REVIEW

of a dissertation
for the acquisition of the educational and scientific degree "Doctor" in

field of higher education – 5 Technical Sciences
professional field – 5.3 Communication and Computer Engineering
doctoral program – "Communication Networks and Systems"

Author: Eng. Teodora Valentinova Zhorova
Topic: Traffic Monitoring in Communication Systems with Artificial Intelligence
Reviewer: Prof. Valentina Ilieva Markova, PhD, Technical University – Varna

1. Topic and relevance of the dissertation work

The dissertation is dedicated to the analysis, identification, and prediction of parameters of the transmission medium in communication systems by applying modern methods from the field of artificial intelligence. The issue is directly related to increasing the reliability and efficiency of communication systems in conditions of various disturbances and traffic loads.

In modem ICT infrastructures, ensuring the quality of service (QoS), the security of the transmission medium, and cyber protection are critical technological priorities. Therefore, the topic is extremely relevant, both scientifically and practically.

The integration of approaches from the field of artificial intelligence to solve classical teletraffic problems is an innovative and promising research approach, the results of which are directly applicable in the design, optimization, and management of intelligent communication networks.

2. Overview of the cited literature

In this dissertation, a detailed review of 161 sources is presented. Basic concepts and approaches for monitoring the transmission environment are considered, along with a detailed classification of machine learning and neural network methods. The different types of noise and interference in communication channels are presented, as well as the basic principles of teletraffic modeling and optimization. An analysis of the available intelligent tools for cybersecurity and attack detection in modern telecommunications is made. Subsequently, important characteristics of network traffic and the limitations of conventional means for its analysis are identified.

The good interpretation of the literary material, the in-depth analysis, and the conclusions drawn prove a high degree of knowledge of the state of the problem by the doctoral student. As a result, the goal of the dissertation and the specific research tasks are correctly defined.

3. Research methodology

The research methodology is based on a combination of analytical, experimental and simulation methods. A complex approach was used, which includes signal modeling, analysis of their characteristics and application of machine learning algorithms. The research methodology is based on a combination of analytical, experimental and simulation methods. The research was implemented using specialized software environments (MATLAB, STATISTICA, Java Modeling Tool). The reliability of the results is guaranteed by strict data

separation and the use of established statistical metrics for error estimation (MSE, MAE, RMSE).

4. Evaluation of the dissertation

The dissertation has a volume of 192 pages and is structured in an introduction, four chapters, a conclusion and a list of references.

Chapter One presents a literature review, which should motivate the need to conduct the dissertation research. The presentation is well structured, has a wide interdisciplinary scope. The text successfully integrates knowledge from three complex engineering areas - classical teletraffic modeling, theory of noise in the physical environment and modem approaches to cybersecurity and prevention of network attacks. The doctoral student demonstrates a high level of knowledge of modem technologies and software frameworks for intelligent analysis. At the end of the chapter, the main goal is formulated and its logical decomposition into ten specific and measurable research tasks, which set the structure of the entire dissertation.

Chapter Two has a clearly expressed research character, focused on the identification of noises through simulations in LabVIEW. Doctoral students use a multidimensional approach, combining spectral characteristics and statistical descriptors from the time domain.

A comparative analysis of a wide range of models (SVM. k-NN. Naive Bayes, ANF1S. CFNN. PNN, GRNN) has been performed, which proves the superiority of PNN and ANFIS for the tasks under consideration. A major limitation is the lack of verification with real hardware traffic, which limits practical applicability. The use of simulation data explains the achieved 100% accuracy.

As a weakness of the research in Chapter Two, I can point out the lack of analysis of computational complexity. Very heavy architectures have been tested, but their training and response times have not been discussed.

Chapter Three of the dissertation is dedicated to the predictive analysis and optimization of the performance of the transmission environment through imitation modeling of ICT infrastructures with a queuing organization. An excellent symbiosis between the classical theory of teletraffic, nonlinear optimization and modem methods of artificial intelligence has been demonstrated.

The doctoral student's ability to work with various software platforms is impressive.

Four different neural network architectures (FFNN, GRNN. RBNN, CFNN) have been studied, and the superiority of radial basis neural networks (RBN) for the purposes of teletraffic forecasting has been categorically proven.

Chapter Four of the dissertation presents a developed methodology for monitoring and diagnosing the state of network traffic to corporate clients using tools from the field of artificial intelligence, including machine learning and deep learning. A thorough experimental analysis has been conducted using multiple neural models (Feed-Forward, Cascade-Forward and Probabilistic Neural Networks), as well as classical machine learning methods such as k-NN, Naive Bayes, discriminant analysis and decision trees. The chapter also has a clearly expressed practical focus, since the proposed models have been applied to tasks such as detecting DoS attacks and analyzing anomalies in the network environment.

5. Contributions of the dissertation work

The dissertation contains 6 scientific and applied contributions and 3 applied contributions, covering a wide range of tasks related to the analysis of noise impacts in communication systems, prediction of signal and traffic parameters, optimization of teletraffic indicators and diagnostics of network traffic using artificial intelligence methods. The

formulated contributions fully correspond to the research work carried out and logically follow the structure of the dissertation.

I accept the scientific and applied contributions defined in this way.

6. Publications and citations of publications on the dissertation work

On the topic of the dissertation work, 7 scientific publications have been presented, which reflect the main results of the research conducted. The publications have been implemented mainly as reports in the proceedings of scientific conferences. Of these, 4 have been published in international scientific conferences, with 2 being indexed in the international scientific database Scopus. This is evidence of the desire to present the results of the research to a wider scientific audience.

The topics of the publications are directly related to the content of the dissertation work and cover the main areas of research - analysis and prediction of signal parameters and noise impacts, modeling and analysis of network traffic, as well as the use of machine learning methods and neural networks for diagnostics and prediction of processes in communication systems.

7. Authorship of the obtained results

From the content of the chapters of the dissertation submitted to me for review, it can be concluded that the presented research, models and experimental results were developed by the author of the dissertation. The methodology, experimental setups and the obtained results and analyses are consistently presented and demonstrate independent research work.

8. Author’s abstract and author’s reference

The presented abstract is 50 pages long. It is designed in accordance with the requirements of the Act on the Development of Academic Staff in the Republic of Bulgaria (ADABRB) and the relevant internal regulations of the Technical University of Gabrovo. It is structured logically and correctly and contains all the mandatory requisites: general characteristics of the work, goal and objectives, research methods, a summary of the content by chapter, general conclusions, conclusion, list of publications and participation in projects.

The abstract reflects the essence of the research conducted, the methodology used and the results obtained in the dissertation work. The selected graphics and tabular material clearly illustrate the most important stages of the doctoral students’ work.

The included author's reference for the contributions is clearly formulated and is correctly divided into two groups: scientific and applied (6 pcs.) and applied contributions (3 pcs.). The formulated contributions arise from the experiments, simulations and analyses conducted, reflecting the personal contribution of the mag. Eng. Teodora Zhorova in the researched subject area - the integration of artificial intelligence and machine learning methods for monitoring and diagnosing network traffic.

The attached 7 scientific publications (two of which in refereed publications, indexed in Scopus) and participation in 3 internal university projects are sufficient evidence of the approbation of the results and their popularization among the scientific community.

9. Comments, recommendations and remarks on the dissertation work

The presented dissertation demonstrates in-depth theoretical and practical knowledge of modem methods for signal analysis, machine learning and modeling of communication systems.

A positive impression is made by the application of a wide range of algorithms for signal and data processing, as well as the conducted precise comparative analysis of their effectiveness.

In a large part of the research, excellent results are achieved (up to 100% accuracy). This is completely normal, since the data are created in an ideal software environment. Since in such simulations there is always a risk of retuning the models, I recommend that the doctoral student test the algorithms with real signals in her future projects. Such a check in real conditions will make the research even more valuable and will facilitate the implementation of these models in practice.

The developed neural networks are impressive and show extremely high accuracy. However, when these systems are used in real time, the speed of the algorithm is just as important as its accuracy. Therefore, I recommend that in her future work, the doctoral student also analyzes the time required for training and responding to the models.

10. Conclusion

I consider that the presented dissertation meets the requirements of the Law 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 Eng. Teodora Valentinova Zhorova in the field of higher education - 5. Technical Sciences, professional field - 5.3. Communication and Computer Engineering, doctoral program – “Communication Networks and Systems”.

05.05.2026 **Reviewer:**

/Prof. Valentina Markova, PhD/