

## **OPINION**

**for the occupation of the academic position “Professor”, in professional field 4.6 Informatics and Computer Science (Computer modeling by CAD systems with application in mechatronics and robotics), for the needs of the Sofia University “St. Kliment Ohridski” (SU), Faculty of Mathematics and Informatics (FMI), declared in the State Gazette No. 20/08.03.2024 and on the Web pages of SU and FMI**

This report is prepared by Assoc. Prof. Dr. Kaloyan Yovchev from Sofia University “St. Kliment Ohridski”, FMI, as a member of the scientific jury for the competition according to Order No. ПД 38-203 / 30.04.2024 of the Rector of SU.

One applicant has submitted documents for participation in the announced competition: Dr. Ivan Chavdarov, Associate Professor at FMI, SU.

### **I. General description of the presented materials**

#### **1. Application details**

The documents of the applicant comply with the requirements of the Act of the Development of the Academic Personnel of the Republic of Bulgaria (ADAPRB), the Rules for the Implementation of the Act of the Development of the Academic Personnel of the Republic of Bulgaria (RIADAPRB) and the Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at SU (RTCAADOAPSU).

For participation in the competition, the candidate, Associate Professor Dr. Ivan Nikolov Chavdarov, submitted a list of a total of 16 titles, including 14 scientific publications and 2 patents. 8 of the presented publications have an impact factor (Web of Science - IF). All of the presented publications have an impact rank (SCOPUS – SJR).

The applicant has submitted for the competition:

- Professional autobiography,
- Copy of diplomas for higher education and for educational and scientific degree “Doctor”,
- Copy of certificate for occupation of the academic position “Associate Professor”,
- Certificate of internship in the specialty,
- Documents proving the fulfillment of the requirements of Art. 115, para. 1, item 2 of RTCAADOAPSU,
- Lists of publications (list of all publications and list of publications presented at the competition),
- List of publications, presentations, projects, and supervision activities, generated by the information system of SU,
- Reference for the fulfillment of the minimum national requirements and the requirements of SU for the professional field 4.6 Informatics and Computer Science,
- Lists of citations of publications of the applicant,
- Reference for original scientific contributions,
- Reference for the degree of fulfillment of the indicators under Art. 122, para. 2 of RTCAADOAPSU,

- Copies of publications presented at the competition,
- Abstracts of the publications presented at the competition (in Bulgarian and in English),
- Copy of the competition announcement in the State Gazette.

The documents of the applicant have been prepared carefully and in full compliance with the requirements of RTCAADOAPSU.

## **2. Candidate data**

The candidate, Assoc. Prof. Dr. Ivan Nikolov Chavdarov, has a technical degree, completed in 1991 at the Technical University, Sofia. In 2006, after successfully defending a dissertation on "Force-metric design of manipulation systems for robots", he received an educational and scientific degree "doctor" (PhD) in the scientific specialty 02.01.52 "Robots and manipulators".

In 1995, he started working in the Central Laboratory of Mechatronics and Instrumentation at the Bulgarian Academy of Sciences (BAS). In 2011, he became an Associate Professor at the Institute of System Engineering and Robotics at the BAS. Since 2017, he is an Associate Professor at Sofia University "St. Kliment Ohridski" to the Department of "Mechatronics, Robotics and Mechanics" of FMI, where he established himself both with his teaching and scientific activities.

## **3. General characteristics of the applicant's scientific work and achievements**

The research activities of Assoc. Prof. Dr. Ivan Chavdarov and the topics of his scientific works are entirely in the field of competition. He participates in the competition with 14 publications and 2 patents.

In accordance with the requirements under Art. 1a, para. 1 of the RIADAPRB, the candidates for the academic position of professor in professional field 4.6 Informatics and Computer Science must have: 50 points in group of indicators "A", at least 100 points in group of indicators "B", at least 200 points in group of indicators "Г", at least 100 points in group of indicators "Д", at least 100 points in group of indicators "E". RTCAADOAPSU does not define higher additional requirements than those specified in the RIADAPRB.

According to the submitted documents the applicant covers:

- 50 points in group of indicators "A";
- 198 points in group of indicators "B";
- 356 points in group of indicators "Г";
- 200 points in group of indicators "Д";
- 170 points in group of indicators "E".

The publication „*Nikolov, V., Dimitrova, M., Chavdarov, I., Krastev, A., Wagatsuma, H., Design of Educational Scenarios with BigFoot Walking Robot: A Cyber-physical System Perspective to Pedagogical Rehabilitation, LECTURE NOTES IN ARTIFICIAL INTELLIGENCE, Lecture Notes in Computer Science, 2022, Volume: 13258, Pages: 259-269, DOI:10.1007/978-3-031-06242-1\_26, 259-269, Published: 2022, ISBN:978-3-031-06241-4*“ is presented as a publication with a Q4 from 2005 and therefore should be evaluated as a publication with an SJR.

Therefore, the minimum national requirements and the additional requirements under Art. 1a, para. 2 and para. 3 of the RIADAPRB for occupation of the academic position of "Professor" in the professional field 4.6 Informatics and Computer Science have been completely covered and exceeded by Assoc. Prof. Dr. Ivan Chavdarov.

As can be seen from the registers of the National Centre for Information and Documentation (NACID) and the evidence provided in addition, the scientific papers submitted by the candidate do not repeat those of previous procedures for obtaining a scientific title and academic position.

There is no legally proven plagiarism in the scientific publications which are submitted for the competition.

#### **4. Characteristics and evaluation of the teaching activity of the candidate**

Assoc. Prof. Ivan Chavdarov has a very intensive teaching activity. His annual lecture load and his total teaching employment is above the norm for the required teaching load at Sofia University. Leads the following compulsory and elective courses for bachelors and masters: "Mathematics", "Kinematics", "Design of mechanical components of robots with CAD systems", "3D modeling and printing and applications in robotics", "Motion planning in complex environments", "Robot Modeling with a 3D Printer", "Programming in a CAD Environment and Applications in Robotics". According to the documents submitted for the competition, he was a supervisor of 2 successfully defended doctoral students and 5 successfully defended master's students. Reviews of his work from students are excellent.

#### **5. Substantive analysis of the scientific and applied scientific achievements of the applicant, presented in the materials for participation in the competition**

The scientific works presented by Assoc. Prof. Dr. Ivan Chavdarov for participation in the competition contain original research results in the field of informatics and computer modeling. The main contributions of the candidate relate to three main thematic areas: modeling by CAD systems of mobile robots, modeling of stationary robots, applications of informatics and computer modeling in mechatronics and medicine. The most significant scientific and scientific-applied contributions in the publications presented for the competition can be grouped as:

- *Group 1. Computer modeling using CAD systems of mobile robots.* A method was created to optimize the main dimensions of a walking robot to reduce energy losses when moving on flat terrain and overcoming higher obstacles. The method is experimentally validated. New methods and models have been created to control the gait of a walking robot based on the sensory information combined with its movements. A walking robot prototype based on a minimalist principle was designed and built. Algorithms have been developed for controlling the movements of a walking robot with the aim of reducing the impact loads when it moves on flat terrain and studying irregularities. Applications of the walking robot "Big Foot" have been found in the education and rehabilitation of children with special needs.
- *Group 2. Computer modeling of stationary robots.* A new method for solving the inverse kinematics problem for open-structure robots is created, and the solutions are divided into types. An algorithm has been developed that allows finding solutions to the inverse problem for a wide range of robots by using a geometric approach representing points in a polar coordinate system. Algorithms have been created for robot movement in an obstacle environment considering joint constraints and different types of solutions to the inverse kinematics problem. A 3D printed prototype of a redundant robot was created. Software running in a CAD environment was created to solve the inverse kinematics problem for a redundant robot. The created methods and algorithms are experimentally validated.
- *Group 3. Computer modeling in mechatronics and medicine.* A 3D printed humanoid robotic arm built on a modular principle was created. An algorithm for determining the main kinematic characteristics of a finger of a humanoid hand is proposed and developed. A computer-brain interface with a fast setup and a minimal learning phase has been investigated, proposing a new way of decoding signals. An approach is presented to control the feed rate during distinct stages of the bone drilling process, using an orthopedic robot.

The obtained results show that Assoc. Prof. Dr. Ivan Chavdarov is an established scientist and leading researcher in the field of computer modeling, through CAD systems with application in mechatronics and robotics. This is also confirmed by the citability of Assoc. Prof. Dr. Chavdarov's scientific works. According to the presented materials, Assoc. Prof. Dr. Ivan Chavdarov has 62 citations in articles by other authors that are published in publications referenced and indexed in Web of Science and/or SCOPUS, 28 of them with impact factor and 16 of them with SJR. He participated in the competition with 14 publications. Of the

publications presented, 8 are in publications with an impact factor, and all have an impact rank. He is the first author of 7 articles, the second author of 2 articles, the third author of 4 articles and the fourth author of 1 article. The scientific publications are related to the implementation of 4 successful research projects.

Assoc. Prof. Ivan Chavdarov also participated in the competition with two patents. 2020 Patent No. 67070 B1 for "Robotic Humanoid Arm" is self-titled, and 2018 Patent No. 66752 B1 for "Walking Robot" is first authored.

I have no doubt as to the applicant's substantial contribution in each of the publications and patents.

#### **6. Critical remarks and recommendations**

I have no critical remarks about the competition materials and about the scientific works of Assoc. Prof. Dr. Ivan Chavdarov. I recommend that he continue to work professionally and actively.

#### **7. Personal impressions of the applicant**

I have known Assoc. Prof. Dr. Ivan Chavdarov since 2017, since he worked in the Department of "Mechatronics, Robotics and Mechanics" at FMI, SU. I highly value his professionalism, thoroughness, and ability to work in a team.

#### **8. Conclusion on the application**

Having become acquainted with the materials and scientific works presented in the competition and on the basis of the analysis of their significance and the scientific and applied scientific contributions contained therein, I **confirm** that the academic achievements of the candidate Assoc. Prof. Dr. Ivan Chavdarov fully correspond to the requirements of the ADAPRB, the Regulations for its application and the corresponding Regulations of SU for the occupation of the academic position "Professor" in the professional field 4.6 Informatics and Computer Science. In particular, the applicant meets the minimum national requirements in the professional field and no plagiarism has been detected in his scientific papers submitted to the competition.

I give a **positive assessment** of the application of Assoc. Prof. Dr. Ivan Chavdarov.

## **II. GENERAL CONCLUSION**

Based on the above, I **recommend** the scientific jury to vote on a proposal to the Council of the Faculty of Mathematics and Informatics of Sofia University "St. Kliment Ohridski" to **select Assoc. Prof. Dr. Ivan Chavdarov for the academic position of "Professor" in the professional field 4.6 Informatics and Computer Science.**

18.06.2024

Member of the Scientific Jury: .....

(Assoc. Prof. Dr. Kaloyan Yovchev)