

## OPINION

on competition for the occupation of an academic position "Associate Professor" in professional field 5.2. Electrical engineering, electronics and automation, academic discipline "Control of Electromechanical Systems", announced in SG No. 53 of 20.06.2023, with candidate: Chief Assist. Prof. Dr. Eng. Zhivko Stefkov Zhekov  
Member of the scientific jury: Prof. Dr. Eng. Mikho Rachev Mikhov



### 1. General characteristics of the candidate's scientific research and applied scientific activity

To participate in this competition, the only candidate Zhivko Zhekov has submitted 25 scientific publications (articles and papers). In 8 of them, he is a sole author, the rest are joint works. In 4 of them he is the first author, in 8 – the second author and in 5 – the third author. Out of all the publications, 14 are in English and 11 in Bulgarian.

As equivalent to a monographic work, 10 publications [B 4.1 – B 4.10] are presented in editions that are referenced and indexed in world-renowned databases with scientific information. The candidate is a sole author of 3 of them, in 3 he is the first author, in 2 – the second author and in 2 – the third author. These publications can be summarized thematically under the general heading "Study and Control of Electromechanical Systems". Outside of this group, 2 publications are presented in editions that are referenced and indexed in world-renowned databases with scientific information [Г 7.1, Г 7.2] and 13 in non-refereed journals with scientific review or edited collective works [Г 8.1 – Г 8.13].

The scientific research and applied scientific activity of Zhivko Zhekov is aimed at developing, researching and practical application of systems for control and automation. The proposed solutions are studied mainly by means of mathematical modeling and computer simulation, and a part of them also experimentally, proving their workability and efficiency.

The candidate has participated in the development of 6 research projects, 2 of which are national ones. He was the head of 1 of the projects financed by the Technical University of Varna.

The submitted materials are in the field of the competition and they are prepared according to the relevant regulatory documents. All indicators for occupation of the academic position "Associate Professor" are met.

### 2. Evaluation of the pedagogical experience and activity of the candidate

The work experience of Zhivko Zhekov as a full-time lecturer on a main employment contract at the Technical University of Varna is over 14 years. From 2009 until now, he has successively held the academic positions of assistant and chief assistant in the College within the structure of the Technical University of Varna and chief assistant in the Department of Industrial Automation at the Faculty of Computing and Automation of the same University.

In 2017 he defended his dissertation work on the topic "Development of Systems for Sensorless Vector Control of Induction Motors" and received the educational and scientific degree "doctor". During the last 3 academic years, he has lectured on the subjects of "Robot Drive", "Fundamentals of Automation", "Control of Electromechanical Systems", "Automated Production Systems", "Intelligent Control Systems", "Industrial Robots" and "Fundamentals of Automatic Control" with a total of 479 hours. In the period of the academic years 2017/2018 – 2022/2023 he has lectured on a total of 12 different courses. He was the scientific supervisor of the theses of 19 "Bachelor" graduates and 14 "Master" graduates. He participated in the compilation of curriculums for 6 disciplines and the development of 4 new academic courses. He is a co-author of the teaching aids "Handbook on Fuzzy Control Systems" and "Handbook on Control of Electric Drives". He made a significant contribution to the modernization of the laboratory base of the Department of Industrial Automation. A reference for international mobility for training is attached.

Based on the information presented by the candidate, I rate highly his pedagogical experience and activity.

### **3. Basic scientific and scientific-applied contributions**

I accept the attached reference of the contributions, including in the publications equivalent to a monographic work, which in my judgment can be summarized and grouped as follows:

#### **Scientific contributions**

An online trained neural controller is developed, which is used in vector control systems of induction motors, as well as in robot control systems [B 4.4 – B 4.7, B 4.9, B 4.10, Γ 8.11]; trainable neural approximators of the inverse kinematics of robots are proposed, the workability of which is confirmed when they are used in control systems of two-jointed planar robots [B 4.6, Γ 7.2].

#### **Scientific-applied contributions**

The adjustment of the regulators in a system for subordinate regulation of a two-jointed planar robot is analyzed, with the aim of achieving certain quality indicators [Γ 7.1]; the possibility of detecting failures of direct current motors in real time with an unnatural change of their variables and parameters is investigated [B 4.2]; two-channel systems for sensorless vector control of induction motors, combining known neural regulators and estimators in a new way are proposed [B 4.1, Γ 8.2]; 2 systems for sensorless direct torque control of induction motors are developed, characterized by modified iterative estimators [Γ 8.6, Γ 8.7]; systems using linearizing feedback for control along a set trajectory of two-jointed robots moving in the horizontal or vertical plane are proposed [Γ 8.4, Γ 8.5, Γ 8.9]; systems for adaptive control of an induction motor and a synchronous motor with permanent magnets are developed, applying the theory of hyperstability [Γ 8.1, Γ 8.10]; a comparative analysis of the applicability of different recursive methods for estimating the parameters of direct current motors during their adaptive control by means of self-adjusting regulators is made [B 4.3, B 4.8].

#### **Applied contributions**

The following are developed: a control system for a twin-propeller laboratory model of an aircraft, implemented with a personal computer using Simulink [Γ 8.3]; a two-loop DC motor control system based on TMS320F28335 digital signal controller [Γ 8.8]; a two-jointed robot-manipulator and a system for its control, enabling the creation and research of various control algorithms [Γ 8.12]; a model in the Matlab/Simulink programming environment for the study of a two-channel two-motor electric drive control system, synchronizing the operation of two axes [Γ 8.13]. This group of contributions can also include the developed application systems for control and automation, in connection with the presented scientific research projects.

Attached is a reference for 7 citations in publications referenced and indexed in world-renowned databases of scientific information, 4 of which are by foreign authors.

### **4. Significance of the contributions for the science and practice**

The candidate's contributions are mainly related to modern control methods of electromechanical systems with DC and AC motors. In-depth scientific research has been carried out and original results have been obtained, applicable in industrial automation, which are also useful for the educational process.

Zhivko Zhekov has achieved a good balance between his research and teaching activities. The quantitative indicators of the criteria for occupying the academic position "Associate Professor" have been met and exceeded. The presented reference on the found citations gives me reason to conclude that the candidate is known and recognized among the scientific circles at home and abroad.

### **5. Critical notes and recommendations**

I have no substantial fundamental remarks on the materials for participation in the competition, which are well prepared. I will only note that all the publications presented are from conferences held in Bulgaria and in some Bulgarian publications. In this regard, I recommend that Zhivko

Zhekov direct his future publication activity to scientific forums outside the country as well as to renowned journals abroad, which will contribute to a wider recognition by the international scientific community.

### CONCLUSION

The materials for participation in the competition comply with the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for its application. Based on a thorough familiarization with the presented scientific works, their importance, the scientific, scientific-applied and applied contributions contained in them, I find it justified to propose Chief Assist. Prof. Dr. Eng. Zhivko Stefkov Zhekov to occupy the academic position "Associate Professor" in the professional field 5.2. Electrical engineering, electronics and automatics, academic discipline "Control of Electromechanical Systems".

**Date:** October 20, 2023.

**JURY MEMBER:**

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