OPINION

for the acquisition of ESD "Doctor"

in the field of higher education 5. Technical Sciences
in professional field 5.3. Communication and computer technology
in the scientific specialty – Communication networks and systems

developed by: eng. Dionnisia Daskalaki
Title: „Detection and analysis through communication channels of physical characteristics of metals, using ultrasonic sensors"

member of the scientific jury: Prof. Eng. Teodor Bozhidarov Iliev, PhD

General description of the PhD thesis and the presented materials.

The PhD thesis includes 152 pages and is structured in four chapters – Chapter I Technical sensors and AI based models for analysis of transmitted signals and parametric information, Chapter II – Noise and signals with noise recognition in simulated communication channels, Chapter III – Models for qualitative and quantitative analysis of information from strain gages, Chapter IV – Forecast analysis of traffic in imitation modeled information-communication channels of the Markov chain type. The thesis consist 116 figures (21 figures in chapter 1, 29 figures in chapter 2, 33 figures in chapter 3, 33 figures in chapter 4), 30 tables and 7 equations.

1. Topic and relevance of the dissertation work

The topic of the PhD thesis is in the field of industrial areas for testing metal objects with integration of information and communication technologies (ICT). Unwanted overlap of various interferences and noises in the communication communication channels, an important task related to the quality of registered measurement information, is to ensure the data transmission from the input nodes with functional converters of the used sensor networks and systems. This is necessary in connection with the adequate functioning and adaptability of the subsequent system modules for visualization and correct analysis of the processed information arrays of procedures for parametric remote monitoring. For this purpose it is necessary to use appropriate statistical tools for noise reduction, type diagnosis and degree of impact, which determines the relevance of the topic of the thesis.

2. Review of the cited references

The PhD student demonstrates in-depth knowledge of the state of the problems on the topic of the dissertation, expressed through the scope and depth of interpretations of the used literary sources in the literature review. The list of used references includes 132 sources, of which 2 in Cyrillic (in Bulgarian) and 130 in Latin, most of which are from the last 10 years.

The cited publications of articles in scientific journals and collections of scientific reports fully reflect the achieved world level in the field of industrial directions for testing of metal objects with ICT integration.

3. Research methodology

The PhD student has formulated the following general goal: *to develop a software monitoring system for measurement and research of applied forces on metal parts, objects and structures with provision of the transmission medium and processing of incoming traffic*

of registered measurement data of sensory data integration of the concept of qualitative and quantitative information through artificial intelligence.

Appropriate tools were used in the simulation studies. The chosen methodology for analytical and simulation research is adequate. The methods used for computer modeling and analysis in the environment of LabVIEW and MATLAB, as well as experimentally derived mathematical regression models with STATISTICA package, allowed the PhD student to realize predicted values of the impact force in the cases of one or two strain gages. The results of the research are presented in graphical and tabular form, with the corresponding analysis and conclusions.

4. Contributions to the PhD thesis

My personal opinion is that the contributions of the thesis are scientifically applied and applied with significance and usefulness in predicting the amplitude levels of simulated potential interference in communication channels when transmitting measurement and specific information in communication channels for communication in a simulation environment. In my opinion, they can be summarized as follows:

Scientific and applied contributions:

1. A methodology for identification of disturbing impacts and forecasting of the capacity of the served traffic when applying forces on metals with compensation of the influence of noise and optimization of the processed consumer requests has been developed;
2. Structures of artificial neural networks with error backpropagation based on Levenberg-Marquardt and Scaled Conjugate Gradient with different activation functions have been selected with accepted quality indicators for identification of Gaussian constant noise and periodic constant noise in communication channels;
3. Neural models have been created for the right propagation of signals and back propagation of the error in different training algorithms for quantitative identification of applied working strain gauge transducers in monitoring and registration of forces on metals;
4. Neural structures with backpropagation of the error and generalized regression neural networks for forecasting the potential applied force loads on test metal samples in mechanical test procedures are derived;
5. Models based on artificial intelligence for predictive analysis of service traffic in simulated information and communication units with the help of Generalized Regression Neural Networks, Feed-Forward Neural Networks and Cascade-forward Neural Networks in LM, SCG and BR training algorithms with confirmed advantages over classical regression analysis.

Applied contributions:

1. A conceptual system for studying the characteristics of strain gauge sensor elements in measuring forces on metals with introduced modules for digital filtration in connection with noise reduction and descriptive analysis of processed data is proposed;
2. Linear regression models are derived when switching on one and two working strain gauge transducers for predictive analysis of the change of applied force loads in testing of metal samples;
3. Analytical polynomial models based on regression analysis for forecasting the potential served traffic with packet measuring and specified data with consideration and assessment of the influence of the controlled factors in simulated telecommunication systems are obtained.

The contribution moments have a scientific-applied and applied character with the significance of novelty in the considered issues and are an extension of the existing knowledge.

5. Publications and citations of publications on the dissertation work

The main results obtained in the development of the PhD thesis are published in 6 scientific papers, two of which are scientific articles in journals: Journal of Engineering Science and Technology Review (JESTR) and Advances in Intelligent Systems and Computing, two papers were presented at the International Scientific Conference Unitech, the other two papers at the conferences TechCo'21 and CIEES'2021.

The publications were made during the period 2019–2021 and I have a full positive attitude towards the representation of scientific forums. The reports contain the most important moments from the research conducted by Eng. Dionysia Daskalaki and I believe that they gave the scientific community the opportunity to get acquainted with her dissertation.

I accept the participation of the doctoral student in all co-authored publications as equal.

There is no data on citations of the publications presented in the dissertation.

6. Authorship of the obtained results

One independent publication of the doctoral student Eng. Daskalaki, as well as one publication in which she is in the first place, are proof of her leading participation in conducting research on her dissertation. The presented scientific ideas and approaches, presented and defended at various scientific forums, are an assessment of the personal contribution of the doctoral student.

From all this it follows that the materials presented in the dissertation are an independent development of the doctoral student.

7. Abstract and author's reference

The abstract has a volume of 51 pages and the numbering of mathematical expressions and figures correspond to that in the dissertation. I believe that the abstract is well structured and in accordance with the requirements and reflects sufficiently fully and correctly the relevance of the work, its purpose and objectives, results, applicability of the results and testing. The content and layout of the abstract is made in accordance with the requirements of the law for the development of the academic staff in the Republic of Bulgaria.

8. Critical comments and recommendations

The most of the assessment of the PhD student's research and creative work has been consistently set out above in the opinion. Here I will focus only on some remarks and recommendations for the future work of Eng. Dionysia Antimos Daskalaki:

1. There are some stylistic, terminological and some editorial errors that do not determine the quality of the work;
2. The literature used is not arranged according to generally accepted requirements;
3. My personal opinion is that the volume of the abstract is too large (51 pages) especially in comparison with the PhD thesis and with the requirements of 32 pages A4;
4. I recommend the PhD student to continue her research work in this field and focus more on publishing scientific material in prestigious journals in Bulgaria and abroad and on scientific conferences indexed in Scopus and WoS.

The established remarks and recommendations do not belittle the work of the doctoral student on scientific topics and the achievements of the dissertation.

Conclusion

My personal opinion is that the presented PhD thesis **meets** the requirements of the Law for the Development of Academic Staff in the Republic of Bulgaria. The achieved results give me grounds to propose to **obtain** the educational and scientific degree "Doctor" from **Eng. Dionysia Antimos Daskalaki** in:

in the field of higher education 5. Technical Sciences

in professional field 5.3. Communication and computer technology

in the scientific specialty – Communication networks and systems.

June 12, 2022   **Member of the scientific jury: /signature/**
                                                                              /Prof. Teodor Iilev, PhD/