STATEMENT REPORT

under the procedure for acquisition of the educational and scientific degree "Doctor"
by candidate **Lyubomira Lachezarova Miteva,**
of the PhD Thesis entitled: "Modeling and control of an anthropomorphic robot arm",
In the Scientific field: **4. Natural Sciences, Mathematics and Informatics**
Professional field: **4.6. Informatics and Computer Sciences**
Doctoral program "Information systems"- Embedded and autonomous systems,
Department „Computer Informatics",
Faculty of Mathematics and Informatics (FMI), **Sofia University "St. Kl. Ohridski" (SU),**

The statement report has been prepared by: Prof. Dr. Zlatinka Svetoslavova Kovacheva, as a member of the scientific jury for the defense of this PhD thesis according to Order № RD 38-114/06.03.2023 of the Rector of the Sofia University.

1. **General characteristics of the dissertation thesis and the presented materials**

   The presented dissertation contains 132 pages and consists of an introduction, four chapters and a conclusion. It includes 75 figures and 11 tables. The presented bibliography contains 98 titles.

2. **Short CV and personal impressions of the candidate**

   Lyubomira Lachezarova Miteva graduated as a Bachelor of Software Engineering in 2017 and as a Master of Informatics - Mechatronics and Robotics in 2019 at Sofia University "St. Kliment Ohridski", Faculty of Mathematics and Informatics. From 2020 to 2023, he worked as a part-time lecturer in the same faculty.

   I got acquainted with the candidate's work from the submitted documents.

3. **Content analysis of the scientific and applied achievements of the candidate, contained in the presented PhD thesis and the publications to it, included in the procedure**

   In the dissertation, a mathematical model of a planar robot with additional degrees of freedom was created. Approaches have been proposed for optimal time motion execution and trajectory planning in the presence of static and dynamic obstacles in the robot's working area. A planar robot prototype with 4 rotary joints was designed and realized using 3D printing.

   The main scientific-applied contributions can be summarized as follows:
   - In Chapter 2, an approach for classifying the solutions of the inverse kinematics problem for a planar robot with additional degrees of freedom is proposed. The workspace of such a robot has been analyzed in terms of available obstacles. The corner of a service in the work space was studied;
   - In Chapter 3, a planar robot trajectory planning algorithm with additional degrees of freedom and limited joint space is created based on graph theory. An approach for

planning the robot's motion in the presence of static obstacles is proposed. An algorithm was created for real-time avoidance of dynamic obstacles in the robot's workspace.

The main applied contributions are the following:
- In Chapter 3, a hardware and software system for controlling a planar robot with additional degrees of freedom is designed;
- In Chapter 4, a computer experiment of the developed trajectory planning methods using simulation software is conducted. Real experiments were conducted with a 3D printed prototype of the robot.

According to the author's declaration, the obtained results and contributions of the conducted research are original and are not borrowed from research and publications in which she has no participation.

4. Approbation of the results

Research results are presented in 6 publications referenced in Scopus, 3 of which are in publications with SJR. Declarations are provided by all co-authors that their contributions to the joint publications are equal. Documents are presented that certify that the discovered similarities in the dissertation work are regulated and do not bear signs of plagiarism.

Four talks were presented at international conferences. The doctoral student participated in the development of 5 scientific research projects - 2 of them, financed by the Scientific Research Fund of the Ministry of Education and Science and 3 - by the Scientific Research Fund of SU "St. Kl. Ohridski".

Based on the above, I confidently affirm that:
a) the scientific works of the doctoral student meet the minimum national requirements (under Art. 2b, para. 2 and 3 of ADASRB) and respectively to the additional requirements of Sofia University "St. Kliment Ohridski" for acquiring the educational and scientific degree "Doctor" in the scientific field and professional field of the procedure;
b) the candidate has not participated in previous procedures for acquiring a scientific title and academic position;
c) there is no plagiarism proven in the legally established order in the submitted dissertation work and scientific papers under this procedure.

5. Qualities of the abstract

The presented abstract fully meets all the requirements for its preparation and correctly presents the results and content of the dissertation work. The careful and comprehensive layout of the dissertation and the abstract is impressive.

6. Critical notes and recommendations

I have no questions or critical remarks to the candidate. I recommend that she continue to work in this area based on the prospects for future research development outlined in the abstract.

7. Conclusion

Having become acquainted with the PhD thesis presented in the procedure and the accompanying scientific papers and on the basis of the analysis of their importance and the scientific and applied contributions contained therein, **I confirm** that the presented PhD thesis and the scientific publications to it, as well as the quality and originality of the results and achievements presented in them, meet the

requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, the Rules for its Implementation and the corresponding Rules at the Sofia University "St. Kliment Ohridski" (FMI-SU) for acquisition by the candidate of educational and scientific degree "Doctor" in the Scientific field 4. Natural Sciences, Mathematics and Informatics, Professional field 4.6. Informatics and Computer Sciences. In particular, the candidate meets the minimal national requirements in the professional field and no plagiarism has been detected in the scientific papers submitted for the .

Based on the above, **I strongly recommend** the scientific jury to award Lyubomira Lachezarova Miteva, the educational and scientific degree "Doctor" in the Scientific field 4. Natural Sciences, Mathematics and Informatics, Professional field 4.6. Informatics and Computer Sciences.

Date: 23.05.2023   Signature: ....
                                                                    /Prof. Dr. Zlatinka Kovacheva/