OPINION
of dissertation work
for the acquisition of the educational and scientific degree "PhD" in

field of higher education - 5. Technical sciences,
professional field - 5.1 Mechanical Engineering,
Doctoral Program - Hydraulic and Pneumatic Drive Systems
Author: M. Eng. Docho Svetlozarov Dimitrov
Topic: " Research of dynamic processes in the control of pneumatic motors using pulse-width modulation"

Member of the scientific jury: Prof. Dimitar Diakov, DSc

1. Topic and relevance of the dissertation

The presented dissertation work for the acquisition of the educational and scientific degree " PhD ", on the topic "Research of dynamic processes in pulse-width modulation control of pneumatic motors", contains five chapters, a list of symbols and abbreviations used, an introduction and main results of the dissertation work with scientific-applied and applied contributions, a list of literature used consist of 140 sources, with a total volume of 164 pages including 103 figures and 7 tables.

The conclusions made in Chapter I clearly demonstrate the relevance of the dissertation work being developed. The clearly formulated goal of the dissertation is to study the dynamic processes in electro-pneumatic systems using fast-acting 2/2 type electromagnetic valves controlled by pulse-width modulation, and to develop mathematical models that allow for a more accurate description and analysis of the operating characteristics of such systems.

Each of the chapters of the dissertation ends with inferences and findings, and in conclusion, the results of the theoretical and experimental work performed are presented in 4 scientific-applied and 4 applied contributions.

The need to increase the requirements for accuracy, energy efficiency levels and dynamic characteristics of pneumatic drive systems makes the development of implementation models and methods for their research and optimization relevant.

2. Research methodology

To achieve the main goal of the dissertation, the structural and dynamic characteristics of fast-acting electromagnetic valves type 2/2 were studied, mathematical models were developed, experimental studies were conducted to determine the parameters of the model, simulation studies and verification of the developed mathematical models were performed.

I believe that the methods, approaches and tools used in the dissertation are adequate to the set goal and objectives.

3. Contributions of the dissertation work

As a result of the theoretical and experimental research conducted, to solve the goals and objectives set in the dissertation, 4 scientific-applied and 4 applied contributions have been formulated.

Scientific-applied contributions

1. A mathematical model of the actual flow characteristic of high-speed 2/2-way electromagnetic pneumatic valves has been developed, and the model has been verified using experimentally determined static characteristics.

2. A mathematical model of the electromagnetic and mechanical dynamics of high-speed 2/2 pneumatic valves has been developed, enabling analysis of the valve opening and closing processes and determination of its dynamic characteristics.

3. An extended mathematical model of an electro-pneumatic positioning system controlled by pulse-width modulation has been developed, which integrates the models of the system's main components: the pneumatic power unit, pneumatic lines, pneumatic cylinder, and high-speed solenoid valves.

4. Simulation models have been created in the Matlab/Simulink environment to study the transient processes and dynamic characteristics of an electro-pneumatic positioning system with high-speed valves and PWM control.

Applied contributions

1. An automated measurement system with virtual instruments in the Lab View environment has been developed for the acquisition, processing, and visualization of experimental data in static and dynamic studies of electro pneumatic systems.

2. An experimental test bench has been implemented to study the dynamics of an electro-pneumatic positioning system controlled by pulse-width modulation.

3. The influence of the control signal frequency and the duty cycle of the PWM signal on the dynamic characteristics of an electro-pneumatic positioning system has been experimentally investigated.

4. An energy-efficient electronic unit for PWM control of high-speed pneumatic valves has been developed, designed for use in electro-pneumatic control and positioning systems.

I accept the contributions formulated in this way and believe that they correctly reflect the main work done in the dissertation.

4. Publications and citations of publications on the dissertation work

Results of the dissertation work are presented in five publications, part of the dissertation work, of which four are co-authored and one is independent.

The presented materials are reports from scientific conferences with international participation. I believe that the publications reflect the main ideas and essential points of the dissertation work.

5. Authorship of the results obtained

Having familiarized myself with the dissertation and the attached materials, I found no place for suspicion of plagiarism. The overall presentation in the dissertation, the conclusions in the individual chapters, the formulated contributions and their justification, speak of a pronounced personal participation of the dissertationist. This is also evidenced by the fact that there is also an independent publication.

6. Opinions, recommendations and remarks on the dissertation work

The topic and tasks on which the doctoral student worked in the presented dissertation work are of research interest, and the results have the potential for utility in the field of pneumatic drive systems. The work includes in-depth preliminary studies, theoretical research, modeling and experiments, demonstrating skills in working with research software and analyzing results.

I have no significant comments on the dissertation.

I recommend that the doctoral student continue his research activities, as well as publish his results in prestigious international forums.

7. Conclusion

I believe 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 "Philosophy Doctor" be acquired.
by M. Eng. Docho Svetlozarov Dimitrov in
field of higher education - 5. Technical sciences,
professional field - 5.1 Mechanical Engineering,
doctoral program - Hydraulic and Pneumatic Drive Systems.

07.06.2026

Signature: