
“GEORGY STOYKOV RAKOVSKI” MILITARY ACADEMY

OPINION

From Assoc. Prof. Rosen Georgiev Miletiev, PhD
Technical University of Sofia, Faculty of Telecommunications
Department of Radio communication and Video technologies

Address: Sofia 1000, 8 Kliment Ohridski Blvd, bl.1, room 1229

Email: miletiev@tu-sofia.bg

for the PhD thesis of **Yoana Atanasova Ivanova** entitled “**Study of the cyber-attack influence on the transport management system**”, which is presented to obtain the qualification and scientific degree of Doctor (PhD) in the professional field 5.3. Communications and Computer Science, and in the specialty „Automated systems for Information Processing and Control”

This Opinion was prepared in my capacity as a member of the Scientific Jury as defined by Order No. SI29-RD-13 / 15.01.2020 of the Head of the Military Academy "G. S. Rakovski."

1. Relevance and significance of the scientific problem

The cyber-attacks to the various automated management systems are extremely relevant topic, given the fact that these cyber-attacks can lead to a denial of service or, in the worst case, a loss of control of the system. This fact also determines the need to study the impact of various types of cyber-attacks on critical national security systems such as transport.

The impact of cyberattacks on critical infrastructure has also been explored by many other authors, given the importance of the problem and the increasing number of these attacks in recent years has seen a significant number of publications on the topic, some of which the author has cited in the literature review. Based on some of the published models and analyzes of cyber-attacks [48, 54, 70, 89], the author has proposed an adaptive architecture of a cyber-defense system, as well as simulation modeling of Traffic Control Center (TCC), including simulation of cyber-attack on it and on the system for signaling the traffic lights, which prove the working hypothesis of the thesis. The author examined both the direct impact of cyberattacks on TCC operation (reduction of the duration of signaling on traffic flow, time delays, queue size, etc.), but also the indirect impact of these attacks, such as increasing levels of air pollutants. The simulation study was conducted in several simulation environments, both to evaluate the impact of cyber-attacks on the signaling system, the environmental effects and parameters of the traffic flow, and to evaluate the reliability of the obtained results.

1. Main scientific results and contributions in PhD thesis.

The documentation submitted by the applicant fully complies with the claims, which are published in three publications for last 3 years in Bulgarian and English languages.

An updated model of the cyber-attack defense system is proposed as the simulation model of Traffic Control Center, which is optimized on the basis of the firewall integration. The algorithms for study of the proposed models are also represented as these algorithms determined the sequence of steps for model simulations. The methodology for the vulnerability assessment and planning measures to increase the sustainability of the transport management system is also analyzed.

The obtained results may be applied to increase the sustainability of the Traffic Control Center, development of advanced cyber-attack defense models and for additional study of the cyber-attack influence over the critical infrastructures.

The published claim should be assumed as a result of the PhD study on the bases of the publications attached to the PhD thesis and the author's publications cited in the literature review [7-10].

2. Opinion on the presence or absence of plagiarism.

The claims and the results represented in the thesis and the attached publications are not established in the other scientific publications and on the basis of the absence of the motivated written signals for the availability of plagiarism, I think that the submitted materials are entirely prepared by the PhD candidate.

3. Critical remarks about the reviewed works.

1. In Figures from Fig.52 to Fig.54 it is recommended to represent the results as a $\log V$ function on Y axis according to the Table 40 results
2. The obtained results in Appendix IV should be represented in the main body of PhD thesis in paragraph 3.4
3. The Appendix V – VII are not directly connected with the PhD results and should be removed
4. The Chapter I volume is too high and some paragraphs may be removed such as 1.3.2 and 1.3.3, which are not connected with the analysis of the transport management system
5. The contribution 3.1 also have to be removed from the claims as the clarification of the functional logic of the transport management system may be treated as a part of the study of the problems in the literature review;
6. There is a mistake in the equation (20) in $n!$ function is representation.

4. Conclusion.

On the basis of the materials, which are submitted, and related to the research and applied activity of the applicant, by volume, structure and content, I think that the PhD thesis and publications are in the field of the scientific specialty and the candidate fulfill the minimum required points for all groups of indicators of the Rules for Implementation of the Academic Staff Development Act in the Republic of Bulgaria to award the educational and scientific degree of Doctor (PhD) in the professional field 5.3. "Communications and Computer Science".

5. Assessment of the applicant.

On the basis of all mentioned above, I confidently give my **positive** assessment of the PhD thesis and recommend to the members of the Scientific Jury to vote to award **Yoana Atanasova Ivanova** the educational and scientific degree of Doctor (PhD) in the professional field 5.3. "Communications and Computer Science", and in the specialty „Automated systems for Information Processing and Control".

Date: 26.02.2020

Member of the Jury: