STATEMENT
considering the procedure for
„associate professor"
in the field of 4.6. Informatics and
Computer Science (Software and hardware implementation of models and algorithms for motion control of manipulators),
for the needs of Sofia University "St. Kliment Ohridski" (SU),
Faculty of Mathematics and Informatics (FMI),
announced in State Gazette (SG), issue 61 from 02.08.2022 and on the faculty and university websites

The statement is written by: **Assoc. Prof. Dr. Ivan Nikolov Chavdarov,** SU, 4.6. Informatics and Computer Science / Robotics, as a member of the Scientific Committee on the procedure, in accordance with Order No. РД-38-562/28.09.2022 of the Rector of Sofia University.

The only candidate in the procedure who submitted documents is:

Ch. assistant, Dr. Kaloyan Mariyanov Yovchev, SU "St. Kliment Ohridski", Faculty of Mathematics and Informatics.

I. General description of the submitted documents

1. Application details

All the documents presented by the applicant are in accordance with the requirements of required laws in republic of Bulgaria, namely: ЗРАСРБ, ППЗРАСРБ; as well with the requirements of Sofia University (ПУРПНСЗАДСУ).

In his application the candidate Kaloyan Yovchev has ppreseted a list of 14 articles, including 14 publications in Bulgarian and international scientific journals and scientific forums, 0 studies, 0 monographs, 0 books, 0 certificates and patents, 0 textbooks or other educational materials Four of the presented publications are separated as habilitation work according to criteria B4 of ППЗРАС. Two other documents (in the form of official notes and certificates from the employer, project manager, funding organization or project contractor, references and testimonials, awards, and other relevant evidence) supporting the applicant's achievements are also presented. The total number presented in the candidate's documents is 546 points compared to 400 required in the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ППЗРАСРБ) which satisfies the requirements of the applied position.

Notes and comments on the documents.

All submitted documents meet the requirements and regulations of the SU.

Two of the submitted works were used in the candidate's dissertation and should not be considered and points from them should not be considered, these are the articles: "3. B4.3 – AJC 2018, Web of Science IF Q3 - 45 points, State Space Constrained Iterative Learning Control for Robotic Manipulators, Asian Journal of Control" and "6. D7.2 – MMS ILC 2019, Scopus SJR - 30 points, Iterative Learning Control for Precise Trajectory Tracking Within a Constrained Workspace, Mechanisms and Machine Science, 2019".

2. Candidate information

Kaloyan Yovchev graduated with a master's degree in Mechatronics and Robotics at the Sofia University "St. Kliment Ohridski", where he defended his doctoral dissertation in Informatics and Computer Sciences (Information Technologies) with the title "Iterative learning control for robotic manipulators". Since October 2015, he has been a part-time assistant at Sofia University. Since October 2019 he works as a cheaf assistant at the Faculty of Mathematics and Informatics of Sofia University. In parallel, since 2019, he has been working at the Bulgarian Academy of Sciences, Institute of Robotics as a part-time assistant. He has excellent knowledge of programming and software development.

3. General character of the scientific works and contributions of the candidate

The scientific work and results of Kaloyan Yovchev can be defined in three general directions:

- *Iterative learning control for robotic manipulators.* This direction is covered by works 1, 2, 11. These works have scientific and scientific-applied contributions;

- *Control systems for service robots.* An intelligent remote control and communication system for service robots has been developed. The system has been implemented in practice [7, 9, 13]. Remotely controlled service robots have been studied by performing experiments, and the control is based on a multi-channel system for distributing data from external devices [4, 10, 12]. Here the contributions are scientific-applied and applied;

- *Design, hardware and software implementation and control of mechatronic devices.* This topic is covered by works 5, 8, 10, 14.

The results of the candidate's activity have been presented at international scientific forums in the country and abroad. Of the reviewed works, three articles have been published in scientific journals and nine in conference proceedings. All presented works have been peer-reviewed and referenced in global databases. The works fully comply with the minimum national requirements (according to Article 2b, paragraphs 2 and 3 of the ЗРАСРБ) and, accordingly, with the additional

requirements of SU "St. Kliment Ohridski" for occupying the academic position of "associate professor" in the scientific field of the procedure. There is no evidence of plagiarism in the scientific works submitted for the competition.

4. Characteristics and evaluation of the teaching activities of the candidate

The candidate's teaching activity is described in application 15. It can be seen that his teaching activity significantly exceeds the norm for required teaching activities for chief assistant and is sufficient for the academic position of associate professor.

5. Content analysis of the scientific and applied achievements of the candidate, contained in the presented materials

Three of the works presented [1, 2, 11] are dedicated to iterative learning control of robots. It has been proposed a new method based on the bounded error algorithm (Bounded Error Algorithm, BEA) and solves the problem of the presence of transient error growth, which is a major obstacle in the implementation of Iterative Learning Control (ILC), methods to nonlinear systems with constraints. Unlike other ILC approaches, the method uses an algorithm that stops the iteration before a violation occurs in any of the state space constraints. The convergence of the proposed numerical procedure is proven, which is a significant contribution. The robustness and convergence of the method make it applicable to robot control. A computer simulation of the proposed numerical procedure for controlling a SCARA-type robot has been performed. A general method and an efficient computational procedure are presented for motion planning with respect to state space constraints, considering a dynamic model of the robot. The results extend the applicability of the proposed method and provide a means to improve the overall performance of robot trajectory tracking.

Five articles are related to the development of control systems for service robots. [4] and [10] consider different methods for remote control of a mobile service robot, with a manipulator. Methods based on gesture control, voice commands and web-based graphical user interface are analyzed. A new control of the Robco 19 robot has been developed via Leap Motion sensor. Real experiments were conducted and presented in [7] and [9]. In [13], a universal control and management system for service robots with remote access is presented.

The remaining articles are related to the design and implementation of various mechatronic devices. In [5], hardware and software were developed for a 3D printed redundant learning robot. The robot performs point-to-point and trajectory movements. The design is validated through real experiments. A bipedal robot was developed and designed a new walking pattern to achieve dynamic gait stability [8].

[14] examines the control of robotic flying systems (drones). The influence of disturbances caused by atmospheric turbulence is considered. An experimental set-up was created to compare and evaluate different trajectory control methods.

The first group of articles has scientific contributions related to the enrichment of existing knowledge. The second and third groups have scientific and applied contributions, with the results tested experimentally on real prototypes.

The works have been presented in articles published in journals and at international conferences. The distribution of the considered 12 publications by scientific metrics is as follows: Q1 – 0 articles; Q3 – 1 article; Q4 – 1 article; SJR without quartile – 8; Peer-reviewed and indexed without SJR/IF – 2. The articles are co-authored, where I have assumed that each author has the same contribution. A list of citations is presented, of which 50 are in articles referenced in SCOPUS and Web of Science. These indicators confirm the high value of the presented scientific works.

6. Critical notes and recommendations

I think that the reference to the original scientific contributions could be better structured by grouping the articles by topics related to various robotic devices. My overall impression of the works presented for consideration is excellent. I find the field in which the candidate works extremely promising. Achievements related to iterative learning and robot control are at a high level, which is confirmed by the large number of citations of works in peer-reviewed publications with an impact factor. I recommend that work in these areas be developed in his future work. Since most of the articles are co-authored, it can be more categorically said that the achievements presented in the author's reference for original scientific contributions are the work of the candidate, of which I have no doubt. The candidate is a leader and participant in numerous scientific projects in the field of robotics, which should also be reflected more visibly in the provided documents.

7. Personal impressions about the candidate

I have known the candidate Kaloyan Yovchev since 2017, and I have excellent impressions of his professional, scientific, and teaching work.

8. Conclusions about the application

After reviewing the documents and scientific materials presented in the procedure, based on the analysis of their significance and the scientific and scientific-applied contributions contained in them, I **concur** that the scientific achievements meet the requirements of the Law for Development of the Academic Staff in the Republic of Bulgaria (ЗРАСРБ), the order of its application, and the corresponding rules of Sofia University „St. Kliment Ohridski“, for the academic position of

"associate professor" in the scientific field of the procedure. In particular, the candidate fulfills the minimal national requirements in that field and no evidence for plagiarism has been found in the presented scientific works.

I give my **positive** evaluation of the candidate.

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II. GENERAL CONCLUSIONS

Based on the above, I **recommend** that the scientific jury to propose to the competent authorities of choice in the Faculty of Mathematics and Informatics, SU "St. Kliment Ohridski" to choose Kaloyan Mariyanov Yovchev for the academic position of "associate professor" in scientific field 4.6. Informatics and Computer Science (Software and hardware implementation of models and algorithms for motion control of manipulators).

Sofia, 15.11.2022.   Written by: Associate Professor Ivan Chavdarov, Ph.D