**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. Docho Svetlozarov Dimitrov

Topic of the dissertation: "Research of dynamic processes in the control of pneumatic motors using pulse-width modulation"

Opinion from: Prof. Dr. Eng. Milcho Stoyanov Angelov, University of Food Technologies - Plovdiv, member of the scientific jury.

**1. Topic and relevance of the dissertation**

The problem developed in the dissertation is relevant, both from a scientific and scientific-practical point of view. The relevance of the dissertation work is determined by the applicability of the theoretical and practical aspects of electropneumatic drives, which are used in automated production lines, robotic systems, transport mechanisms and positioning devices. When using fast-acting electromagnetic valves, control is implemented by pulse-width modulation (PWM). The doctoral student considers a number of theoretical and practical issues that are of utmost importance for developing methods for studying specific dynamic processes related to the characteristics of valves, air compression and nonlinear properties of pneumatic elements. The detailed critical analysis of the literature sources concerning the research of pneumatic drives and the dynamics of systems with PWM control confirms 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 for theoretical and experimental research. The doctoral student successfully combines experimental research with theoretical model research. I assess that the methods chosen by the author provide a correct answer to the tasks set in the dissertation. The tasks that have been successfully solved in the dissertation are:

• A flow characteristic model of a fast-acting pneumatic valve type 2/2 has been developed and a mathematical model of the real flow characteristic of the valve has been created.

• A number of experimental studies have been conducted to determine the parameters of the model.

• A mathematical model of an electropneumatic positioning system with PWM has been developed.

• Simulation studies and verification of the developed mathematical model have been carried out.

**3. Contributions of the dissertation work**

I accept the claims of the dissertation candidate indicated as scientific-applied and applied contributions. At the end of the individual chapters of the dissertation, the author summarizes the presented materials and draws conclusions. I find that the conclusions made 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 mathematical models have been compiled and model studies have been carried out.
- Proving with new means of significant new aspects in existing scientific problems, by developing 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 was created, which are directly applicable in the design and implementation of relevant propulsion systems.

**4. Publications and citations of publications in the dissertation work**

From the submitted copies of five publications and 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 ZRASRB. One of the works is independent. No data for citing the scientific works are attached.

**5. Authorship of the results obtained**

I find that the dissertation is the personal work of the author under the supervision of the scientific supervisor Assoc. Prof. Dr. Eng. Hristo Hristov

**6. Opinions, recommendations and remarks on the dissertation**

The doctoral student has coped very well with the two components of the doctoral work. The educational part is proven by the studied and applied theoretical and experimental research methods. The scientific part is fulfilled by the five published scientific works. I have some recommendations and remarks on the work:

a. An incomplete bibliographic description of some of the literary sources is observed. The sources in Cyrillic are not placed in the correct place according to the current standard.

b. The term “high accuracy” in the text of the work (p. 78 and others) is not sufficient for use without indicating a numerical value. c. It is necessary to indicate the accuracy class of the manometers and other measuring devices used.

d. The use of the SI system in the text is mandatory.

**7. CONCLUSION**

I find that the presented dissertation meets the requirements of the Act on the Development of 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 M.Eng. Docho Svetlozarov Dimitrov**

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professional field 5.1. Mechanical Engineering

**under the doctoral program** “Hydraulic and Pneumatic Drive Systems”

4.6.2026. Signature:

/prof. dr. eng. Milcho Angelov/