O P I N I O N

by

Assoc. Prof. Dr. Irina A. Radeva
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for dissertation work for obtaining the educational and scientific degree "Doctor"
in **professional field 4.6 "Informatics and Computer Science"**
doctoral program "Informatics"

titled "**Modelling network attacks and security algorithms"**
by Petya Ivanova Petrova

Pursuant to Art. 18, para. 1 and para. 3 of the Regulations for development of the academic staff of BSU and decision of the Scientific Council of BFU from 15.04.2022 for opening a procedure for defence of a dissertation for obtaining the educational and scientific degree "Doctor" in professional field 4.6. "Informatics and Computer Science", doctoral program "Informatics" by Petya Ivanova Petrova with a dissertation on "Modelling of network attacks and protection algorithms" with supervisors Prof. DScTech Andon Dimitrov Lazarov, VVMU “N. Y. Vaptsarov” and Prof. Dr. Georgi Georgiev Dimitrov, University of Library Science and Information Technology with order UMO-126/28.04.2022 of Prof. Dr. Milen Baltov - Rector of BSU, I have been appointed a member of the Scientific Jury.

As a member of the Scientific Jury, I received:

1. Order UMO-126/28.04.2022;
2. Request to the dean for opening a procedure for defence of the dissertation;
3. Dissertation;
4. Abstracts in Bulgarian and English;
5. Creative CV;
6. List of author's publications on the dissertation;
7. Declaration of compliance of the dissertation on "Modelling of network attacks and protection algorithms" with the requirements of Art. 5, para. 3 of ADASRB.

When evaluating the dissertation, the requirements of Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Regulations for its implementation (RIADASRB) and the Regulations for the development of the academic staff at BSU are applied.

The dissertation is 114 pages long and includes: list of abbreviations used, list of 7 figures, introduction, purpose and tasks of the dissertation, three main chapters, conclusion - summary of results, declaration of originality, appendices, bibliography from 114 sources, thanks and a list of author's publications on the topic of the dissertation.

The abstract in Bulgarian is 36 pages and in English is 33 pages and presents the dissertation.

The aim of the dissertation is formulated on page 22: „Mathematical modelling of processes in computer networks when impacted by malware, construction and application of genetic algorithms to detect intrusions into the computer network and data protection.“

In accordance with the formulated aim, the following 4 main tasks are defined:

- Modelling processes when a computer network is impacted by malware.
- Construction and application of genetic algorithms to detect intrusion into the computer network.
- Determining the Fitness function in the genetic algorithm to detect intrusion into computer networks.
- Implementation of network security through encrypting with a genetic algorithm.

The formulated aim and tasks have scientific and scientific-applied potential in the context of trends for research and solving problems related to cyber security of computer networks and information systems. The topic of the dissertation is particularly relevant and covers one of the active research and applied areas in this field.

The results in the dissertation can be systematized as follows:

Scientific results:

1. A model of the processes of susceptibility, exposure, infection and recovery of a computer network in case of exposure to malware, described by a system of differential equations for instantaneous and predictive assessment of the state of the computer network.
2. A solution of the system of differential equations for the cases of equilibrium for constant variables and lack of equilibrium for time-dependent variables, defining the classes of states of machines in the computer network, is proposed.
3. Analytical expressions for calculating the network characteristics of machines in the computer network during an attack with malware are derived.

Scientific applied results:

1. A software tool for protection of a computer network by encrypting the transmitted information with the application of the operators of a genetic algorithm implemented with the C# p has been developed.
2. Software products developed in Matlab environment have been developed to illustrate the solutions of the system of differential equations for instantaneous and predictive estimation.
3. The list of attributes, gene structure and codes of network characteristics of the chromosome (rule) in the genetic algorithm has been expanded, expanding the scope of its action to detect network penetrations.
4. The structure of the fitness function of Firas Alabsi was evaluated and an experimental evaluation of the parameters A, AB of the fitness function of Firas Alabsi was performed in simulating network communications of the type Normal, DoS, R2L, U2R, Probe, realized with random generated network characteristics of five chromosome structures for each category.

The presented results correspond to the scope and content of the set aim and tasks and have the potential for further development. The dissertation proves that the doctoral student has the necessary theoretical and practical knowledge in the specialty, has developed skills in research and development of the presented topic and can conduct independent research.

There are presented 6 publications on the dissertation: 1 publication is with SJR, Q2 (No. 2); 3 publications are in journals (No. 1, 4, 5), one of which is electronic (No. 5); 1 publication in print is in the proc. of an international symposium and 1 publication is in the yearbook of BSU. 3 publications are in English and 3 in Bulgarian, all co-authored. The presented publications are for the period 2018 - 2022.

There is no presented list of citations.

The publications on the dissertation show that at the main stages the work and the results were presented to the scientific community.

The minimum national requirements of ZRASRB, PPZRASRB and the Regulations for development of the academic staff at BSU have been met.

Critical remarks:

1. In the bibliography, references [70] and [75] are the same publication.
2. There are incomplete references without pages, publisher, ISSN or ISBN, etc.
3. The declaration of originality of the results is unsigned.

Questions on the dissertation:

1. Can the statement and analysis of the results of the numerical experiment and the presented figures from pages 41 - 44 be explained?
2. How can it be justified and proved that "the developed encryption algorithm with the application of genetic algorithm operators reaffirms the encryption properties of known similar algorithms by developing a new software product" and that it has “high-reliability and reliable encryption for protection… ”(page 88)?

C O N C L U S I O N

I accept that the dissertation meets the requirements of ADASRB, RAADASRB and the Regulations for the development of the academic staff at BSU and give a **positive opinion** for obtaining the educational and scientific degree "Doctor" of **Petya Ivanova Petrova**.

I propose to the Scientific Jury to vote for Petya Ivanova Petrova the educational and scientific degree "Doctor" in the professional field 4.6. "Informatics and Computer Science", doctoral program "Informatics".

17.05.2022 г.

Signature: .....

Assoc. Prof. Dr. Irina Radeva