



STATEMENT

on the competition for the academic position of **Associate Professor** in the professional field 5.2 "Electrical Engineering, Electronics and Automation", discipline "Management of Electromechanical Systems", at the Department of Production Automation at the Faculty of Computing and Automation of the Technical University - Varna, announced in State Gazette No. 53 / 20.06.2023 with the only candidate Asst. Prof. Dr. Eng. Zhivko Stefkov Zhekov

Reviewer: Prof. Dr. Todor Stefanov Yonkov, TU Sofia, Faculty of Automation, Department of Automation of Electric Drives

1. General and biographical data

Assist. Prof. Zhivko Stefkov Zhekov (born in 1980) graduated from the Technical University of Varna - Master's degree in Automation of Production in 2002. He has defended his dissertation for the PhD "Doctor" - the topic of the PhD "Development of sensorless vector control systems for induction motors", cipher 02.21.08. He is the author and co-author of 37 publications and 2 textbooks, he has participated in the development of 17 scientific projects. Adaptive Control, Intelligent Control, Digital Control Systems, Control Theory, Electric Drive, Technical Means of Automation, Modeling and Optimization of Technological Processes, Automation of Technological Processes, Systems Identification. He has been awarded best paper awards at two international forums in 2008 and 2012.

2. General description of the submitted materials

The candidate submits a total of 25 scientific papers for participation in the potential competition for Associate Professor: 3 articles in a Bulgarian journal, 18 papers printed in full text at international conferences and national conferences with international participation, 4 publications in yearbooks. He is the sole author of 8 of the papers, and 17 are co-authored (of which he is the first author in 4). 12 of the publications are indexed in the SCOPUS database. There are 17 citations visible in the SCOPUS database. The h-index of the candidate is 3, which is a positive assessment of the quality and citation rate of his publications. The publication activity of the head asc. Zhekov's research activity has been relatively constant over the last 5 years. The same applies to the citation rate of his works.

Asst. Prof. Zhekov is co-author of 2 published textbooks (E. Marinov, J. Zhekov, C. Todorov, Control of Electric Drives (Handbook), TU-Varna, 2014, ISBN:978-954-20-0711-1, issued under project BG051PO001-4.3.04-0014 "New electronic forms of training at TU-Varna" (as. Naumov, Zh. Zhekov, Fuzzy Management Systems (Handbook), TU-Varna, 2014, ISBN:978-954-20-0660-2, issued under project BG051PO001-4.3.04-0014 "New Electronic Forms of Learning at TU-Varna" (asst. J. Zhekov has prepared topics 3, 9 and 10).

The candidate meets the minimum requirements for an **ASSOCIATED PROFESSOR** as follows:

Group of indicators	Indicator	Number of points, required for the position of Associated Professor	Number of points of the candidate	
A	1. Dissertation for the award of educational and scientific degree "PhD"	50	50	
B	4. Habilitation work - scientific publications (not less than 10) in publications that are refereed and indexed in world-known databases with scientific information	100	340	
C	7. Scientific publication in publications that are refereed and indexed in world-renowned databases of scientific information	200	80	210
	8. Scientific publication in non-refereed peer-reviewed journals or edited collective volumes		130	
D	12. Citations or reviews in scientific journals referenced and indexed in world-renowned databases of scientific information or in monographs and collective volumes	50	70	
E	29. Number of lectures given at TU-Varna in the last three years (1 point for each lecture hour)	30	310	

It is noteworthy his very high activity as a teacher - on this criterion he exceeds the minimum requirements more than 10 times. At the same time, it would be useful for his future development to intensify his publishing activity in scientific journals to a greater extent, at the expense of conference papers, even though the ones he submitted under the procedure are printed in full text. This will undoubtedly and substantially increase his citation rate in the future.

3. General characteristic of the candidate's research and applied scientific activity.

The candidate has participated in a total of 17 scientific research projects, and from 2017 to 2023 has led 1 project funded by the state budget, participated in 2 national projects and 3 projects funded by the state budget.

4. Evaluation of the candidate's pedagogical training and activity.

The candidate has the necessary pedagogical training. Since 2017 he has taught several independent courses, and in the last 3 years he has taught the lectures and exercises on "Control of Electromechanical Systems", "Intelligent Control Systems", "Robot Actuation", "Industrial Robots", "Fundamentals of Automation", "Automated Production Systems" for the Bachelor's degree and "Control of Electrical Drives" for the Master's degree.

Under his supervision 16 graduates from the specialties "Automation, Information and Control Computer Systems", "Automation, Robotics and Control Computer Systems", "Robotics and Mechatronics" from the Bachelor's degree, as well as 14 graduates from the specialties "Siemens PLC Control Technologies", "Building Automation Systems", "Industrial Robotic Systems and Automation" from the Master's degree.

Under the guidance and with the active participation of As. System for positioning of a screw-nut type actuator, driven by a synchronous motor with permanent magnets and with a built-in position sensor - resolver; System for tracking the sun along two axes - azimuth and elevation, for directing a photovoltaic cell; 3. System for controlling process air flow quantities - velocity, pressure and flow rate. The setup enables airflow control by changing the duct characteristic by means of a damper and by changing the fan speed; 4. A mock elevator control system where the motor is controlled by a Siemens Micromaster 440 frequency converter; 5. Control system for a two-joint robot; 6. Control system for a mock-up of a thermal object. Other experimental setups have been developed to control current, speed and position of DC, brushless DC, induction and stepper motors.

The applicant has carried out a teaching mobility for the purpose of training at Brno University of Technology, Czech Republic, from 30.05.2016 to 03.06.2016 within the ERASMUS programme.

5. Main scientific and applied contributions.

The essence of the contributions in the works boils down to the formulation or substantiation of a new theory or hypothesis; proving by new means of essential new aspects of already existing scientific fields, problems, theories, hypotheses; creating new classifications, methods, constructions, technologies; obtaining confirmatory facts.

Contributions of priority scientific nature:

An online-trained neural regulator characterized by the use of a gradient algorithm to compute its weights based on the weights of an online-trained neural model of the object and the error between the task and the adjustable variable is developed. The performance of the controller

has been validated in its use in vector and sensorless vector control systems for induction motors, and robot and underwater robot control systems.

Learnable neural approximators of robot inverse kinematics are proposed. The performance of the approximators is validated and analyzed when used in control systems for two-joint planar robots. The approximators allow the control systems to operate under unknown robot kinematics.

Contributions of scientific and applied nature:

An approach involving the fine-tuning of controllers in the implementation of combined yaw and set-point control in position loops is proposed to achieve satisfactory quality performance in modular and symmetric optimum tuning of controllers in slave control systems of a two-joint planar robot.

Based on a preliminary analysis, a methodology for applying the principal component method for real-time fault detection of DC motors under unnatural variation of their variables and parameters is proposed.

Systems for sensorless vector control of an induction motor combining known neural controllers and estimators in an original way are proposed. The systems are built as two-channel systems and use two identical neural regulators. Systems for sensorless direct torque control of an induction motor are proposed, characterized by modified iterative estimators to enhance the estimation quality and system performance during motor warm-up.

Systems using the linearizing feedback method are proposed to control along a given trajectory two-joint robots moving in the horizontal or vertical plane.

Systems for adaptive control of AC motors - asynchronous motor and permanent magnet synchronous motor are proposed. The hyperstability theory is applied to synthesize the control of the two systems.

The applicability of the recursive methods of: least squares, weighted least squares and instrumental variable for estimating the parameters of DC motors in the implementation of adaptive control using self-tuning controllers is researched.

Applied contributions

The following systems have been developed: a control system for a two-propeller laboratory model of an aircraft, allowing the development and study of different control laws for the horizontal stabilization of the vehicle, a two-loop DC motor control system based on a digital signal controller TMS320F28335, a two-joint robot manipulator and its control system.

A two-channel coordinated control system for a two-motor electric drive synchronizing the operation of two axes is modeled and researched.

6. Significance of contributions to science and practice.

The contributions are definitely the personal work of the candidate for Associate Professor. The significance of the contributions in the candidate's scientific works is unquestionable both in the development of advanced digital control systems for electromechanical systems and in the daily engineering and laboratory practice related to various industrial applications of robots and manufacturing units and systems.

7. Critical comments and recommendations.

The fundamental achievements of the chief asst. Zhivko Zhekov are in the field of implementation of modern systems for digital process control and robotic systems. In practice, he has achieved the implementation of his interests in the teaching process, which is the most important for a lecturer at TU-Varna. His subsequent development as such will benefit if he is able to strengthen in line with his great scientific and applied achievements and his publication activity in international journals.

8. Personal impressions and review opinion.

I know the candidate from previous procedures. He is known among the automation and robotics specialists in Bulgaria as a respected and leading specialist. He is a member of the John Atanasoff Union of Automatics and Informatics (SAI) and a member of the national organizing committee of the International Conference Automatics and Informatics (ICAI) for the period 2020-2022.

CONCLUSION

Taking into account the fulfillment and over fulfillment of all the indicators of the accepted requirements at the national level and in the Regulations of TU-Varna for holding the academic position of ASSISTANT PROFESSOR, the presented scientific works, their significance, the scientific, scientific-applied and applied contributions contained in them, I find it justified to propose to the head as. Dr. Zhivko Stefkov Zhekov to occupy the academic position of "Associate Professor" in 5.2 "Electrical Engineering, Electronics and Automation at the Department of Production Automation at the "Faculty of Computing and Automation" of the Technical University - Varna.

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(Prof. Dr. Todor Yonkov)