

# REVIEW

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on the competition for the academic position "PROFESSOR"  
in a professional direction 5.2. "Electrical engineering, electronics and automation",  
scientific specialty "Application of the principles and methods of cybernetics in different areas of  
science", thematic area "Robotic systems with human-machine interface",  
announced by the Institute of Robotics at the BAS, Sofia, in State Gazette no. 26 of 21.03.2023 for the  
needs of Department "Interactive Robotics and Control Systems"

## 1. LEGALITY OF THE CONTEST

The competition for PROFESSOR was announced in the "State Gazette", issue 26 of 21.03.2023 (one position) in professional direction 5.2 "Electrical engineering, electronics and automation", scientific specialty "Application of the principles and methods of cybernetics in different areas of science", the scope being limited to the topic area "Robotic systems with human-machine interface". Documents in the competition for professor were submitted by the only candidate, Assoc. Prof. Dr. Maya Ivanova Dimitrova. The competition meets the requirements of the Law on the development of the academic staff in the republic of Bulgaria (ZRASRB) and the requirements of the Internal Rules for the Development of the Academic Staff of the Institute of Robotics at the Bulgarian Academy of Sciences (IR-BAS).

## 2. BRIEF BIOGRAPHICAL INFORMATION ABOUT THE CANDIDATE

Assoc. prof. dr. Maya Dimitrova was born in 1961 in the city of Sofia. In 1980, she completed secondary education at the First English Language High School in Sofia, and in 1985, higher education at the University of St. Petersburg, majoring in Psychology. In 1994, she obtained a master's degree at the Faculty of Psychology of the University of Warwick, UK. In 2002, Maya Dimitrova defended her PhD dissertation on the topic "Adaptive human-computer interface" in the scientific specialty "Application of the principles and methods of cybernetics in different areas of science" at the Institute of Control and Systems Research - BAS. From 2007 to the present, she has been an associate professor successively at the Institute of Control and Systems Research (2007-2010), the Institute of Systems Engineering and Robotics (2010-2017) and the Institute of Robotics, Department "Interactive Robotics and Control Systems". She has been on specialization abroad many times. She participated in the development of prestigious Bulgarian and international projects.

## 3. BRIEF DESCRIPTION OF THE MATERIALS SUBMITTED BY THE CANDIDATE FOR PARTICIPATION IN THE COMPETITION FOR PROFESSOR

After a detailed review of the materials, presented in the competition, and the scientific works, with which the candidate participated in the competition, I think that there is a correspondence between the presented

publications and the theme of the competition for PROFESSOR. They are from the scope of the scientific specialty and the announced thematic area and are dedicated to current scientific and applied problems.

A total of 32 works are presented in the competition materials, of which 27 are scientific publications and five are chapters in collective monographs.

The presented materials can be grouped as follows:

- Publications in foreign journals – 9 publications (4.1, 4.3, 4.5, 4.6, 4.11, 7.1, 8.12, 8.14, 8.15);
- Publications in a journal in Bulgaria – 1 publication (8.5);
- Reports of international conferences in full text – 10 publications (4.4, 4.7, 4.8, 4.9, 4.10, 8.1, 8.2, 8.6, 8.7, 8.11);
- Reports of national conferences in full text - 7 publications (4.2, 8.3, 8.4, 8.8, 8.9, 8.10, 8.13);
- Chapters in collective monographs – 5 chapters (9.1, 9.2, 9.3, 9, 4, 9.5).

Twelve of the publications are indexed in Web of Science and/or Scopus (4.1-4.11; 7.1), with 9 publications having an impact factor or rank (4.1-4.5; 4.7-4.9; 4.11; 7.1). Five of the scientific publications and three of the chapters in the collective monographs are single-authored.

When comparing the minimum required points by groups of indicators for occupying the academic position "professor" in IR-BAS in Direction 5. Technical Sciences, and the number of points achieved by the candidate:

<i>Group of indicators</i>	<i>Minimum No of points</i>	<i>No of points of the candidates</i>
Indicator <b>A</b>	50	50
Indicator <b>B</b>	100	191
Indicator <b>Г</b>	200	205
Indicator <b>Д</b>	100	824
Indicator <b>E</b>	150	345

it can be seen that the submitted publications for the competition fully satisfy the minimum national requirements of the Regulations for the implementation of the RASRB for the professional direction 5.2. "Electrical Engineering, Electronics and Automation". The requirements of the Internal Rules for the development of the academic staff of IR-BAS are also fully covered and exceeded several times for some of the indicators (indicators in groups **D** and **E**). The publications in group **B** (4.1-4.11), which are equivalent to a habilitation work, are 11 (with the requirement that they be no less than 10).

There is complete correspondence between the presented List of publications for participation in the competition and the candidate's own works in the competition. The documents present a reference to Maya Dimitrova's scientific and scientific-applied contributions. One of the presented publications (4.9) was awarded the Best Presentation Award at the IEEE International Conference on Information Technology Based Higher Education and Training (ITHET), November 4-5 2021, Sydney, Australia.

The candidate has submitted a List of 6 scientific research projects, and a certificate from IR-BAS has been attached for her participation in the respective projects. A report on the citations of the scientific production of the candidate for the competition Assoc. Prof. Dr. Maya Dimitrova is also presented, which impresses with their large number.

#### 4. MAIN SCIENTIFIC AND SCIENTIFIC-APPLIED CONTRIBUTIONS



The review considers and analyzes the relevant scientific and scientific-applied contributions and results of the candidate and the works in which they are contained. The candidate's scientific and applied scientific contributions and results are in the field of cognitive, neuro-cognitive and social aspects of modeling human-robot systems and are thematically grouped as follows:

1. Publications - equivalent to habilitation work

- In publication 4.1 a conceptual model is proposed of neuro-cognitive processing of semantic/abstract and perceptual/concrete information in the learning process of human-robot interaction, based on modern research on EEG signals as markers of cognitive processes. Pedagogical recommendations are proposed for designing humanoid robots, assistants to the teacher, as part of the cyber-physical system for pedagogical rehabilitation in inclusive education.
- Publication 4.2 presents a cognitive architecture RELA that develops models, reinstating the functional specialization of the human brain (with the aim of application in special education). The results of publications 4.1 and 4.2 can be referred to the group of the scientific contributions as they present a new focus on known cognitive phenomena.
- A new iterative approach and formal method for designing games for cyber-physical pedagogical systems is proposed, taking into account the correspondence of the individual needs of the child and the judgment of the educator (publication 4.3) and successfully applied to the design of 4 types of games for special education. Publication (8.1) presents the context in which the developed approach towards the cyber-physical systems in education and pedagogical rehabilitation is formulated, and publication (8.2) examines children's first positive reactions to robot games.
- A new cyber-physical approach to designing games with non-humanoid robots (with several types of interfaces for different sensory or cognitive needs – keyboard, joystick or contactless eye tracking device) that support children's socialization in inclusive education is proposed in publication 4.4.
- Publication 4.5 presents an approach for analyzing teachers' and parents' attitudes about the inclusion of robotics and information technology subjects in primary school, implemented in a questionnaire survey (conducted in Bulgaria, Greece, Croatia and Bosnia and Herzegovina). M. Dimitrova's contribution is the formulation of the questions related to the cognitive and social development of the child in the context of the cyber-physical systems for pedagogical applications.
- A structural approach to the analysis of security aspects and user acceptance of socially competent robotic systems is considered. A "top-down" model of user acceptance assessment of a socially competent robotic system is proposed in publication (4.6). In publication (4.7), the approach was applied to assess the implicit acceptance of different types of robots in socially oriented professions such as co-therapists. Publication (4.8) applies the two-dimensional model of emotion to the analysis of the perception of emotional stimuli.
- An innovative approach to designing knowledge accessibility systems in digital and physical repositories is proposed, developing the concept of accessibility by adding 2 layers - knowledge/experience and motivation - as barriers to knowledge accessibility (Publication 4.9). Publication (8.3) presents a game with the non-humanoid robot BigFoot in order to overcome the internal - motivational - barrier to the accessibility of knowledge and skills obtained through games.
- In publication (8.4) the inclusion of robots in the artistic training of children in special education is justified. For objective reasons/due to my participation in it/ I have not reviewed the fourth publication from this group (4.10), but the contributions are reflected in the final evaluation of the contest.

- The following four publications present a new cognitive approach to design of intelligent agents supporting knowledge access in terms of user preferences for expert or popular presentation, as well as detailed or synthesized text. A new method for search, extraction, and automatic classification of text content on Web pages is proposed (release 4.11). The method is based on established cognitive features of text items – for example, different frequency of occurrence in natural language of words of a certain length that characterize popular or expert text (publications 8.5 and 8.6). In publication (8.7), a neural network was used to recognize text features in Web pages classified by experts as text-dominated. The method is applicable in automatic dialogue generation in human-robot systems.

I define the contributions of Maya Dimitrova in the considered publications 4.1–4.11 (equivalent to habilitation work and contributing to the coverage of indicators of group B) as scientific and scientific-applied contributions, considering her results of these studies to be the most significant. As a very important contribution and of great scientific value, I find the researched impact of the human-robot system and the role of incorporating robots for greater socialization and increasing human knowledge. I also find it very positive to use statistical methods to draw the conclusions (proof of their correctness).

## 2. Other scientific and scientific-applied contributions of Maya Dimitrova are the following:

- Modular neural networks for human-robot interaction style diagnosis have been investigated in three publications. Publication 7.1 proposed a new neural method for user profile recognition that trains faster in cases where the input vectors are similar.
- In publication (8.8), conditions for accelerated and more precise learning with a neural network are investigated in cases of different degrees of correlation of the input matrix of the data and the output matrix of the classes. Publication (8.9) proposed a new system architecture for monitoring the effects of the environment, the instrumentation, and the state of the person performing the surgical manipulation, whether in or out of the operating room, to predict the overall reliability of the system.
- The concept of designing high-level synthetic sensors for improved human-robot communication is a scientific-applied contribution presented in publication 9.1, and its application is discussed in 8.10, 8.11 and 8.12 (the so-called “cyber-physical medical sister”).
- In publication (9.2), a new neuro-cognitive approach for the design of intelligent agents with autobiographical memory is proposed, inspired by the results of an experimental study of memory retrieval processes. Publication (8.13) proposed a method for personalized retrieval of information from the network by analogy with the formation of autobiographical memory in humans.
- A concept for modeling learning processes in a human-computer context and in the context of interaction with web-based intelligent agents is presented in publication (9.3) and developed in publication (9.4).
- An approach to the design of humanoid robots capable of performing professional roles was explored. Publication (8.14) substantiated the concept of humanoid robots capable of modeling social skills and, respectively, performing professional roles. In publication (9.5), the factors of cognitive motivation and social motivation in students were studied, when the role of a teacher (in zoology) is fulfilled by a humanoid robot, and conclusions were drawn about the socializing role of humanoid robots in ordinary, as well as special education and in inclusive education.
- Publication 8.15 proposes a new approach to designing the classroom of the future using disruptive technologies, formulated as modern technologies, at equal with artificial intelligence or the “internet of things”.



I believe that these contributions and results of Associate Professor Maya Dimitrova can be classified as scientific and scientific-applied contributions. All presented and described results and contributions can be classified as proving with new methods and means known problems in the context of the human-robot systems and the creation of new methods and approaches for their study. Original high-level results have been achieved.

I accept as correctly prepared the attached by the candidate statement for her scientific and scientific-applied contributions.

## **5. EDUCATIONAL AND METHODOLOGICAL ACTIVITY OF ASSOCIATE PROFESSOR DIMITROVA**

According to the attached documents, the academic commitment of Assoc. Dr. Maya Dimitrova includes reading lectures and lecture courses:

- University lecturer (1996-2001);
- Course of lectures at the BAS Training Center on the topic: "Modelling of human-robot systems" (since 2017);
- Delivered a course of lectures on the topic: "Modeling of cognitive processes in human-robot systems" (2014).

A good impression makes the fact that the discipline, for which the current competition is announced, is provided with lecture courses. In addition, I would like to add that Associate Professor M. Dimitrova was the supervisor of two doctoral students, who successfully defended their PhD theses.

This pedagogical activity is entirely oriented towards the announced competition topic for PROFESSOR.

## **6. SCIENTIFIC RESEARCH ACTIVITY AND PROJECTS**

The research activity in the period 2015-2023 of Assoc. Dr. Maya Dimitrova is represented by six research projects, in two of which she is the leader. Three of the projects are international, and two projects are financed by the "Scientific Research" Fund of the Ministry of Education and Science. In the competition materials, a certificate from IR-BAS with information on these projects is presented, and as a result of their implementation are the peer-reviewed scientific works.

## **7. OTHER INFORMATION AND REVIEWER COMMENTS**

I have known Associate Professor Maya Dimitrova for about 7 years in relation to similar research topics, from competition procedures, scientific forums and from scientific projects of our institutes at BAS. During all these years, I have had excellent impressions of Maya Dimitrova's scientific work. I can confidently state that her research, contributions and results in the submitted papers are to a large extent the work of the candidate. From the attached reference, it can be seen that Associate Professor Dr. Maya Dimitrova is the lead author in almost all of the 32 publications attached (84%), and in only 5 of them she is not the first author (in 2 of these five she is the second author). In the materials there are no statements of the percentage participation of the authors in the presented publications, I accept the equal participation of Prof. Dimitrova and the other co-authors. In all publications, the relevant primary sources are cited.

All this is proof of Maya Dimitrova's high level as a scientist and gives me the reason to confirm the creative participation of Assoc. Dr. Maya Dimitrova in the contributions she has indicated, as well as their significance. No plagiarism was found in the scientific works submitted for the competition.

## 8. CRITICAL NOTES AND RECOMMENDATIONS

After familiarizing myself with the materials and scientific works presented in the competition, I have no critical comments on the submitted works and materials. In the works and materials of Assoc. Dr. Maya Dimitrova, there are no false facts and statements compromising the final results. I would recommend the candidate to formulate the more interesting results on the topic of the competition in a separate monographic work, through which these results will be systematized and summarized.

## 9. FINAL CONCLUSION

On the basis of the materials provided and the works of Assoc. Prof. Dr. MAYA IVANOVA DIMITROVA in the competition for PROFESSOR and the performed analysis, as well as the scientific and scientific-applied contributions contained therein, I confirm that:

1. The scientific achievements of the candidate fully meet the requirements of the ZRASRB, the Regulations for its application, the Regulations on the Terms and Conditions for the Acquisition of Scientific Degrees and the Occupancy of Academic Positions at the BAS, as well as the Internal Rules for the Development of the Academic Staff of the IR-BAS for Employment in the academic position of PROFESSOR.

2. I give my positive assessment and with full conviction propose to the Scientific Jury for the competition for PROFESSOR to elect Associate Professor MAYA IVANOVA DIMITROVA to the academic position "PROFESSOR" in professional direction 5.2. "Electrical engineering, electronics and automation"; scientific specialty "Application of the principles and methods of cybernetics in different areas of science", thematic area "Robotic systems with human-machine interface".

12.07.2023

Veliko Tarnovo

Reviewer:

/Prof. Dr. Galina Bogdanova/