R E V I E W

by competition for the academic position of professor of
5.2 "Electrical engineering, electronics and automation" (Interactive robotics in
education), announced in the State Gazette, no. 44 of May 21, 2024,
with candidate: Snezhanka Petrova Kostova, PhD, associate professor
Reviewer: Petko Hristov Petkov, DSc, Professor

1. General and biographical information

In the competition for "Professor" in "Electrical Engineering, Electronics and Automation"
(Interactive Robotics in Education) at the Institute of Robotics (IR) at BAS - Sofia, only one
candidate submitted documents: Dr. Snezhanka Petrova Kostova, Associate Professor at the
"Interactive robotics and control systems' in IR. The candidate graduated from the "Agricultural
Technology" major at the University of Ruse with a "mechanical engineer" qualification in
1982, after which, in the period 1982-1984, she continued with a specialization in "Applied
Mathematics and Informatics" at the TU-Sofia. In the period 1984-1987, she was an assistant
in mathematics in the Department of "Mathematics and Statistics", Academy of Economics
"D.A. Tsenov", Svishtov, and from 1987 to 1988 she was a part-time assistant in Mathematics
at the IHS, Sofia. Since 1995, she has been a research assistant at IUSI-BAS, and in 2002 she
received the scientific degree "doctor" with a dissertation on the topic "Analysis and synthesis
of positive linear discrete systems". Since 2007, she has been an associate professor at IR-BAS,
and since 2010, she has been the head of the "Systems Engineering" department and a member
of the Supervisory Board of the same institute. From 2022 to the present, she is the scientific
secretary of the IR. She has completed a number of specializations in scientific institutes and
universities in Norway, Spain, Germany and Australia. In 2015, she taught a doctoral course at
the University of St. Kliment Ohridski" and has lectured at the universities of Valencia,
Grenoble, Kavala and Portsmouth. She is the author or co-author of 70 scientific articles and
reports at international conferences. She speaks English and Russian.
The competition was announced in the State Gazette, no. 44 of May 21, 2024, based on a
decision of the Scientific Council of IR. Formal requirements in connection with the procedure
have been fulfilled within the necessary time limits.

2. General description of the presented materials

The candidate participates in the competition with a total of 26 works, of which 10 are
presented as equivalent to a monograph (all referenced in SCOPUS) and 16 are articles in
scientific journals and periodicals published at home and abroad. Of the 16 papers presented in
the competition, 5 are referenced and indexed in SCOPUS or Web of Science and 11 are
scientific publications in non-refereed editions or in edited collective volumes. A detailed
reference for 52 citations of the candidate's works, most of them by foreign authors, is also
presented. Documents for participation in 12 scientific projects and contracts were presented,
5 of which Assoc. Prof. Kostova was the supervisor (4 national and 1 international). The
amount of funds raised under these contracts is over BGN 300,000. The candidate is a co-
founder (since 2018) and co-chair of the Robotics and ICT assisted wellbeing symposium,
organized within the International Conference on Software, Telecommunications and
Computer Networks (SoftCOM) of the IEEE, for which she has reviewed numerous papers.

The candidate was a member of the jury in procedures for filling the academic positions of associate professor and chief assistant, and for the educational and scientific degree of doctor.

3. General characteristics of applicant's research and scientific applied activity

The candidate has a sufficiently representative scientific research output, the result of uniform work in the period 1995-2024. As significant results of this work, the defended dissertation for a doctorate in the field of modern management theory should be noted, as well as the significant number of publications in journals and periodicals. Prof. Kostova has made serious scientific and applied contributions in several important areas such as the management of positive systems and the use of robots in the assistance, training and social integration of people, including children with intellectual problems. Prof. Kostova also has a significant number of citations of her works by foreign authors. All this characterizes Prof. Snezhana Kostova as a well-rounded scientist with very good research and applied scientific activity.

4. Evaluation of the pedagogical preparation and activity of the candidate

From the references presented, it can be seen that the candidate worked as an assistant in mathematics for 5 years at the Academy of Economics "D.A. Tsenov", Svishtov and IHS-Sofia. In addition, there is a teaching activity in a doctoral course at the Faculty of Economics of SU-Sofia. In the presented materials, there is no data on graduate students or specialists who have been led so far. In conclusion of this point, it can be stated that Prof. Kostova has a sufficient volume and successful educational activity.

5. Basic scientific and scientific-applied contributions

The candidate's contributions of a scientific and scientific-applied nature can be divided into contributions related to the habilitation work and contributions outside of it. I support the applicant's contention that the articles presented as equivalent to a monographic thesis contain sufficient contributions to the field of robotics in education, on the basis of which a habilitation thesis for a professorship can be submitted. In particular, the following results can be noted:
-A systematic and in-depth analysis of the use of commercial social robots and platforms in education was made, evaluating their effectiveness in terms of their technical characteristics, advantages, disadvantages and their potential for wider use in schools [Works 4.5, 7.4, 8.7, 4.7].
- Cyber-physical systems for interactive games with humanoid and non-humanoid robots have been created for the purpose of inclusive education of children with special educational needs. The systems make it possible to take into account the individual needs of children and, through personalization of the therapy, to increase its effectiveness [Works 4.8, 8.2, 8.4].
- The psychosocial and psychophysical aspects of interaction with humanoid and non-humanoid robots are investigated. A formalization of the iterative game process of children's interaction with robots by using the apparatus of linear discrete control systems is proposed [Work 4.10].
- Developed and experimentally tested speech therapy system [Works 4.9, 8.8 and 8.9].
- A brain-computer interface was created that allows the data to be used to control a robot, thus giving the child feedback on their level of concentration [Works 4.4, 4.6, 8.5, 8.6].
-Three problems of the management of positive linear discrete systems are solved, which are

used for modeling the game educational and therapeutic process [Works 4.1, 4.2, 4.3 и 8.3]

The candidate's presented works relate to the development of methods for the analysis and synthesis of positive systems, the use of social humanoid robots as assistive technology for people with autism spectrum disorders, as well as the development of methods related to environmental protection. The content of these works shows that the candidate works continuously on improving the approaches used and seeks to expand the possible areas of application. In my opinion, the most significant scientific and scientific-applied contributions of the candidate can be noted:

1. Scientific contributions
-The relationship between controllability of a positive linear discrete system and the existence of a solution to the synthesis problem by given eigenvalues is investigated. For this purpose, existing literature results for the controllability criteria and the corresponding canonical forms were used. Sufficient conditions imposed on the system matrices and the set of eigenvalues of the closed system are proved. They guarantee the existence of a feedback matrix that assigns the desired spectrum to the closed system while preserving its positivity. [Work 7.1]
-The problem of maximizing the robustness radius of a positive linear discrete system through state feedback to reduce the sensitivity of the system to external disturbances is solved. A solution to the problem is proposed in the case of a monomial control matrix. The two cases were considered - in the presence of a non-negative control restriction and without restriction. Conditions under which the only possible solution is the zero solution are proved. Illustrative examples are given. [Work 7.3]
-A model is proposed to describe the pollution of connected sea basins using the apparatus of positive linear discrete systems. Parameters, states, control, dynamics and existing constraints are described. Special attention is paid to the compartmental nature of the system, which determines the structure of the system matrices. [Work 7.2]

2.Scientific and applied contributions
- A comparative analysis of the good practices available in the literature in the use of social humanoid robots as assistive technology for people with autism spectrum disorders (ASD) was made. For the selected robots, an analysis of their technical characteristics, advantages and disadvantages was made. The existing good practices from the literature are systematized, including clinically validated ones, which can easily be used on a large scale in practice. Problems facing the wider use of robotic devices for individuals with ASD and ways to overcome them are commented. [Work 7.5]
-A conceptual framework is proposed that integrates robotics and assistive technologies and is applicable in all stages of the rehabilitation process - preventive, restorative, supportive and palliative. All aspects of the recovery process – physical, emotional and mental – are included in the framework. Multiple solutions are available that provide personalized patient care from diagnosis through the active recovery process. Physical, emotional, and virtual devices are included, such as collaborative and socially assistive robots, haptic devices, virtual and augmented reality, motion capture systems, human-computer interface, smart wearables, and more. [Work 8.10]
- The results of a study conducted using the Delphi method among a group of experts from Bulgaria - teachers, social workers, psychologists, etc. - were reported. about their attitudes and expectations from the use of assistive technologies for people with neurodevelopmental disorders. [Work 8.11]. Research is part of the activities within the COST programme.
-A methodology for calculating the external environmental costs accompanying each activity and the existing information products for the application of the methodology are described. It

is illustrated with an example from coal power generation and using EcoSence to quantify environmental external costs.[Paper 8.1]

A number of other significant results have also been achieved, which are detailed in the author's statement of contributions, which I fully accept.
All contributions discussed above are the work of the candidate and are reflected in detail in her publications and fully meet the habilitation requirements for the title of "Professor".

6. Significance of contributions for science and practice

The methods of analysis and synthesis of positive management systems proposed by the candidate provide an opportunity to achieve a higher quality of dynamic processes in such systems. What distinguishes the candidate is that these methods have been applied in the management of specific and practically important processes related to environmental protection. I highly appreciate the candidate's works related to the application of assistive technologies for people, including children with neurodevelopmental disorders. The number of scientific publications in which Assoc. Prof. Kostova's contributions are presented meets the quantitative requirements in all indicators for obtaining the title of "professor". As pointed out in section 2, the candidate's works were cited 52 times, the majority of them by foreign researchers in international publications. That is why it can be considered that the contributions of Associate Professor Kostova have received the necessary recognition from the scientific community at home and abroad. In addition, the candidate's contributions to student learning should be noted.

7. Critical notes and recommendations

The high level of a number of the obtained results gives reason to recommend their wider publication in publications with an impact factor.

8. Personal impressions and opinion of the reviewer

I have personal impressions of the candidate in relation to her thesis for the scientific and educational degree "Doctor", of which I was the supervisor in the final stage. The doctoral student had very good mathematical and special training, which allowed her to obtain new scientific results and successfully defend her dissertation. The significant scientific, scientific-applied and scientific-organizational activity carried out in the period after her habilitation in 2007 is impressive. I think there are very good prerequisites for her future work.

CONCLUSION

The serious scientific and scientific-applied contributions of the candidate, their publication in prestigious international publications, the significant number of citations of the works, as well as the successful academic activity of the candidate, give me reason to confidently propose Assoc. Prof. Dr. Snezhanka Petrova Kostova to occupy the academic position " professor" in the professional direction 5.2 "Electrical engineering, electronics and automation" in the specialty Interactive robotics in education.

08/19/2024   Prepared the review:

                                             /Prof. DSc Petko Petkov, BAS/