

REVIEW

by

Acad. Ivan P. Popchev

of dissertation paper for the educational and scientific degree "**Doctor**" in the 4.6 Informatics and Computer Science professional direction, titled "Modeling network attacks and security algorithms"

by **Petya Ivanova Petrova.**

Pursuant to Art. 18, para. 1 and para. 3 of the Regulations for the BFU's academic staff development and the BFU's Scientific staff decision of 15.04.2022 on opening a procedure for dissertation defense for Petya Ivanova Petrova by order UMO-126 of 28.04.2022 of prof. Dr. Milen Baltov, BFU's Rector, I am appointed as a member of the Scientific Jury.

As a member of the Scientific Jury, I have received:

1. Rector's order UMO-126 of 28.04.2022 of Prof. Milen Baltov;
2. Dissertation;
3. Autoreferat.

For the evaluation of the dissertation paper, the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB) and the Regulations for Applying the Act on the Development of the Academic Staff in the Republic of Bulgaria (RAA) are decisive. The relevant texts are as follows:

1. According to Art. 25 of RAA "the ones who are admitted to defend a dissertation paper in relation to the award of the educational and scientific degree" Doctor " are the doctoral students who are charged with the right to defend and meet the minimum national requirements.";
2. According to Art. 6 (3) of ADASRB, the dissertation paper must contain scientific or scientific applied results, which represent an original contribution to science. The dissertation paper must show that the applicant has in-depth theoretical knowledge in the respective specialty and capacity for independent scientific research.";
3. According to Art. 27 (2) of RAA, the dissertation paper must be presented in a form and volume corresponding to the specific requirements of the primary unit. The dissertation paper must contain: title page; contents; introduction; presentation; conclusion-summary of the results, accompanied by a declaration of originality, bibliography. "

Scientific leaders of the part-time doctoral student Petya Ivanova Petrova are: Prof. DScTech Andon Dimitrov Lazarov, VVMU “N. Y. Vaptsarov” and Prof. Dr. Georgi Georgiev Dimitrov, University of Library Science and Information Technology.

The aim of the dissertation paper is defined on page 22, as "mathematical modeling of processes in computer networks under the influence of malware and unregulated user behavior, construction and application of genetic algorithms for detecting intrusions into the computer network and data protection.

In accordance with that goal, **4 main tasks** are defined.

Focused at the goal and the main tasks, the dissertation paper, in the volume of 114 pages, includes:

- Contents:
- List of abbreviations used (5);
- List of figures (6);
- Introduction. Dissertation paper’s objectives and tasks (7-23);
- Modeling the processes under the impact of a computer network with malicious software (**Chapter II**, 24-44);
- Development of a genetic algorithm to detect intrusions into the computer network (**Chapter II**, 45-66);
- Implementation of network security using an encrypting genetic algorithm (Chapter III, 67-88);
- Conclusion-summary of the results obtained (**Chapter IV**, 89-91);
- Declaration of originality (92);
- Appendixes (93-99);
- Bibliography (100-112);
- Acknowledgments (113);
- List of author's publications on the dissertation topic (114).

The bibliography covers 114 titles, of which 99 are in English, 3 in Bulgarian and 15 represent Internet resources and it presents the discussed topics at a good level. It is worth noting that Bulgarian authors are cited, including the researchers Assoc. Prof. Dr. Veselina Zhecheva, Assoc. Prof. Dr. Penka Georgieva, Prof. Dr. Daniela Orozova and BFU's Prof. DScTech Andon Dimitrov Lazarov.

Six publications are included **in the list of publications under the topic of the thesis** on page 114 . The analysis of these publications shows the following:

- **1 publication is in a SJR magazine 0.27, Q2 (No 2);**
- 1 publication is in the academic journal (No 1);
- 2 publications are published in the electronic magazine of BFU's CITS (Nos 4 and 5);
- 1 publication - in SIELA work (No 3);
- 1 publication - in BFU's yearbook (No 6).

Three publications (Nos 1, 2 and 3) are in English and three publications (Nos 4, 5 and 6) are in Bulgarian.

All publications are **co-authored**. There is no list of citations found.

The minimum national requirements for a "doctor"-degree under 4.6 Informatics and Computer Science have been met, according to the CMD № 26/February 13, 2019.

On pages (89-91) in "**Conclusion-summary of the results obtained**" are presented 3 scientific, 2 applied-science and 3 applied results. Art. 6 (3) of the ADASRB stipulates that "the dissertation paper must contain scientific and applied-science results, which represent an original contribution to science.

The **scientific results** obtained may then be presented as follows:

1. A model of the processes in the computer network is proposed as they are described by a system of differential equations for network instantaneous evaluation and estimate in case of malicious software;
2. Analytical expressions have been obtained to calculate network characteristics in case of susceptibility, exposure, infection, and recovery of machines in the computer network during a malware attack.

Accordingly, the obtained **scientific applied** results are as follows:

1. A software tool in the C # language has been developed to protect a computer network by encrypting the transmitted information using a genetic algorithm;
2. Some software products for solutions to the system of differential equations for instantaneous evaluation and estimate have been developed in a Matlab environment.

Critical remarks

1. Where purpose is described on page 22, "... construction and application of genetic algorithms ..." is defined, and according to Chapter II, the thematic algorithm built is only one. This is also stated in the scientific applied results in item 4.2.1;
2. In the "references" to the publication in Engineering Sciences 2022, № 1 an article (in print) co-authored with Petya Petrova is listed under № [21], which is missing in the bibliography and in the list of publications under the dissertation.
3. There are inaccuracies and gaps in the bibliography. According to the headings of Nos 52 and 53, these are the same publication;
4. It is not clear to which Chapter the VI "Annexes" refers.

Questions on the dissertation paper

1. Item 2.9 Conclusions, on page 66, defines "future activity of the author ... envisages construction of a database (rules, knowledge) for new unexplored structures of network characteristics of computer attacks, as well as methods for their counteraction and prevention"

Several questions can be asked, but one is essential: Can an example be given of the design of such a database (rules, knowledge) and methods?

2. Item 3.6 Conclusions, on page 88, states that "the genetic algorithm developed and implemented in the C # environment has reliable and stable encryption and can be applied in the exchange of data requiring a high level of security"

What means measured "reliable and stable encryption"? What is meant by "high level of security"? It is interesting to find which data exchange does not require a "high level of security"?

3. Is it possible to assess the future consumer, and why not commercial interest in the developed software tool, presented as a scientific-applied result in item 4.2.1, on page 90?
4. Is it possible for the developed software products in item 4.2.2 scientific applied results, on page 90, to be included in the minimum organizational measures of the subjects under Art. 4, para. 1, items 1 and 2 of the Cyber Security Act?

5. How are future studies and applications marked in Chapter IV, pp. 90-91, assessed over time and as necessary resources?

The Autoreferat presents the dissertation paper.

Conclusion

The dissertation paper on the topic "Modeling of network attacks and protection algorithms" meets the requirements of ADASRB and RAADASRB.

I give a positive conclusion to the educational and scientific degree "Doctor" of Petya Ivanova Petrova.

I propose that the scientific jury unanimously votes for Petya Ivanova Petrova to get the educational and scientific degree "Doctor" in the 4.6. Informatics and computer science professional direction

May 18, 2022

Reviewer:

Acad. Ivan P. Popchev