

REVIEW

**on the competition for the academic position “Associate Professor”
in the professional field 4.6. Informatics and Computer Sciences, Informatics
(Software and Hardware Implementation of Models and Algorithms for Motion
Control of Manipulation Robots),
for the needs of Sofia University „St. Kliment Ohridski“ (SU),
Faculty of Mathematics and Informatics (FMI),
announced in SG No. 61 from 02.08.2022 and on the Internet pages of FMI and SU**

The review is prepared by: **Professor Evgeniy Hristov Krastev(PhD)**, FMI at SU, Department of Mechatronics, Robotics and Mechanics, appointed a member of the scientific jury for the academic position Associate Professor in **professional field 4.6. Informatics and Computer Science** and according to **Order No ПД 38-562/28.09.2022** of the Rector of the SU.

A single candidate has submitted documents for participation in the announced competition:

Assistant Professor Dr. Kaloyan Mariyanov Yovchev from Sofia University St. Kliment Ohridski Kliment Ohridski (Faculty of Mathematics and Informatics), Department of Mechatronics, Robotics and Mechanics.

I. GENERAL DESCRIPTION OF THE APPLICATION DOCUMENTS

1. Information about the application

A careful examination of the submitted documents for this competition allows to summarize the information about the application as follows. The list of documents and their content corresponds entirely to the requirements of art. 107(1) of the Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at SU (PURPNSZADSU) as well as the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (ZRASRB) and the Regulations for the Implementation of the ZRASRB (PP ZRASRB) for participation in a competition for "Associate Professor".

For participation in the competition, the candidate Kaloyan Marianov Yovchev, has presented a list of 31 publications in foreign scientific journals and reports on scientific forums specialized in the field of robotics and implemented in the period 2015-2022. For participation

in the competition he has presented 14 of these publications. The reference for meeting the minimum national requirements under art. 2b of the ZRASRB for scientific field 4. Natural sciences, mathematics and informatics, professional field 4.6. Informatics and Computer Science for the acquisition of the academic position "Associate Professor" is correctly completed and is accompanied by the necessary evidence. Therefore I fully agree with the data presented by the candidate.

2. Information about the candidate

Assistant Professor Kaloyan Marianov Yovchev graduated from the Sofia High School of Mathematics in 2009. In 2013 he acquired a Bachelor's Degree in Informatics, majoring in Computer Science at SU and subsequently, in 2015 he acquired a Master's Degree in Informatics, specialty "Mechatronics and Robotics" at SU. During the period 2015-2018 he has been a PhD student at FMI, where in 2018 he has defended a dissertation on "Iterative Learning Control (ILC) of Manipulation Robots" and has acquired the educational and scientific degree of "Doctor" (PhD).

The applicant is Assistant Professor at FMI since 1990 and satisfies the requirements of Article 105(1) of the PURPNSZADSU. Concurrently, since 1990 he serves also as a Specialist in Planning Information Technologies at the Institute of Robotics of the Bulgarian Academy of Sciences. Previously. Earlier, in the period 2015-2019, he has been a part-time lecturer at FMI, as well as a member of the Standing Committee on Natural Sciences, Mathematics and Informatics at the National Evaluation and Accreditation Agency.

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

The candidate has ORCID <https://orcid.org/0000-0001-7536-2717>. The list of all 31 publications covers 4 publications with impact factor and SJR (two with Q2 and 2 with Q3), 16 publications with SJR (two with Q2, seven with Q3 and four with Q4) and 7 publications without impact factor and SJR, but indexed in science-metric databases (SCOPUS, IEEE Xplore, Google Scholar). He has published 9 papers in renowned scientific journals as well as delivered 15 reports at international scientific conferences specializing in robotics.

Assistant Professor Kaloyan Yovchev has 13 publications that are referenced in Web of Science and these publications have a total of 42 citations. In Scopus, the candidate has an H-index equal to 4 and a total of 34 refereed publications and 50 citations of his publications after 2015. In Google Scholar, the candidate has an H-index equal to 7 and 38 referenced posts.

The publications of the only candidate in this competition are entirely in the field of robotics and are dedicated to current and socially significant problems in connection with software and hardware implementation of models and algorithms for controlling the movement of manipulators. Most of the publications are devoted to finding original solutions to specific problems in this area for motion control of manipulators and vehicles in an environment with obstacles through the methods of ILC. The list of publications generated by the "Authors" system of SU and attached to the application documents shows that the applicant has participated in 12 scientific projects since 2012. In one of these projects he is the team leader (Competition of the Ministry of Education and Science NSF for financing basic research of young scientists and postdoctoral students – 2020), and in the others he is a member of the team implementing the project.

The information submitted by the applicant in relation with art. 2b of ZRASRB contains all the necessary evidence that the scientific papers submitted by the candidate for participation in the competition fully meet and exceed the minimum national requirements for acquiring the academic position of Associate Professor. The numerous publications and lectures of the candidate at international conferences on robotics provide evidence that the scientific and applied results achieved by him have been reviewed by anonymous reviewers, discussed and well accepted at many specialized forums. It is noteworthy that in a relatively short period the candidate has shown outstanding publication activity with a high number of citations of his publications having impact factor and SJR. There is no evidence for plagiarism in the scientific papers submitted to this competition that is proven by the regulations established by law.

4. Characterization and evaluation of the applicant's teaching activity

Assistant Professor Yovchev has more than seven years of professional experience in teaching students at FMI in courses from bachelor's and master's programs, initially as a part-time lecturer and after 2019 as Assistant Professor. The applicant has not provided evidence of specific course names competition materials. At the same time, as a colleague in the same department he works at FMI, I am aware that the candidate delivers lectures and/or practical classes in robotics (masters), functional programming (bachelors), image processing (masters) and programming with MATLAB (masters). These courses are available in the platform for teaching with remote access, Moodle, at Sofia University, where the candidate publishes educational materials for the students. In my opinion, the quality and content of these courses, as well as the methods of teaching of the candidate deserve to be highly appraised, as they are based on modern reference materials, resources and teaching technologies.

5. Thorough analysis of the scientific and applied achievements of the candidate contained in the materials for participation in the competition

There are 14 publications that have been submitted for participation in the competition. In six of these publications, the candidate Kaloyan Yovchev is a leading author. The candidate's contributions in these publications are organized in the Author's Reference (see 14. *Contributions* in the competition materials) in the following three groups:

- 1 Scientific contributions
- 2 Scientific- applied contributions
- 3 Applied contributions

The scientific contributions of the candidate are the field of manipulator motion control by means of ILC. This is a very promising area for research in robotics. Motion control of robot arms through ILC stands out among the methods of adaptive control with its ability to accomplish repetitive tasks with high accuracy taking into account the "unmodeled dynamics". It compensates the errors in feedback control and unmodeled dynamics when the control law is based on the robot's dynamics model. The scientific contributions are defended in publications [1- 3] cited in the attached by the candidate list of references in his Author's Reference. I consider the most significant scientific contribution of the candidate to be the development of a control method that extends ILC method application in the presence of constraints in the space of the joint coordinates of the manipulator, a method referred to as Constrained Output ILC (COILC) in his works. There is no evidence in the existing literature of any other method for ILC of nonlinear systems, such as manipulation robots, which takes these constraints into account. The second most important scientific contribution of the candidate is the proof of convergence for the proposed COILC published in his papers. This mathematical proof shows his ability to employ a rather complex mathematical apparatus for modeling highly nonlinear systems. It is noteworthy that the candidate is the lead author in publications [1-3]. Also, these publications have a total of 26 citations in Scopus and Web of Science..

The scientific contributions of the candidate have been confirmed by numerous computer simulations on real physical models of manipulation robots. The results of these computer experiments are reported in publications [1-3] and are part of the scientific and applied contributions of the candidate in this competition. Other aspects of scientific and applied contributions are presented in publications [5,6,7,8 ,9,11,13]. The most significant of these contributions are a method of control with iterative self-learning in the presence of obstacles

(4 citations), a method for precise positioning of the gripper using computer vision in the conditions of a rather approximate representation of the mathematical model of the robot (3 citations), a zero-moment method for driving "forward" a two-legged robot with 10 degrees of freedom of movement (2 citations)

A significant applied contribution of the candidate is the development of software tools and the assembly of teaching anthropomorphic robots. The results of a computer simulation of motion in real motion experiments have been published in [4, 8, 9,10, 11, 12, 14] with a total of 8 citations. Assistant Professor Yovchev is also the author of a number of publicly available videos published on YouTube illustrating the successful implementation of these computer experiments (<https://www.youtube.com/@kyovchev/videos>).

The candidate's scientific and applied contributions demonstrate excellent knowledge in the field of mathematics and computer modeling of manipulation systems and robotic autonomous systems. On the other hand, the development of computer experiments to study these models with real data prove skills for hardware implementation of physical models of manipulation systems, including assembly of the mechanical structure and the components of driving and controller manipulation systems. Additionally, these skills require hands-on experience in software development in a wide range of programming languages in the MS Windows, Linux and Robotic Operating System environments.

6. Critical notes and recommendations

I don't have any critical comments on the merits..

7. Personal impressions of the candidate

I have excellent personal impressions of the candidate, initially as a scientific supervisor of his doctoral studies, and subsequently as a lecturer and colleague at FMI. In this regard, I had the opportunity to follow his scientific growth and his transformation into a respected lecturer at FMI. This gives me the right to say that Kaloyan Yovchev has the necessary professional competencies for research and teaching activities in the field of software and hardware implementation of models and algorithms for controlling the movement of manipulators. He is a good example of a young scientist constantly developing and enriching his knowledge and scientific interests. His professional skills are in fully aligned with personal qualities such as modesty, diligence, initiative, precision and responsibility in fulfilling his commitments.

8. Conclusion on the application

After getting acquainted with the materials and scientific works presented in the competition and based on the analysis of their significance and contained in them scientific and applied scientific contributions, I **confidently confirm** that the scientific achievements meet the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria, the Regulations for the Application of this law as well as the Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at Sofia University "St. Kliment Ohridski" for the candidate's occupation of the academic position "Associate Professor" in the scientific field and professional field of the competition. The award of the academic position "Associate Professor" will be fully deserved and will create additional stimulus for further development of the research and teaching activities of Kaloyan Yovchev. In particular, it satisfies the minimum national requirements in the professional field and no plagiarism has been established in the scientific papers submitted to the competition.

I give my **positive** assessment of the application

II. OVERALL CONCLUSION

The above gives me reason to recommend the Scientific jury to make a proposal to the competent authority for the election at the Faculty of Mathematics and Informatics at Sofia University "St. Kliment Ohridski". Kliment Ohridski" supporting a decision to **award Assistant Professor Dr. Kaloyan Marianov Yovchev** the academic position of **Associate Professor** in professional field **4.6. Informatics and computer science** (Software and hardware implementation of models and algorithms for control of the movement of manipulators).

24 November 2022 .

Reviewer:.

(Professor Dr. Evgeniy Hristov Krastev)