R E V I E W

by Prof. Eng. Nikolay Dimitrov Madjarov, PhD – Technical University of Gabrovo
of the materials submitted for participation in the competition for the academic position of "Associate professor"
in the field of higher education: 5. Technical Sciences,
professional direction: 5.2. Electrical Engineering, Electronics and Automation,
specialty - „Automated Systems for Information Processing and Control "(Technical Means for Automation, Design of Control Systems).

1. Brief biography.

In the competition for the position of "associate professor", which has been announced in The State Gazette, issue 48 from 13.06.2025 and also on the website of the Technical University of Gabrovo, as a candidate for the needs of the department of Automation, Information and Control Systems at the faculty of Electrical Engineering and Electronics participates Chief Assist. Prof. Eng. Georgi Ivanov Mihalev, PhD.

Georgi Mihalev was born on February 9, 1989, in Gabrovo, Bulgaria. He completed his higher education at the Technical University of Gabrovo, obtaining a Bachelor's degree in 2012 and a Master's degree in 2013, with a professional qualification of Master Engineer in Automation.

Between 2012 and 2017, he worked as an orientation specialist and fitter at the company TEMP-01, Gabrovo, and since 2017 he has held the position of Production Organizer in the same company.

In 2017, following a competitive selection procedure, he was appointed Assistant Professor in the Department of Automation, Information and Control Systems at the Technical University of Gabrovo. Since 2019, he has held the position of Chief Assistant Professor.

His research activity began in 2013, when he enrolled as a full-time PhD student in the Department of Automation, Information and Control Systems at the Technical University of Gabrovo. In 2017, he successfully defended his doctoral dissertation on the topic "Intelligent Control of a Class of Discrete Technological Processes" in the scientific field Automated Systems for Information Processing and Control (Diploma No. 0071, dated September 20, 2017).

He is a member of IEEE and the Union of Automation and Informatics. He has a good command of English and an intermediate level of German, which enables him to maintain professional contacts and exchange scientific information with colleagues abroad working in his research field.

2. General description of the submitted materials.

The candidate has presented a list of eight publications related to the doctoral dissertation. For the current competition, 44 scientific papers, one textbook, and one teaching aid—published after the defense of the PhD thesis—have been submitted for review.

Of the reviewed scientific works, eleven are research papers published in conference proceedings in Bulgaria and Romania, indexed in Scopus [B.4.1 – B.4.11]. The remaining 33 papers and reports [G.8.1 – G.8.33] have been presented at scientific forums in Bulgaria, including six papers published in the journal Automation and Informatics [G.8.14, G.8.21 – G.8.24, G.8.29] and 27 papers in the proceedings of national and international conferences held in Bulgaria.

Among these works, eleven are written in Latin and thirty-three in Cyrillic. Four are single-authored; ten are co-authored with one collaborator; eighteen with two co-authors; and the remaining twelve involve three or more co-authors. The candidate is listed as first author in 18 publications, second in 13, and third in 13.

Regarding the evaluation according to the groups of indicators for meeting the minimum national requirements, Chief Assistant Professor Dr. Eng. Georgi Ivanov Mihalev has presented evidence of accumulated points as follows:

Group A (*minimum 50 points*) – Doctoral dissertation: **50 points**;

Group B (*minimum 100 points*) – Scientific publications equivalent to a monograph: 11 publications with varying numbers of co-authors, totaling **271 points**;

Group G (*minimum 200 points*) – Scientific papers in non-indexed peer-reviewed journals or edited collective volumes: 33 publications, totaling **266.72 points**;

Group D (*minimum 50 points*) – Citations: **D12:** Citations in internationally indexed and referenced scientific journals – *4 publications cited 6 times* – **60 points**; **D13:** Citations in monographs and peer-reviewed collective volumes – *7 publications cited once each* – **21 points**; **D14:** Citations or reviews in non-indexed peer-reviewed journals – *2 publications cited once each* – **4 points**. **Total for Group D – 85 points**.

The minimum number of points required by the Law for the Development of the Academic Staff in the Republic of Bulgaria and the regulations of the Technical University of Gabrovo for acquiring academic degrees and positions is 400 points. Chief Assistant Professor Eng. Georgi Ivanov Mihalev, PhD has accumulated a total of 672.72 points, representing 168% fulfillment of the required indicators.

Through the submitted materials—11 scientific papers equivalent to a monograph, 33 additional scientific publications, and 15 citation references—the candidate fully meets the minimum national requirements for holding the academic position of Associate Professor in the field of Technical Sciences, as stipulated in Article 2b of the Law for the Development of the Academic Staff in the Republic of Bulgaria.

3. Impact of the candidate's scientific publications within the academic community (known citations).

The works of Chief Assistant Professor Eng. Georgi Ivanov Mihalev PhD are well known within the scientific community in the research field to which the presented report pertains. It is noted that seven of his publications have been cited a total of fifteen times in the scientific works of other researchers. A significant portion of these citations appear in international scientific journals. As a result of his publication activity, the author currently has a Hirsch index (h-index) of 1, excluding self-citations.

4. Overview of the content and results presented in the submitted works.

The 44 submitted scientific publications are directly related to the academic field for which the competition has been announced. Based on their content and obtained results, they can be grouped as follows:

4.1. Modeling and control of electrohydraulic systems.

The majority of the publications were produced in the period 2020–2024 (eight of which are indexed in Scopus) and address specific challenges in modern manufacturing, contemporary environmental protection requirements, and the role of electrohydraulic servo systems, which provide precise control and high efficiency in a wide range of industrial applications.

Within this thematic area, the candidate presents methods for identification and parametric optimization of an electrohydraulic system [B.4.1, B.4.2]. Based on the developed simulation model, both a nonlinear model and a linearized state-space model have been

constructed. Various types of controllers have been developed and tested, including conventional PI and PID controllers [B.4.1, B.4.2], fuzzy controllers [B.4.3], robust controllers [B.4.5, G.8.14], adaptive and multiparametric controllers [B.4.8, G.8.31], a model predictive controller [B.4.9], and switching multiregulator control strategies [B.4.7], among others. Additionally, the influence of the working fluid temperature on the dynamic performance of the electrohydraulic servo system has been investigated, and the results concerning control quality are presented in [B.4.6].

4.2. Artificial intelligence and machine learning in automation.

These works correspond to the field of industrial artificial intelligence, which is a multidisciplinary research area focused on various components of industrial processes with the aim of achieving sustainable productivity. In [B.4.10], key approaches for the implementation of artificial intelligence in PC-based control systems for industrial processes are studied and proposed. The developed RAD application functions as a GPT terminal that receives messages for consultation or data analysis. An example of implementing artificial intelligence in a PC-based control application for a solar power plant is presented in [B.4.11]. The proposed architecture ensures modularity between the AI logic, auxiliary functions, and control mechanisms. For simulation testing, a bidirectional connection with a Matlab/Simulink model has been implemented, and the obtained results demonstrate improved efficiency under dynamic conditions. In [G.8.28], the author discusses the main approaches for developing algorithms for business analytics and presents examples of their application in real business scenarios, demonstrating how AI can transform traditional processes and foster innovation and sustainable growth.

Some of the works focus on the use of deep learning platforms [G.8.17] for the development of applications running on superclusters built from embedded (on-board) computers [G.8.15].

The possibility of applying conventional artificial neural networks (ANNs) for the control of environmental systems, in particular beehives, is also explored. A real-time beehive monitoring system has been developed [G.8.20, G.8.21], measuring parameters such as hive weight, internal and external temperature, and humidity. To automate and optimize beehive maintenance, ANNs are employed to predict hive weight, and three network types—NARX, NAR, and NIO—are investigated [G.8.19].

In [G.8.29], the problem of approximating impulse (transient) system responses is addressed through the use of Laguerre orthonormal functions and artificial neural networks. The study aims to optimize the process of generating the Laguerre function set for systems with parametric uncertainties, resolving issues related to determining the time-scaling factor, the number of orthonormal functions, and the decomposition coefficients.

4.3. Automation and robotics.

This thematic area includes research in two main directions — modeling of robotic manipulators and the use of industrial robots. A robotic system of the anthropomorphic finger type has been developed. The research focuses on issues related to the construction and analysis of the kinematic model, proposing a functional interdependence between the motions of individual joints [B.4.4]. Servomotors are used as the main actuating elements, and in [G.8.25] a mathematical description of the DM-S2006MD servo drive has been developed, along with a corresponding Simulink model. The previously unknown parameters of the drive have been identified.

In the second direction, a combination of an industrial robot Fanuc LRMate 200iD 4S and a CMM (Coordinate Measuring Machine) is investigated for camera calibration, with the aim of enabling subsequent 3D scene reconstruction. The author proposes solutions to certain problems arising in the use of industrial robotic systems and their associated software. Subsequently, the camera calibration process based on Zhang's method is explored [G.8.9, G.8.10]. An alternative approach is proposed, replacing the previously used region-of-interest feature detection algorithms with segmentation algorithms based on edge and boundary detection in the image [G.8.23].

4.4. Intelligent systems for process monitoring and control.

The main developments in this thematic area concern the design and implementation of intelligent systems of various types, including:

- **intelligent system for part orientation** – a system for part orientation in a vibratory bowl feeder has been developed [G.8.1], based on an artificial neural network and a coordinate measuring machine (CMM). With minor modifications, the same system has been applied to monitor the alignment of printed images on film as part of an automated production line [G.8.2]. The system was further extended by developing a controller for the vibratory feeder [G.8.4], complemented by a virtual monitoring tool for detecting the resonance frequency [G.8.5]. The control of the object using a model predictive controller has been investigated [G.8.12], as well as various techniques for preventing integral windup when using PID controllers [G.8.11, G.8.16, G.8.27];
- **system for monitoring labor productivity** – a real-time production load monitoring system has been developed and implemented. It is based on the ESP32 microcontroller and organized into three hierarchical levels: controller level, server level, and configuration software level [G.8.6, G.8.7];
- **intelligent system for waste collection management** – The structure of an intelligent waste management system for urban and suburban environments is presented. The system aims to optimize waste collection schedules and reduce overall operational costs. It provides real-time information about the amount of waste in collection points, household waste generation, and landfill deposits [G.8.22];
- **system for health monitoring of pregnant women** - A maternal health monitoring system has been designed and implemented, focusing on the use of modern IoT technologies to provide accessible and efficient monitoring solutions. The system enables continuous observation of key health parameters such as heart rate, oxygen saturation, body temperature, and microclimatic conditions, which are essential for the prevention of risk conditions and timely response to complications [G.8.24];
- **traffic management system** – he use of multi-agent system technology for regulating urban traffic is presented, focusing on optimizing the operation of traffic light cycles to improve traffic flow [G.8.18];
- **other specialized systems** – Although not directly related to the specific field of the competition, these developments are closely connected to the candidate's teaching and research activities. Among them is an ***intelligent system for food quality assessment***, developed using metal-oxide gas sensors. Artificial neural networks trained with data collected from the same system are used as classifiers. The system has been successfully applied to identify the quality of various types of meat (pork, beef, and duck), achieving over 90% recognition accuracy [G.8.3, G.8.13]. Other specialized systems with specific applications have also been developed, including ***software-based test systems for***

verifying electrical connectivity in sensor design [G.8.31, G.8.32] and a ***smart application for setting operating parameters of a plastic extrusion machine*** [G.8.33]

5. General characteristics of the candidate's professional activity.

5.1. Teaching and pedagogical activity (work with students and doctoral candidates).

Chief Assistant Professor Eng. Georgi Ivanov Mihalev PhD has eight years of experience as a university lecturer in the Department of Automation, Information and Control Engineering, Faculty of Electrical Engineering and Electronics, at the Technical University of Gabrovo.

He has participated in the educational process by delivering lectures in disciplines related to the thematic scope of the competition, including Technical Means for Automation, Advanced Mathematics I, Advanced Mathematics II, and Informatics. He has also conducted laboratory exercises in a wide range of subjects, such as Programming and Computer Use, Applied Programming, Design of Control Systems, Real-Time Control Systems, Informatics, Advanced Mathematics I, Advanced Mathematics II, and Practical Training.

He has supervised course projects in Technical Means for Automation and Design of Control Systems. He is a co-author of one textbook and author of one teaching aid.

In March 2025, under his supervision, a team of students from the ARKUS specialty participated in a **hackathon on the topic "Artificial Intelligence and Smart Cities"** and won first place with the project titled "Guide Stop".

Since 2017, the candidate has supervised 33 diploma (graduation) theses and has reviewed 44 diploma works. His participation in professional qualification courses and seven research and educational projects has significantly contributed to his excellent preparation and competence as a university lecturer.

5.2. Research and applied scientific activity.

The candidate's first publications (eight in total) were produced during the period 2013–2016 and are related to his doctoral dissertation. His main research and applied scientific activity, which is directly relevant to the present competition, began in 2017, following his appointment as an Assistant Professor at the Technical University of Gabrovo. This activity is represented by 44 scientific papers, one textbook, and one laboratory manual.

A characteristic feature of the candidate's research and applied work is its practical and application-oriented focus. Evidence of this is his participation, during the period in question, in seven university research projects, whose topics include:

- a system for the protection of classified information in automated information systems and networks;
- a methodology for the use of generative artificial intelligence in the preparation of scientific publications;
- a drug dispensing system with an architecture ensuring the protection of personal data;
- methods and solutions for the security of cyber-physical systems in the context of Industry 4.0;
- an electronic voting system for the Technical University of Gabrovo;
- and the optimization of an automated electrohydraulic system with intelligent control.

In summary, the research and applied scientific activity of Chief Assistant Professor Dr. Eng. Georgi Ivanov Mihalev is concentrated in the areas of modeling, control, and practical implementation of intelligent systems for process monitoring and control, as well as artificial intelligence, machine learning in automation, and robotics.

5.3. Implementation activity

In the materials submitted for the competition, no official documents certifying practical implementation have been included. However, a review of the attached publications reveals that a substantial portion of the candidate's research output is closely oriented toward solving practical problems related to the thematic scope of the competition — namely, automated systems for information processing and control. It should also be noted that Chief Assistant Professor Eng. Georgi Ivanov Mihalev, PhD is employed under a secondary labor contract as a Production Organizer at the company TEMP-01 Ltd., where he undoubtedly applies and implements his scientific developments in the fields of mechanization and automation.

6. Contributions (scientific, scientific-applied, and applied).

The main contributions in the works of Chief Assistant Professor Dr. Eng. Georgi Ivanov Mihalev fall within the category of developing new and improving existing research methods, designs, and studies in the field of design and implementation of control systems and technical means of automation. More specifically, they pertain to the following areas: Modeling and control of electrohydraulic systems; Artificial intelligence and machine learning in automation; Automation and robotics; Intelligent systems for process monitoring and control.

The contributions contained in the materials submitted by Chief Assistant Professor Dr. Eng. Georgi Ivanov Mihalev for participation in the competition can be systematized as follows:

Scientific and applied contributions.

1. Development and verification of a nonlinear mathematical model of an electrohydraulic laboratory stand and a system for dynamic control of various operating modes, functioning in real time and based on Matlab/Simulink and National Instruments modules.
2. Synthesis, implementation, and verification of a fuzzy control algorithm for an electrohydraulic system, utilizing data obtained from a tuned PID controller and a simulation model of robust control created through the application of the H∞ synthesis method.
3. Development of a PID controller with functional correction of the transfer function coefficients, taking into account the variations in temperature regimes across different zones of the electrohydraulic system.
4. Design of an architecture and simulation model of a supervisory multiregulator control system, accompanied by an analysis of the stability of the controlled object.
5. Development of a novel MISO (Multiple Input, Single Output) control architecture, consisting of a conventional PID controller operating in the deviation control loop and a fuzzy PID controller operating in the disturbance control loop.
6. Implementation of a model of an automated system with parametric uncertainties, achieving robust performance through a predictive controller utilizing Laguerre orthonormal functions and an additional output signal.
7. Derivation of a kinematic model of an anthropomorphic finger movement, as part of a robotic hand, using a hybrid approach and establishing the key functional relationships. An analysis and experimental study of the robotic system have been performed using differential kinematics and the workspace of the manipulator.
8. Development of RAD (Rapid Application Development) applications employing artificial intelligence to explore the potential of GPT models in the control of technological processes.

9. Enhancement of the synthesis of model predictive controllers for systems with structural and parametric uncertainties, through an approximation methodology in which artificial neural networks are used for the automatic generation of Laguerre orthonormal function decomposition coefficients.
10. Development of a novel methodology for automated industrial camera calibration, based on Zhang's algorithm applied to a set of positioned images, implemented through an industrial robot and a custom-developed hardware–software system.

Applied contributions.

1. Synthesis of a PC-based control system for a photovoltaic solar power plant, whose innovativeness lies in its specific architecture ensuring modularity between the AI logic, auxiliary functions, and control mechanisms, as well as the implementation of a bidirectional connection with a Matlab/Simulink model for simulation testing purposes.
2. It has been demonstrated that the use of image segmentation algorithms significantly improves the density of the generated 3D object. This feature has been applied in 3D scene reconstruction by integrating camera calibration and image segmentation–based visual processing into a unified robotic platform.
3. Synthesis of an integrated control system for the feeding and orientation module of different parts, using a machine vision system that includes modules for passive orientation, refilling, active orientation, computer vision, and intelligent centralized control with automatic resonance frequency detection.
4. Development and implementation of a real-time predictive monitoring system for beehives, utilizing artificial neural networks to forecast and analyze the condition of the hives.
5. Algorithm design, programming, and implementation of a hardware–software system for real-time monitoring of labor productivity and production capacity utilization in a light industry enterprise.
6. Design and construction of an integrated IoT-based intelligent waste collection management system, operating in real time and capable of dynamic planning and optimization of waste disposal processes.

7. Evaluation of the candidate's personal contribution.

The candidate's publication record — 44 scientific papers, one textbook, one teaching aid, and 29 known citations (according to the Scopus reference report) — clearly demonstrates that Chief Assistant Professor Eng. Georgi Ivanov Mihalev PhD is an active researcher, who possesses an excellent understanding of the current state and scientific achievements in his field, as well as a clear vision for the future directions of his research. Based on this information, I consider him to be an experienced and well-prepared lecturer. I am convinced that the formulated scientific-applied and applied contributions, as well as his teaching and methodological work, are the candidate's own achievements and demonstrate that his academic and research activity is innovative and fully consistent with the requirements for the academic position of Associate Professor.

8. Critical remarks and recommendations.

I have no significant critical remarks concerning the materials submitted for the competition. When reviewing the publications for participation in the competition, some overlap in topic and content is noticeable. I would, however, recommend that the candidate

focus his research and applied activity on a smaller number of thematic areas and accelerate the publication of his works in reputable journals with an impact factor. No official documents certifying the practical implementation of the research results have been provided, although such implementations undoubtedly exist, given the successful projects carried out by the research team at the Technical University of Gabrovo and the candidate's additional professional work as a Production Organizer at TEMP-01 Ltd..

9. Personal impressions

I have not collaborated with Chief Assistant Professor Eng. Georgi Ivanov Mihalev PhD in joint publications or projects. Based on the materials submitted for the competition and my personal impressions of his teaching, research, and design activities, I consider him to be a highly qualified and well-prepared lecturer in the field of Automated Systems for Information Processing and Control, and in particular in the areas of Technical Means for Automation and Design of Control Systems. His active publication record and additional professional engagement at TEMP-01 Ltd. demonstrate that he is an active researcher who is thoroughly familiar with the current state and scientific achievements in his field and has a clear vision for the future directions of his research.

10. Conclusion:

In view of the above, I propose that Chief Assistant Professor Eng. Georgi Ivanov Mihalev PhD be elected to the academic position of Associate Professor in the field of higher education 5. Technical Sciences, in the professional field 5.2. Electrical Engineering, Electronics and Automation, specialty "Automated Systems for Information Processing and Control" (Technical Means for Automation, Design of Control Systems).

20.10.2025 г. **Reviewer:**

/ prof. eng. Nikolay Dimitrov Madjarov, PhD /