

### REVIEW

for the competition for academic position "Professor" in the area of higher education 5. Technical Sciences, professional field 5.2. Electrical Engineering, Electronics and Automation, scientific specialty "Application of the Principles and Methods of Cybernetics in Various Fields of Science" (Robotic Technologies with Human-Machine Interface), announced in DV, No. 26 from 21.03.2023, p. 34.

REVIEWER: prof. Tanio Tanev, Institute of Robotics - BAS

#### **1.** General Description of the Presented Materials

Documents have been submitted by one candidate - **Assoc. Prof. Dr. Maya Ivanova Dimitrova** from the Institute of robotics at the Bulgarian Academy of Sciences. The applicant has submitted the following documents:

- CV;
- PhD degree diploma;
- Associate professor diploma;
- List of publications in specialized scientific publications, equivalent to a monograph, and other publications;
- Author's report of the original scientific contributions в in publications in specialized scientific publications, equivalent to a monograph, and in other publications;
- List of citations;
- Information for the fulfilment of the minimum national requirements for occupying the academic position "professor";
- Certificate of scientific supervision of successfully defended doctoral students;
- Certificate of Participation and Project Management;
- Copies of publications in accordance with minimum national requirements 32 publications;
- Declarations 2 ;
- Other materials which complement and characterize the applicant's scientific activity.

Of the 32 publications submitted for participation in the competition for the academic position of "professor", 11 were designated as equivalent to a monograph. There are 12 refereed publications in the Scopus and Web of Science databases, while the remaining 20 are not referenced in these databases, but are peer-reviewed or in edited

volumes. There are 2 publications in journal with impact factor and 8 with SJR index. Eight of the works presented are with one author (the applicant). The remaining 24 scientific works are co-authored.

It should be noted that 8 of the works presented (4.11, 7.1, 8.5, 8.6, 8.7, 8.8, 8.13 and 9.3) were published before 2007, when Maya Dimitrova held the position of "Associate professor". According to the Law of the Development of the Academic Staff in the Republic of Bulgaria (LDASRB), candidates for the academic position of "professor" must have submitted a published monographic work or equivalent publications in specialized scientific publications, which do not repeat those submitted for the acquisition of the educational and scientific degree "doctor ", for the scientific degree "Doctor of Sciences" and for occupying the academic position "Associate professor". The reviewer assumes that Assoc. Prof. Maya Dimitrova has correctly fulfilled this requirement (a declaration of familiarity with LDASRB and the relevant regulations is attached) and has provided only works that do not repeat those when occupying the academic position of "associate professor" is missing.

The scientific papers are presented and systematized in accordance with the requirements of the Act on Development of the Academic Staff and the corresponding regulations of BAS and the Institute of Robotics-BAS.

It may be pointed out that most of the papers have been published in reputed journals and in international conferences.

### 2. Brief CV of the Applicant

Maya Dimitrova graduated from the University of Saint Petersburg, Russia (Department of Psychology) in 1985 and holds a Master Degree from the University of Warwick, UK (Faculty of Psychology) in 1995.

In 2002, she defended his doctoral thesis at the Institute of Control and System Engineering - BAS, Sofia, and obtained the educational and scientific degree "doctor", with the thesis topic "Adaptive Human Computer Interface".

From 1989 until now, she has worked in institutes at the Bulgarian Academy of Sciences, and has successively held positions such as assistant, chief assistant, associate professor. He is currently an associate professor in the Interactive Robotics and Control Systems Department at the Institute of Robotics, BAS, conducting scientific research on human-robot systems, humanoid robots, rehabilitation robotics and socially competent robotic systems.

She was a member of the Management Board of COST Action IC 1404 MPM4CPS ("Multiparadigm modelling in cyber physical systems") 2016 - 2018. She is a member of the Union of Scientists, a member of the Psychonomic society, of Women in Cognitive Science, etc.

She is a project evaluator and a participant in the panel of evaluators for the EC Horizon 2020 and Horizon Europe programs from 2014 to now.

### 3. General Characteristics of the Applicant's Scientific, Teaching and Applied Activities

The scientific activity of Assoc. Prof. Dr. Maya Dimitrova is in the field of the announced competition and the reviewer accepts that the presented scientific works do not include publications presented at previous procedures for occupying academic positions and acquiring scientific degrees, as mentioned above.

From the information provided, it is obvious that the minimum required points by groups of indicators of the professional field 5.2 Electrical Engineering, Electronics and Automation for the Academic Position "Professor" have been met:

Group A: Diploma No.27845/15.04.2002 for the PhD degree - 50. The applicant fulfils the requirement of this indicator.

Group C: The requirements have been fulfilled with a list of 11 scientific papers in publications that have been referenced and indexed in world-renowned databases of scientific information – 190.69 τ. (required minimum is 100);

Group D: The requirements are met by submitting a list of a total of 21 scientific publications in journals that are grouped according to the table of the minimum requirements – total points are 204.68 (required minimum is 200);

Group E: The requirements have been met, and a list of a total of 111 citations has been presented. Of these, citations in scientific publications, referenced and indexed in world-famous databases with scientific information or in monographs and collective volumes are 70, citations in monographs and collective volumes with scientific review -12, citations in non-refereed journals with scientific review - 29. The total number of points for this indicator is 824 with a required minimum number of 100. And here it should be noted that cited publications of the candidate published before 2007 are included (from the first group there are 6 cited articles that received 27 citations in scientific publications, referenced and indexed in world-famous databases with scientific information or in monographs and collective volumes). But even with the reduction of these citations, the candidate receives a sufficient number of points on this indicator and fulfils the requirement for this group.

Group F: Supervisor of two PhD students, participation in a national scientific or educational project (2), participation in an international scientific or educational project (2), management of a national scientific or educational project (1), management of an international scientific or educational project (1), attracted funds for projects managed by the candidate. The total number of points for this indicator is 345 (with a required minimum number of 150). The candidate fulfils the requirement under this indicator.

In conclusion, it can be pointed out that the Assoc. Prof. Dimitrova's personal indicators in all groups significantly exceed the minimum requirements.

Assoc. Prof. Dimitrova is a participant and leader of several scientific and scientificapplied projects, both national and international. The scientific supervision of two successfully defended doctoral students is indicated as a teaching activity.

## 4. Analysis of Scientific and Applied Achievements According to the Materials Submitted for Participation in the Competition

The scientific papers submitted for participation in the competition contain original research results related to cognitive, neuro-cognitive and social aspects of modelling human-robot systems, which can be grouped and summarized as follows:

- 1) A conceptual model of neuro-cognitive processing of semantic/abstract and perceptual/concrete information in the learning process of human-robot interaction. The model explains specific psychological phenomena that are present in the process of human-robot interaction in the form of subjective barriers that do not allow the robot to be accepted as a useful human helper/assistant in professional fields such as pedagogy, social services, etc. The model formally presents the subjective effect of the information coming through the sensory systems in the form of a statistical normal distribution. This model explains various subjective phenomena occurring at the neural, cognitive, and social levels in human-robot interaction. The consideration of experimentally established effects leads to a more adequate design of intelligent systems adapted to the individual user of the technical system.
- A cognitive architecture of the learning process that develops models replicating the functional specialization of the human brain, iterative and cyber-physical approaches to design robot games that support children's socialization for special education applications.

This cognitive architecture consists of 2 main modules for processing the information coming from the sensory systems - an interpretation module on two hierarchical levels where parallel processing takes place - on a rational and intuitive level, and a module that shapes behaviour. An iterative approach and formal method for designing games for cyber-physical pedagogical systems is proposed in accordance with the individual needs of the child and the judgment of the educator. The process of designing a specific game for learning certain skills is represented as a linear system. A cyber-physical approach has been developed to design games with non-humanoid robots that implicitly support the socialization of children in the process of play. This group of contributions has a practical application in the creation of the cyber-physical system for pedagogical applications.

3) A structural approach to the analysis of security aspects and user acceptance of socially competent robotic systems. The approach develops the theory of social motivation as the main determinant of a person's behaviour, where the reward is a type of attention or treatment from other people, rather than a material incentive. The physical behaviour of the robot is evaluated first as a social signal to the human, then as an emotional signal and finally as a functional signal. This model leads to a better understanding of the signals generated by the robot and - respectively - to a greater safety of the human-robot interaction.

- 4) An approach to designing knowledge accessibility systems in digital and physical repositories and a cognitive approach to designing intelligent agents supporting knowledge access in terms of user preferences for expert or popular representation. The first approach extends the meaning of the concept of accessibility, which also considers the layers of knowledge/experience and motivation when creating new cyber-physical systems to support learning in the presence of sensory or cognitive disabilities by proposing the so-called "cyber-physical teacher" and " a cyber-physical museum guide'. A cognitive approach is proposed for the design of intelligent agents for search, retrieval, and automatic classification of text content on Web pages. A neural network is 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.
- 5) Developed networks and concept in human-robot interaction and specifically modular neural networks for human-robot interaction style diagnosis, concept for designing high-level synthetic sensors for improved human-robot communication and concept for modelling learning processes in a human-computer context. A new neural user profile recognition method is proposed, which learns faster in cases where the input data vectors are similar. Simulations of the method were performed. The method is applicable for automatic recognition of users from registered data about them concentration of attention, short-term memory, etc. In the proposed high-level synthetic sensor design concept, the human-robot interaction is considered at 3 levels – physical, social, and psychological. This concept is applied in the creation of the so-called "cyber-physical nurse", concluding that the rehabilitation process with the help of social robots for seriously ill or elderly people is more successful when the robot initiates a dialogue in which the patient shares positive memories such as moments of "attachment" to loved ones.
- 6) Approaches to designing intelligent agents with autobiographical memory, to designing humanoid robots capable of performing professional roles, and to designing the classroom of the future using disruptive technologies. The humanoid robot design approach establishes the levels at which interaction is acceptable—physical and social—as well as the level at which it is unacceptable—psychological. It is suggested that these levels should be considered when designing the professional roles of the humanoid robot in order to overcome possible negative states caused by the interaction with the robot.

The approach to designing the classroom of the future proposes a smart sensor architecture for embedding in the environment that registers the child's eye blinks during a lesson to predict the level of concentration or distraction. The purpose of incorporating smart sensors is to ease the learning process from repetitive or boring activities and at the same time ensure a better understanding and retention of the learning material by all children. In conclusion, it can be pointed out that the scientific papers of Assoc. Dr. Maya Dimitrova, submitted for participation in the competition, contain original scientific and scientific-applied contributions. These contributions are proof that Associate Professor Dr. Dimitrova is a well-established leading scientist in this specialty.

# 5. Impact of the Applicant's Results Reflected in the Works of Other Authors

Associate Professor Dr. Maya Dimitrova has presented a list that includes cited articles both before taking up the academic position "Associate Professor" (2007) and cited articles published after 2007.

According to the list, the candidate's works have been cited in a total of 111 independent publications, and the citations are divided into the following groups:

5.1. Citations in scientific publications, referenced and indexed in world-renowned databases of scientific information or in monographs and collective volumes. 22 numbers of cited publications are indicated, which are cited in 70 independent papers.

5.2. Citations in peer-reviewed monographs and collective volumes. 9 cited publications are listed here. These 9 publications have been cited in 12 independent papers.

5.3. Citations in non-refereed peer-reviewed journals. 15 cited publications are listed, which are cited in 29 independent works.

These facts are an indicator of both the international fame of the candidate and the quality of the scientific contributions of the publications and are recognitions of the expert qualities, and it can be noted that Assoc. Prof. Dimitrova has received very good recognition from the international scientific community.

### 6. Critical Notes and Recommendations

I have not found any fundamental errors or inaccuracies in the candidate's works. I have no significant critical comments on the scientific works submitted for participation in the competition. From a formal point of view, the following critical remarks can be made:

- There is no division of author's and habilitation reports. According to the reviewer, the habilitation report is hidden in the author's one. An extended habilitation statement of scientific contributions should be submitted, which is a brief statement in which the candidate describes the place of the research carried out in the relevant scientific field and his personal contributions. The habilitation statement should contain an introduction, main scientific contributions, and a bibliography;
- The list of citations does not clearly indicate whether these are all the candidate's citations;
- It would be good to present a list of all publications, which would contribute to a more complete description of the candidate's scientific activity.

Considering the substantial accumulated experience and scientific results, I recommend Assoc. Prof. Dimitrova to pass on the accumulated research experience by training more doctoral students and young specialists.

#### 7. Conclusion

The submitted materials for the competition meet the requirements of the LDASRB, the Regulations for its application, the internal regulations of the BAS and the Institute of Robotics at the BAS for the occupation of the academic position "Professor". The candidate's works have original scientific and scientific-applied results. The achieved scientific and applied contributions of Assoc. Prof. Maya Dimitrova and the complex evaluation of the submitted materials for the competition give me the reason to evaluate her research activity highly and positively.

I find it justifiable to propose to the Scientific Panel and the Scientific Council of the Institute of Robotics at BAS to appoint **Assoc. Prof. Dr. Maya Ivanova Dimitrova** to the academic position PROFESSOR in the professional field 5.2. Electrical Engineering, Electronics and Automation.

Sofia,

Reviewer:

14 July 2023

/prof. Tanio Tanev/

