OPINION

on PhD thesis

Author of the thesis: **mag. eng. Stefan Karastanov**

Dissertation thesis: **Reengineering of industrial robots**

Member of the Scientific Jury: Assoc. Prof. PhD Vera Angelova Angelova - IICT - BAS

1. Actuality of the problem - degree and level of the actuality of the problem and the specific tasks developed in the thesis.

The sustainable tendency of mechanization and automation of the production process in all possible spheres of the economy naturally leads to the development and use of industrial robots. The dynamic development of the market requires the replacement of expensive, high-tech industrial robots with new ones before the end of their life cycle. A sensible and environmentally friendly consequence of this is that the decommissioned still-working industrial robots are being re-engineered for further use in other areas of the industry. In this sense, the objective of the dissertation: Reengineering of second-hand Industrial Universal Robots (IUR) by renovating the mechanics, building new electronics and software, testing the robotic system and implementing them in new industrial applications, is obviously up-to-date.

2. Level of knowledge of the state of the art of the problem and creative interpretation of the literature.

The author reviews 78 literature sources in the fields of optimal control, robotics and mechatronics. The analysis of the types of mechatronic robotic systems, the study of the kinematics, mechanical, dynamic, hardware and software systems of an industrial universal robot, shows a very good knowledge of both present-day trends and achievements, as well as understanding the important specifics related to the engineering of industrial universal robots.

3. Conformity between the selected research methodology, the objectives as well as the research tasks of the dissertation and the contributions of the dissertation.

The choice of the research methodology is determined by the specific tasks formulated in the thesis, at achieving the dissertation's objective. The methodology involves a deterministic approach to parameter identification for the precise determination of all basic dynamic parameters - system identification by direct synthesis of control by self-learning on a point-to-point basis, which creates the precondition for simultaneous consideration of interrelated problems of dynamic modelling, parametric identification and optimal control; virtual simulation and the metric and mathematical models developed for this purpose for complex study of hardware and software systems - solving the so-called right and inverse kinematics problems for the complete description of the mathematical model of the industrial universal robot, kinematic representation of the robot using the Denavit-Hartenberg concept and applying a geometric approach to solving the inverse problem of determining the angles of

7. Conclusion

The dissertation fully complies the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its Implementation and the Regulations for the Terms and Procedure for Acquisition of PhD degree at IICT - BAS in scientific area 5. Technical Sciences, professional field 5.2. Electrical engineering, electronics and automation, scientific discipline: "Automated information processing and control systems". **I give a positive evaluation**.

Date: 10/23/2019

Member of the Jury:

/V. Angelova /