

OPINION

On the dissertation for the acquisition of the educational and scientific degree
“**Doctor**”,

field of higher education 5. Technical sciences,

professional field 5.1. Mechanical engineering

on the doctoral program “**Hydraulic and pneumatic drive systems**”

Author of the dissertation: **M.Eng. Krasen Ivanov Kostov**

Topic of the dissertation: “**Intelligent control of an electro-hydraulic drive system**”

Opinion by: **Prof. Dr. Eng. Milcho Stoyanov Angelov**, University of Food Technologies – Plovdiv, member of the scientific jury.

1. Topic and relevance of the dissertation

Modern electrohydraulic systems are widely used in industrial, transport and energy systems. The problem developed in the dissertation is relevant from a scientific and practical point of view with the study of high positioning accuracy, speed and reliability of systems in the presence of significant external influences and internal nonlinearities. The relevance of the dissertation is determined by the applicability of theoretical and practical aspects in the study of electrohydraulic tracking systems that operate under variable load regimes and changes in operating conditions and external disturbances. The doctoral student studies and applies a number of theoretical and practical issues that are of utmost importance for the development of methods for studying specific dynamic processes and the development of adaptive, intelligent and robust control methods. The detailed critical analysis of the literature sources and the conclusions drawn concerning the research of electrohydraulic systems control confirm the relevance of the problem.

2. Research methodology

The goal and tasks set by the doctoral student are defined in accordance with the conclusions from the literature review. They are realistic to implement according to the selected research methods - experimental and theoretical. The doctoral student has studied and used modern methods of theoretical and experimental research. The doctoral student successfully combines theoretical model research with experimental research. I appreciate that the work is performed skillfully and using a lot of interdisciplinary knowledge. The tasks that have been successfully solved in the dissertation are:

- A mathematical model of an electrohydraulic tracking system with a rotary actuator and a hydraulic loading subsystem has been developed.

- Experimental studies of an automatic electrohydraulic system with a rotary actuator and classical regulators have been conducted.
- Identification of the parameters of the electrohydraulic tracking system with a rotary actuator has been carried out.
- Design of intelligent control for an electrohydraulic tracking system in different dynamic modes.

3. Contributions of the dissertation

I accept the claims of the dissertation candidate as scientific-applied and applied contributions. I find that the conclusions drawn are correct and correspond to what was obtained in the dissertation. The main scientific-applied and applied contributions contained in the development can be categorized as follows:

- Creation of new research methods - specific nonlinear and linearized mathematical models have been compiled and model studies of a system with a rotary actuator have been carried out.
- Proving with new means significant new aspects in existing scientific problems, by developing laboratory experimental stands and comparing the experimental results with those of the theoretical solution and proving their accuracy and applicability in practice.
- With the help of the developed models, a database of experimental and numerical results has been created, which find direct application in the design and implementation of relevant systems with high positioning accuracy. A large part of the development has been implemented in the educational process.

4. Publications and citations of publications on the dissertation work

From the submitted copies of seven publications and the information about them, it is evident that they were presented at conferences with international participation, held in the country and abroad. In terms of content, quality and quantity, they comply with the requirements of the Bulgarian Law on the Promotion of Scientific Research and Development. One of the works is independent. Two articles have been published in refereed journals in Bulgarian. Four of the publications are refereed in Scopus, one of which has an SJR=0.203. Four citations of the scientific works in Scopus are indicated, which show the relevance and high quality of the research.

5. Authorship of the obtained results

I believe that the dissertation work is the personal work of the author under the guidance of his scientific supervisors Assoc. Prof. Dr. Eng. Krasimir Ormandzhiev and Assoc. Prof. Dr. Eng. Stanimir Yordanov.

6. Opinions, recommendations and remarks on the dissertation work

The doctoral student has coped very well with the two components of the doctoral work. The educational part is demonstrated by studying and applying mathematical

modeling, programming, hydraulic systems, control theory and optimization problems. The scientific part is fulfilled by the seven published scientific works.

I have some recommendations and **remarks on the work**:

- a. An incomplete bibliographic description of some of the literary sources (70) is observed.
- b. The sources in Cyrillic are not placed in the correct place according to the current standard.
- c. The use of the SI system in the text is mandatory.

7. CONCLUSION

I believe that the presented dissertation work meets the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria. The achieved results give me reason to propose that the educational and scientific degree "Doctor" be acquired

by **Mag. Eng. Krasen Ivanov Kostov**

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Signature:

/Prof. dr. eng. Milcho Angelov/