

OPINION

**regarding a dissertation thesis for the acquisition of the educational and scientific degree
"Doctor" (PhD) in**

**Higher Education Area: 5. Technical Sciences Professional Field: 5.1. Mechanical
Engineering Doctoral Program: " Hydraulic and Pneumatic Drive Systems "**

Author: Mag. Eng. Krasen Ivanov Kostov

Topic: " Intelligent Control of an Electro-Hydraulic Drive System "

Member of the Scientific Jury: Assoc. Prof. Vladimir Petrov Dunchev, PhD

1. Topic and Relevance of the Dissertation Thesis

The dissertation is dedicated to a highly relevant scientific and applied problem – improving the quality and stability of the control of complex non-linear objects. Electro-hydraulic servo systems are widely used in modern industry, robotics, and transport. Due to the presence of internal non-linearities, parametric changes (caused by temperature, load, and viscosity), and external disturbances, classical linear control laws often fail to provide the desired quality and real-time performance. This makes the research and application of modern intelligent, hybrid, and robust strategies extremely timely and endowed with great scientific and practical potential.

2. Structure and Volume of the Dissertation

The dissertation is structured in a well-balanced manner and comprises an introduction, five chapters, a conclusion, a list of contributions, and publications. The volume of the work (over 200 pages) demonstrates serious and thorough research and experimental activity.

3. Research Methodology

The methodology applied by the doctoral candidate stands out with its interdisciplinary nature and a fine balance between theoretical approaches and practical verification.

4. Contributions of the Dissertation Thesis

Based on the submitted dissertation thesis, the contributions can be formulated in the following synthesized manner:

Scientific-Applied Contributions:

- A mathematical model of an electro-hydraulic servo system with a rotary actuator has been developed, which successfully encompasses key dynamic and non-linear phenomena within the real technological process;
- A new hybrid control approach has been proposed, combining the flexibility of Fuzzy logic with the established structure of the classical PID controller, aimed at minimizing the impact of non-linear effects;
- Fuzzy, adaptive Fuzzy–PID, and robust H_∞ controllers have been synthesized, specifically designed for an electro-hydraulic system under conditions of pronounced parametric uncertainties and unpredictable external disturbances.

Applied Contributions:

- Functional simulation models have been built within the MATLAB/Simulink environment, enabling a detailed investigation of electro-hydraulic servo systems operating modes as close as possible to real-time operation;
- Experimental validation and verification of the theoretical and simulation models have been conducted through actual laboratory tests under variable load conditions;
- A thorough quantitative analysis of the transient processes has been carried out, proving the actual improvement of quality indicators (reduction of settling time t_s and overshoot M_p) through the utilization of the new intelligent controllers.

5. Publications and Citations on the Dissertation Thesis

The doctoral candidate presents a list of 7 scientific papers reflecting the main results of the work. An exceptionally high validation is the fact that four of the publications are indexed in the global Scopus database, with one of them holding an SJR = 0.203. The volume and scientific quality of the publications fully comply with the national requirements and the regulations of the Technical University of Gabrovo for the acquisition of the educational and scientific degree "PhD".

6. Authorship of the Achieved Results

The authorship of the achieved results is protected through publications in specialized scientific journals and proceedings. The doctoral candidate is the sole author of one paper and the leading (first) author in one of the remaining publications. These facts confirm the candidate's personal contribution to the development of the dissertation.

7. Opinions, Recommendations, and Remarks on the Dissertation Thesis

The dissertation is well-structured and written. From the submitted materials, it is evident that Mag. Eng. Krasen Kostov has independently carried out a vast amount of analytical, software, and experimental work. I have no fundamental remarks.

8. Conclusion

I consider that the presented dissertation thesis meets the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria. The achieved results provide sufficient grounds for me to propose that the educational and scientific degree "**Doctor**" (**PhD**) be awarded to **Mag. Eng. Krasen Ivanov Kostov** in the Higher Education Area: 5. Technical Sciences, Professional Field:

5.1. Mechanical Engineering,

Doctoral Program: "Hydraulic and Pneumatic Drive Systems".

Date: August 3, 2026

Signature:

/Assoc. Prof. Vladimir Dunchev, PhD/