REVIEW

by Dr. Eng. Nevena Stoyanova Mileva, professor at Plovdiv University "Paisii of Hilendarski"

Of a dissertation for the award of an educational and scientific doctorate degree

in: field of higher education 5. Technical sciences

Professional field 5.3. Communication and computer technology

Doctoral program "Automation of areas of the intangible sphere (medicine, education, science, administrative activities, etc.)".

Author: M.Eng. Ivaylo Detelinov Uzunov

Topic: "Simulation Model and Final Solutions of Security Systems"

Scientific supervisor: Prof. Dr. Eng. Slavi Lyubomirov, Plovdiv University "Paisii Hilendarski"

1. General description of the materials presented

By order No. RD-22-534 of 25. 02. 2025 of the Rector of Plovdiv University "Paisii Hilendarski" (PU), I am appointed as a member of the scientific jury for ensuring a procedure for the defense of a dissertation on the topic *"Simulation Model and Final Solutions of Security Systems"* for the acquisition of the educational and scientific degree "doctor" in the field of higher education 5. Technical sciences, professional field 5.3. Communication and computer technology, doctoral program, Automation of areas of the intangible sphere (medicine, education, science, administrative activities, etc.).

The author of the dissertation is Mag. Eng. Ivaylo Detelinov Uzunov– PhD student in full-time study at the Department of Electronics, Communications and Information Technologies (ECIT) with scientific supervisor Prof. Dr. Eng. Slavi Lyubomirov from Plovdiv University "Paisii Hilendarski". The training of PhD student Ivaylo Uzunov was conducted in full-time study at the Department of Electronics, Communications and Information Technologies (ECIT) at Plovdiv University "Paisii Hilendarski". Hilendarski".

The set of materials on paper submitted by Mag. Eng. Ivaylo Uzunov is in accordance with Art. 36 (1) of the Regulations for the Development of the Academic Staff of the University of Sofia, and includes the following documents: a request to the Rector of the University of Sofia for the opening of the procedure for the defense of a dissertation; a curriculum vitae in European format; a transcript-excerpt from the minutes of the Department Council at the Department of ECIT (University of Sofia),

related to reporting the readiness to open the procedure and to a preliminary discussion of the dissertation; a dissertation in a volume of 176 pages; an abstract in a volume of 31 p.; list of scientific publications on the topic of the dissertation -5 issues; copies of the 5 scientific publications submitted under the procedure; declaration of originality and authenticity of the attached documents; certificate of compliance with the minimum national requirements for awarding the educational and scientific degree "doctor".

The doctoral student has submitted five publications, based on which he has earned 60 points, which covers the minimum national requirements for awarding an educational and scientific degree "doctor" in the relevant field.

2. Brief biographical data about the doctoral student

M.Eng. Ivaylo Uzunov graduated from the Vocational High School of Civil Engineering and Architecture in Smolyan in 2005. In 2016, he graduated from the Smolyan Technical College at the Paisii Hilendarski University of Plovdiv in the speciality "Computer and Communication Systems". In 2019, he graduated with a Master's degree in the speciality "Telematics". In 2020, he started working at the Paisii Hilendarski University of Plovdiv, Faculty of Physics and Technology, Department of "Electrical Power Engineering and Communications" as an assistant professor. Until 2021, he worked as an assistant professor at the university above.

In 2021, the Rector of Plovdiv University "Paisii Hilendarski" enrolled him in doctoral studies.

The author has the necessary scientific and research training, proven during his doctoral studies at the Department of Electronics, Communications and Information Technologies at Paisii Hilendarski University of Plovdiv. He has technical skills, computer and communication technology competencies, and works with specialised software products in the specified field.

3. Relevance of the topic and appropriateness of the set goals and objectives

The topic of the dissertation, "Simulation Model and Final Solutions of Security Systems", is of essential importance in the context of the modern development of information technologies and the ever-growing importance of data and information systems protection. Nowadays, information security is one of the most dynamic areas of science and technology, as organisations, governments and individual users are exposed to a wide range of risks and threats. The object of research is real challenges in the security of critical infrastructures and network systems. The goals of the work are clearly defined and aimed at creating a simulation model applicable both for academic purposes and for practical training and analysis.

Over the past decade, cybercrime has grown significantly, becoming increasingly complex and challenging to prevent. Data shows that the number of cyberattacks and their scope are increasing dra-

matically every year, and the damage they cause is becoming more serious. This necessitates the development of new, effective and cutting-edge methods and technologies for protecting information resources.

4. Knowledge of the problem

The author demonstrates in-depth knowledge of the basic principles of information security. Over 140 literary sources, including modern research and standards, are cited, indicating good awareness and analytical depth. Many literary sources suggest that the doctoral student knows the problem well and can cope with the task. Reference to these sources and the achieved results indicates a good understanding of the problem and its creative solution. Basic concepts of cryptography, computer attacks, defence mechanisms, simulation techniques and tools are considered.

5. Research methodology

The research methodology in the dissertation is clearly defined and applied adequately and consistently. The author uses a combination of theoretical analyses and practical experimental methods.

The methodology includes simulations with MATLAB and MATLAB Simulink, experimental tests with tools such as SEToolkit and Discover, and building models for cryptographic protection, SQL Injection, MITM attacks, etc. Specific scenarios have been implemented in which various vulnerabilities are simulated and their impacts on network systems are analysed. The experiments were conducted in a laboratory environment, using appropriate software tools and analyses. The dissertation research aims to create effective models and methods for security simulation and analysis, which will help prevent cyberattacks and build the resilience of information systems against them. The author sets himself the task of developing a practically applicable toolkit that can be integrated both in an academic environment for educational purposes and in the practice of enterprises and organisations.

Particular attention is paid to constructing cryptographic models and simulations of various types of cyberattacks. The second and third chapters describe in detail the modelling and simulation processes of attacks such as SQL Injection, MITM, Replay and DoS. The methodology allows for a systematic study of vulnerabilities and the effectiveness of various protective mechanisms.

In the fourth chapter of the dissertation, methods for checking and removing gaps leading to potential unauthorised access by third parties are researched and presented to reduce attacks and improve security.

AES encryption has been modelled in the MATLAB environment. The AES model in MAT-LAB simulates the encryption and decryption of data, including all the main stages of the algorithm. The encryption code from the AES encryption study is presented. A Man-in-the-Middle attack is studied in a scenario in which a malicious actor intercepts, eavesdrops, or manipulates communication between two parties.

The author uses statistical and analytical methods to process and interpret the results, which adds credibility and reliability to the conclusions drawn.

The specific objectives are well formulated, and their solution would lead to achieving the set goal. The doctoral student, Ivaylo Uzunov, chose a research methodology to achieve the set goal. In this context, it provides an adequate answer to the tasks solved in the dissertation work.

The research methodology fully meets the set goals and allows for an objective assessment of the proposed solutions.

6. Characteristics and evaluation of the dissertation

The dissertation work of M. Eng. Ivaylo Uzunov is thorough and well-structured. It comprises 176 pages, logically organised into an introduction, four main chapters, a conclusion, contributions and a list of references. Over 140 literary sources were used, which indicates a deep knowledge of the topic. The thoroughness of the analysis, the precision in the implementation of the experiments, and the methodological consistency with which the author follows his research plan are particularly impressive. The work is structured and sustained from both a theoretical and a practical point of view.

7. Contributions and significance of the development for science and practice

The author proposes improved methods for simulating and analysing cyberattacks that can be used effectively in educational platforms and professional environments. Significant contributions have also been made to analysing cryptographic methods, identifying opportunities for optimising and increasing their effectiveness.

Systematically, the contributions presented by the doctoral student, M. Eng. Ivaylo Uzunov, united by me, are as follows:

Scientifically applied are:

- 1. A simulation model of AES encryption and MITM attacks has been developed.
- 2. A comparison between different cryptographic approaches was conducted.
- 3. Methods for simulating DOS attacks and analysing their effect are presented.
- 4. Phishing, SQL Injection, and PHP Code Injection attack models are examined.
- Models with Monte Carlo and Agent-Based approaches in the security context were analysed.

Applied, expressed in:

1. A laboratory environment has been built for simulating network attacks.

- 2. Educational scenarios for information security training have been implemented.
- Recommendations for the security of web applications and network architectures are presented.
- 4. Protection results using Web Application Firewall and cryptographic tools were analysed.

I believe that the doctoral student's contributions fully meet the purpose of the dissertation, and I think that they are sufficient in number and significance to obtain a doctoral degree.

8. Evaluation of the publications on the dissertation

In connection with the dissertation work, Mag. Ivaylo Detelinov Uzunov has presented 5 (five) publications. Three articles have been published in a collection of reports from the Scientific Papers of the Union of Scientists in Bulgaria, Smolyan. Two articles have been published at international conferences abroad. It is noteworthy that in all publications, Mag. Ivaylo Uzunov is in first place. One of the publications is independent of the doctoral student. This is a reason to believe that the research results in the dissertation are known to the scientific community.

The publications presented reflect the essence of the dissertation topic. No information on the citation of the publications is provided.

9. Personal participation of the doctoral student

The dissertation was submitted for review, and its publications show that the doctoral student independently conducted the experimental research. The topics and content of the publications are directly related to the dissertation, reflecting all its parts. This testifies to the significant contribution of the doctoral student to the results obtained. I have no common publications with the doctoral student and am not a related person, within the meaning of the law.

10. Abstract

The abstract is presented in Bulgarian and English. It comprises 31 pages, including contributions and publications related to the dissertation. The review of the abstract of the dissertation shows full compliance with the requirements for its preparation, as well as the adequacy of reflecting the main results and contributions of the dissertation.

11. Critical remarks and recommendations

Despite the overall high assessment of the work, the following critical comments and recommendations for improvements can be made: In some parts of the work, a more in-depth comparative analysis between the proposed methods and existing analogous solutions from practice could be added. Presenting more practical scenarios for implementing the developed models in real organisational environments would be helpful. In future developments, the author should pay more attention to integrating the proposed solutions with existing industry standards for security and certification.

These remarks do not diminish the value of the work, but rather can serve as guidelines for subsequent development and deepening of the research.

I have the following question for the doctoral student.

1. In your research on computer attacks on servers and firewall responses, what else needs to be improved so that the system's behaviour can block more packets over time?

12. Personal impressions

I have known M.Eng. Ivaylo Detelinov Uzunov since he started working as an assistant in the Department of Electrical Power Engineering and Communications of the Faculty of Physics and Technology at the Paisii Hilendarski University. My observation is that he approached his teaching activities responsibly during the short period he was an assistant professor.

13. Recommendations for future use of the dissertation contributions and results

In the dissertation, the doctoral student has presented guidelines for future development. Essential prerequisites for future use of the dissertation's contributions and results are that the doctoral student should develop their research through participation in scientific research projects.

CONCLUSION

The presented dissertation represents a valuable scientific work in which the doctoral student has fulfilled the set goal and formulated tasks. The dissertation *contains scientific-applied and applied results that represent an original contribution to science* and meet all requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADSRB), the Regulations for the Implementation of the ADSRB and the relevant Regulations of the University "Paisii Hilendarski". The presented dissertation work of M. Eng. Ivaylo Uzunov is a significant scientific and applied contribution to computer security. His research is methodologically sound, the results are well interpreted, and the contributions are applicable in scientific and practical areas.

The dissertation shows that the doctoral student Ivaylo Detelinov Uzunov possesses in-depth theoretical knowledge and professional skills in the scientific speciality 5.3 Communication and Computer Engineering, demonstrating qualities and skills for independently conducting scientific research.

Due to the above, I categorically give my positive assessment of the research conducted, presented by the dissertation work, abstract, achieved results and contributions reviewed by me above, and I propose to the esteemed scientific jury to award *the educational and scientific degree "doctor"* of Ivaylo Detelinov Uzunov in the field of higher education: 5. Technical Sciences, professional field 5.3. Communication and Computer Engineering, doctoral program "Automation of areas of the intangible sphere (medicine, education, science, administrative activities, etc.)".

24.04. 2025

Reviewer:

(Prof. Dr. Nevena Mileva)