries is getting older. As a result, the drivers are vulnerable to sudden medical emergency events. When the two factors are combined, we can expect a growing number of road accidents in the future due to driver's heart attacks, strokes, or loss of consciousness. These events can strike without warning putting in danger other drivers, passengers, pedestrians, and other road users. Finding a solution to this problem could significantly reduce potential tragedies and prevent serious consequences. Since our modern cars are equipped with advanced electronic systems, they can offer technological solution to the problem by real-time monitoring of the driver's health status by early detection methods.

mong the human factors which contribute to road accidents and crashes special attention deserve medical conditions, drowsiness, and fatigue. The current state of implemented automotive safety technologies in our vehicles include detection of behavioral and psychological driver monitoring by a system called DMS (Driver Monitoring System). The existing DMS detects conditions like awareness, distraction, drowsiness, fatigue, and posture. The future DMS will implement bio-metric sensors for physiological vital sign monitoring. It

will detect heart rate, heart rate variability, respiratory rate, blood pressure, body temperature, skin conductance, and oxygen saturation. The interest of research community and automotive industry in development of methods and techniques for physiological monitoring was described in a PhD literature review. This paperwork includes a study of existing methods like Electrocardiogram, Photoplethysmogram, Electroencephalogram, Electrodermal Activity etc. applied in motor vehicles to improve safety and driver monitoring.

Monitoring the physiological parameters of the vehicle driver in a real-road driving is a very challenging task, as the signals from biomedical sensors are often distorted by noises, motion artefacts and vibrations inside the car. The first steps taken towards mitigation of accidents impact and vehicle collisions are real-time data collection of driver vital physiological signs in real driving scenarios on different road types. The results from that research show the optimal locations of sensing electrodes and sensors on driver's body for obtaining high quality signals. This work was presented at the XXXIII International Scientific Conference "Electronics ET2024" and was published in a paper:

"Driver physiological parameters monitoring–initial study in real-road driving", Radev Hr., Petrova G., Spasov Gr., DOI: 10.1109/ET63133.2024.10721508

Future research will concentrate on applying digital signal processing techniques to the collected data to identify early signs of medical emergency events in drivers. Our final goal is monitoring the health state of the driver to recognize the first predictors of adverse and severe health conditions which can cause road accidents and fatal crashes.