REVIEW

of dissertation work
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: M.Eng. Teodora Valentinova Zhorova
Topic: Traffic Monitoring in Communication Systems with Artificial Intelligence
Reviewer: Prof. Eng. Stanimir Mihaylov Sadinov, PhD, Technical University - Gabrovo

1. Topic and relevance of the dissertation work

The rapid advancement and integration of Artificial Intelligence technologies across all technical aspects of human progress inevitably influence the timeline of their implementation in the management of information resources within system network communications. The broad application of Machine Learning platforms is not limited only to improving coverage in radio and television broadcasting or reducing a number of high-risk effects and physical phenomena during signal transmission. There is a significant need for effective diagnostics of system conditions, as well as optimization of load and performance metrics of network resources within communication infrastructures. An essential aspect is also ensuring the security of operational data clusters and providing efficient monitoring against cyber threats, particularly with regard to access to digital content and services.

The outlined facts establish a technical framework that confirms the undeniable relevance of the need for AI-based technologies to support and enhance the functionality of communication infrastructures. The research presented in this dissertation is focused on the development, modification, and implementation of intelligent analysis tools aimed at improving the monitoring and administration of network services in modern communications.

2. Overview of the cited literature

According to the presented bibliographic reference, a total of 161 scientific sources have been systematized within the scope of the critical analysis on the subject of the dissertation. A strong impression is made by the thorough interpretation and deep understanding of the essence and specifics of the analyzed scientific content. The majority of the cited and analyzed research studies are of international origin and have been published within the last ten years. Emphasis is placed on innovation in technical approaches for diagnosing parameters and the state of the network environment in information and communication systems, as applied in European and global scientific practice.

The analyzed scientific content and developments within the specified research domain can be summarized into the following categories:

- „Technical approaches, methods, algorithms, and analytical tools for knowledge extraction applicable in communications";

- „Classification of disturbances in the communication transmission environment, as well as the applied analytical tools for their identification, classification, and mitigation of background effects“;
- „Specific network environment metrics ensuring packet performance, traffic load, and the efficiency of resource service units in packet data transmission“;
- „Methods and algorithms for optimizing specific metrics of the communication transmission environment to improve the overall service strategy for subscribers in telecommunication networks“;
- „Categorization of types of attacks, as well as AI-based policies and tools for cybersecurity and information security“.

3. Research methodology

The methodology applied in the systematic scientific research of the dissertation integrates a wide range of methods from mathematical and applied statistics, Artificial Intelligence-based approaches, and heuristic methods. Based on computer modeling and analytical diagnostics using the MATLAB and STATISTICA platforms, conceptual AI modules and tools have been developed for recognition, classification, and predictive analysis of objects within the network communication environment. A rich set of data samples has been used in the training procedures for the selection of implemented classifier categories and regression modeling tools, with verified validation of the generalized results across the defined technical directions.

4. Contributions of the dissertation work

In my opinion, the following categorization of contributions should be applied, reflecting the key aspects of the conducted research:

Scientific-Applied Contributions:

- The effectiveness of traditional Machine Learning methods and algorithms, as well as Artificial Intelligence tools, has been confirmed in the recognition, classification, and predictive analysis of noise in communication nodes and channels;
- The efficiency of regression modeling approaches and optimization of network environment metrics through AI-based analytical tools has been demonstrated;
- The advantages of Feed-Forward, Cascade-Forward, Probabilistic, Generalized Regression, and Radial Basis neural network architectures have been established for regression-based diagnostics of traffic service metrics in network environments;
- The superiority of Deep Learning principles over conventional Machine Learning approaches has been proven in detecting cyberattack states on network resources and anomalies in transmitted traffic;
- The feasibility of modifying, adapting, and creating hybrid approaches combining conventional Machine Learning and Deep Learning techniques for classification of web traffic for corporate and industrial users has been confirmed.

Applied Contributions:

- An approach has been proposed for extracting specific features using descriptive analysis and spectral analysis algorithms for recognition, classification, and prediction of noise in communication nodes and channels;
- A simulation modeling and analytical diagnostics approach for information and communication network infrastructures with queuing-based service organization has been developed;
- A structured approach has been established for evaluating primary processing of recorded network environment metrics in cyber threat detection and web traffic classification.

5. Publications and citations related to the dissertation work

To present the achieved results to the scientific community, a total of eight scientific publications have been produced, reflecting simulation, empirical, and experimental research. Three of the publications are in English, while the remaining are in Bulgarian. One publication is authored independently, while the others are co-authored with the scientific supervisor and other researchers. All publications have been presented at scientific symposia with international participation and conferences held both nationally and internationally. Two of the publications are indexed in global databases such as Scopus:

- International Scientific and Practical Conference "Environment. Technology. Resources", Rezekne, Latvia;
- International Conference on Electronics, Engineering, Physics and Earth Science, Kavala, Greece.

Additional publications have been presented at national scientific events, including:

- International Scientific Conference UNITECH, Technical University of Gabrovo;
- Student Scientific Session, Technical University of Gabrovo;
- Scientific Conference of the University of Ruse "Angel Kanchev" and the Union of Scientists - Ruse.

One of the publications received the "Best Paper Prize!" at a symposium organized by the University of Ruse "Angel Kanchev".

6. Authorship of the obtained results

I believe that a substantial portion of the presented research represents the primary work and personal contribution of the PhD candidate under the guidance of the scientific supervisor. The dissertation demonstrates a high level of technical knowledge and skills in applying, adapting, and modifying algorithmic functionalities of various analytical tools within the paradigms of Artificial Intelligence, Machine Learning, and Deep Learning in the field of communications. The scientific achievements of the candidate are accessible and recognized by a wide range of researchers both nationally and internationally.

7. Abstract and Author's Summary

The abstract accurately and consistently reflects the systematized results across the defined scientific areas of the dissertation. It consists of 51 pages and includes 41 figures and

14 tables. All regulatory requirements, as defined by the Rules for the Acquisition of Academic Degrees and Occupation of Academic Positions at the Technical University of Gabrovo, have been met. The authorship of the results is confirmed, and the relevance, scientific novelty, applicability, and potential for further development of the research area are well justified.

8. Comments, recommendations and remarks on the dissertation work

I know M.Eng. Teodora Valentinova Zhorova as a doctoral student in the structure of the Department of "Communication Engineering and Technologies" as a responsible and executive researcher. The doctoral student is distinguished by high technical qualifications in scientific research activities with the implementation of modern achievements and innovations in Artificial Intelligence and Machine Learning.

I can comprehensively assess that the prepared dissertation fulfills the defined main tasks, reflecting the activities carried out to analyze the state of the issue under consideration in the given subject area. A clear and consistent argumentation of the selected analytical tools in the research methodology has been applied.

Despite the qualities of the scientific research, I believe that certain measures can be taken to improve the method of systematization of the presentation of the research on the dissertation work and future developments on the issue under consideration.

I recommend that M.Eng. Teodora Valentinova Zhorova:

- To focus future research on more narrowly defined scientific areas with prioritized scope and objectives;
- To increase participation in national and international research projects;
- Continue and upgrade your publishing activities in prestigious national and international publications with indexing of scientific content in world-renowned databases and publications with Impact Factor;
- Implemented the results of his scientific research with a practical focus in information service modules in the structures of the "Mobile Operators" and the "Information Clusters and Data Management Centers" built in the country.

9. Conclusion

I believe 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 M. 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"

04.05.2026 **Reviewer:**

/Prof. Eng. Stanimir Sadinov, PhD/