

OPINION

On the competition for the academic position of "**Professor,**" announced by the Institute of Robotics at BAS-Sofia in the State Gazette No. 44, page 18, March 21, 2024, for the needs of the "Interactive Robotics and Control Systems (Interactive Robotics in Education)" section, in the field of higher education 5. Technical Sciences, professional field 5.2 Electrical Engineering, Electronics, and Automation (Interactive Robotics in Education), with the sole candidate, Associate Professor Dr. Eng. Snezhanka Petrova Kostova
Reviewer: Professor Dr. August Yordanov Ivanov, Institute of Robotics "St. Apostle Evangelist Matthew" at BAS, Sofia.

1. GENERAL CHARACTERIZATION OF THE SCIENTIFIC RESEARCH AND APPLIED SCIENCE WORK OF THE CANDIDATE

The materials of Associate Professor Dr. Eng. Snezhanka Kostova are organized and presented in accordance with the requirements for fulfilling the Scientometric Criteria for acquiring academic degrees and holding academic positions.

The scientific works in the competition for professor are listed in a collection of **26** publications, **15** of which are indexed in Scopus and/or Web of Science. Of these, **6** have an Impact Factor (IF), and **7** have an Scientific Journal Rankings (SJR). **One** publication is in a **Q1** journal, **one** in a **Q2** journal, **three** in **Q3** journals, and **six** in **Q4** journals. Four of the publications are sole-authored; in 8 publications, the candidate is the first author, in 2 – the second author, in 4 – the third author, and in the remaining 8, she is listed after the third position in the list of authors. From the works indexed in Scopus and/or Web of Science, the candidate has presented 10 publications, equivalent to a monograph under the general title "Robotic Technologies in Education – State and Perspectives."

For the competition for professor, beyond the publications equivalent to a monograph, to meet the requirements of the Scientometric Criteria for acquiring academic degrees and holding academic positions, **16** works are included. Of these, 5 are indexed in Scopus and/or Web of Science, and **11** are from non-indexed conferences.

The citation report includes a total of **52** citations in scientific journals, referenced and indexed in globally renowned scientific databases (SCOPUS and/or Web of Science).

A list of **seven** scientific specializations is presented, along with a report on meeting the minimum required points by group indicators for the academic position of professor, according to the requirements for fulfilling the Scientometric Criteria for acquiring academic degrees and holding academic positions.

From the attached professional biography, it becomes clear that the candidate is the author or co-author of over 70 scientific articles and conference papers. The number of citations observed: **197** (h-index = 7).

2. BRIEF BIOGRAPHICAL DATA. GENERAL OVERVIEW OF THE CANDIDATE'S ACTIVITY

Assoc. Prof. Dr. Eng. Snezhanka Petrova Kostova completed her higher education at the "Angel Kanchev" University of Ruse, specializing in Mechanical Engineering. She further specialized in "Applied Mathematics and Informatics" (Block **B** and Block **C**) at the Technical University of Sofia, Faculty of Applied Mathematics and Informatics.

She earned her PhD in 2002, with a dissertation on "Analysis and Synthesis of Positive Linear Discrete Systems."

Assoc. Prof. Kostova's professional career began in 1984 as an Assistant Professor of Mathematics at the "D.A. Tsenov" Academy of Economics, Department of Mathematics and Statistics in Svishtov. In 1987, she became an Adjunct Assistant Professor of Mathematics at ICS, Sofia.

From 1995 to 2007, Assoc. Prof. Kostova successively held the positions of Research Associate III, II, and I degrees at the Institute for Control and System Research (ICSR) at BAS, and since 2007, she has been an Associate Professor at the Institute of Robotics at BAS (formerly ICSR-BAS and ISIR-BAS).

Scientific-Organizational and Administrative Activity:

The candidate has been a member of the Scientific Council of the Institute of Robotics at BAS since 2010. During this period, she has been the Head of the "Systems Engineering" division at the Institute. From 2010 to 2022, she served as Chair of the General Assembly of the Scientists at the Institute. Since 2020, she has been a member of the Steering Committee of COST Action CA19104 - advancing Social Inclusion through Technology and Empowerment (a-STEP). Since 2022, she has been the Chair of the Scientific Council of the Institute of Robotics at BAS.

3. TEACHING AND EDUCATIONAL ACTIVITY

Teaching Experience:

1984-1988 – Assistant Professor of Mathematics at the “D.A. Tsenov” Academy of Economics, Svishtov, and ICS – Sofia

In 2015, she taught a doctoral course titled “Linear Quadratic Differential Games and Applications” at the Faculty of Mathematics and Informatics, Sofia University “St. Kliment Ohridski.”

Lectures Abroad:

She has given lectures under the Erasmus and Erasmus+ exchange programs at UPV-Valencia; G-SCOP Laboratory, INPG-Grenoble, France; the University of Kavala, Greece; the University of Portsmouth, UK, and others.

I believe that the teaching and educational activity of Assoc. Prof. Dr. Snezhanka Kostova fully meets the necessary requirements for initiating the procedure for the position of Professor.

4. SCIENTIFIC AND APPLIED SCIENTIFIC ACTIVITY

The presented materials show that the candidate's research and applied work is primarily focused on: Interactive Robotics, Application of Innovative Technologies in Education, Analysis and Synthesis of Control Systems, Positive Control Systems, Mathematical Modeling, and Process Modeling and Control in Environmental Systems.

A significant portion of her publications is related to the themes of the research projects in which she has participated, confirming the scientific and applied nature of Assoc. Prof. Kostova's work.

I would like to emphasize that the topic of her scientific and applied research activity is highly relevant.

5. IMPLEMENTATION ACTIVITIES

A list of participation in "Research Projects and Contracts, Technology Transfer" has been presented, which includes 12 projects, one of which is for the establishment and development of the Center of Competence IMEEST, No. BG05M2OP001-1.002-0023; five projects funded by the European Commission; one project funded by the Financial Mechanism of the European Economic Area (EPI); and five funded by Bulgarian sources such as the National Science Fund (NSF) and the Ministry of Education and Science (MES), among others. In five of these projects, the candidate is the leader, in one she is a member of the management committee, and in the others, she is part of the project teams. Three of these projects are ongoing.

The total funds attracted through the projects led by Assoc. Prof. Dr. Eng. Kostova amount to 304,518 BGN.

6. MAIN SCIENTIFIC AND APPLIED SCIENTIFIC CONTRIBUTIONS

I agree with the author's perspective on the contributions. They are both scientific and applied.

A. Contributions in the publications, equivalent to a monograph titled “Interactive Robotics in Education,” can be summarized as follows:

Applied Scientific Contributions

- A systematic review and thorough analysis of the use of commercial social robots and platforms in education have been made, evaluating their effectiveness in terms of technical characteristics, advantages, disadvantages, and potential for broader use in schools. Seven hypotheses were defined and tested regarding the use of new technologies and robots in the educational process.
- Cyber-physical systems for interactive games with humanoid and non-humanoid robots have been developed for inclusive education purposes for children with special educational needs.
- The psychosocial and psychophysical aspects of children's interaction with humanoid and non-humanoid robots have been studied.
- A system for speech and language therapy (SLT) for children with communication disorders has been developed and experimentally tested, which has the potential for integration with the Internet of Things (IoT). A model for understanding natural language in human-robot interaction using GPT models as a service in IoT has been proposed.
- A brain-computer interface (BCI) has been created based on EEG signals, recorded in real-time through a non-invasive, portable Emotiv EPOC+ device.

Scientific Contributions

- Three problems related to the control of positive linear discrete systems, used for modeling the educational and therapeutic process, have been solved:
 - Stabilization of a positive linear discrete system (SISO and MIMO) via state feedback based on Brauer's theorem.
 - A solution for the Linear Quadratic Regulator (LQR) problem for discrete systems with non-negativity constraints on the state has been proposed.
 - A solution for the Linear Quadratic Regulator (LQR) problem using invariant set theory has been proposed.

B. Contributions in publications outside those equivalent to the monograph

Scientific Contributions

- The relationship between the controllability of positive linear discrete systems and the existence of a solution to the eigenvalue synthesis problem has been investigated.
- The problem of maximizing the stability radius of a positive linear discrete system through state feedback has been solved to reduce the system's sensitivity to external disturbances.

Applied Scientific Contributions

- A comparative analysis of the use of social humanoid robots as assistive technology for individuals with Autism Spectrum Disorder (ASD) has been conducted.
- Modeling, control, and assessment of processes related to environmental protection have been carried out:
 - A model for describing the pollution of interconnected marine basins using the tools of positive linear discrete systems has been developed.
 - A methodology for calculating external environmental costs associated with various activities has been proposed, along with information products for the application of this methodology.
- A conceptual framework has been proposed that integrates robotics and assistive technologies and is applicable at all stages of the rehabilitation process—preventive, restorative, maintenance, and palliative.

In conclusion, I believe that the scientific and applied scientific contributions in the materials submitted for the professorship procedure are of significant importance, especially in the creation of cyber-physical systems for assistive technologies and the resolution of control problems for positive linear discrete systems.

7. SIGNIFICANCE OF THE CONTRIBUTIONS TO SCIENCE AND PRACTICE

Based on the contributions presented by the candidate, it can be concluded that they have both scientific and applied value and are focused on an extremely important topic for science and education—Robotic Technologies in Education.

Assoc. Prof. Kostova is known both in Bulgaria and internationally within the scientific community. This is evidenced by her publications indexed in SCOPUS and/or Web of Science, with IF and SJR in journals with Q1, Q2, Q3, and Q4, as well as 52 citations in scientific publications indexed in globally renowned databases.

8. EVALUATION OF THE CANDIDATE'S PERSONAL CONTRIBUTION

Regarding personal contribution, the candidate's materials demonstrate what can be achieved through teamwork—discoveries, projects, and publications in highly prestigious conferences and journals. Quantitatively, the candidate has **26** publications, participation in **12** projects with leadership and involvement in the themes of the publications, and has attracted **304 518** BGN in project funding.

Considering this information, it can be confidently stated that the personal contribution of Assoc. Prof. Dr. Eng. Snezhanka Kostova in the submitted work is beyond any doubt.

9. CRITICAL REMARKS AND RECOMMENDATIONS

I have no significant critical remarks regarding the materials presented by the candidate for the competition. However, I would like to note:

- Publications numbered 7.4; 8.2; 8.3; 8.4; 8.5; 8.7; 8.8; and 8.9 have been used as additional supporting materials for the contributions equivalent to a monographic work, but they were correctly not included as such in the rest of the contributions.
- The author has not classified their contributions.
- I recommend refreshing the list of publications in National Center for Information and Documentation (NACID) regarding Assoc. Prof. Kostova's profile.

These remarks do not in any way diminish the level of Assoc. Prof. Kostova's work and would only help to make them more comprehensive.

In future activities, considering the candidate's extensive international contacts and joint publications with foreign scientists, I recommend the preparation of a monograph based on the accepted works and its publication in a prestigious outlet.

10. PERSONAL IMPRESSIONS

The candidate's publication and project activities deserve admiration. I would note the link between research, publications, and dissemination of results.

I believe that as a scientist, specialist, and leader, she possesses remarkable qualities. With the successful completion of this competition, the Institute of Robotics at BAS – Sofia will gain an exceptionally well-prepared specialist, researcher, and organizer.

I have no joint scientific research or publications with Assoc. Prof. Dr. Kostova.

11. FULFILLMENT OF THE NACID REQUIREMENTS COMPLIANCE WITH NACID REQUIREMENTS for meeting the minimum national requirements under Article 2b, paragraphs 2 and 3, and respectively the requirements under Article 2b, paragraph 5 of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LDASRB), as defined in the Regulations for the Implementation of LDASRB, for the academic

position of professor in professional field 5.2. Electrical Engineering, Electronics, and Automation.

The publication and scientific activities of the candidate for the position of Professor in the professional field **5.2. Electrical Engineering, Electronics, and Automation (Interactive Robotics in Education)** at the Institute of Robotics at BAS – Sofia, fully meet, and in some areas exceed, the requirements for the academic position of Professor. Indicator group “A” – 50 points; indicator group “B” – 120 points; indicator group “G” – 222 points; indicator group “D” – 520 points; indicator group “E” – 311 points.

12. CONCLUSION

The presence of publications equivalent to a monographic work, publications beyond those, research, applied, implementation, and organizational activities, and the candidate’s wide recognition both in Bulgaria and abroad, provide a strong basis for my proposal that **Assoc. Prof. Dr. Eng. Snezhanka Petrova Kostova be appointed to the academic position of “Professor”** in the professional field: 5.2. Electrical Engineering, Electronics, and Automation, section “Interactive Robotics and Control Systems (Interactive Robotics in Education).” for the needs of the Institute of Robotics at BAS – Sofia.

September 05, 2024
Sofia

Opinion of the reviewer:

/Prof. Dr. A. Ivanov/