

R E V I E W

by Acad. Ivan P. Popchev – BAS

of dissertation for acquiring the educational and scientific degree "Doctor"

In professional direction 5.3. "Communication and computer technique"

Doctoral Program "Computer systems and technologies"

Titled: **"Application of high-performance systems for modelling stability processes in Cohen-Gossbegr type neural networks"**

by Ivan Dimitrov Torlakov

By order № УД-318/23.11.2022 of Magdalena Mitkova, PhD – Rector in accordance with Art. 4, para 2 of the Act on Development on the Academic Staff in the Republic of Bulgaria and by decision of the Faculty Council of the Faculty of Technical Sciences in connection with the procedure for acquiring the educational and scientific degree "Doctor" in professional direction 5.3. "Communication and computer technique", Doctoral Program "Computer systems and technologies" by Ivan Dimitrov Torlakov with a PhD thesis on "Application of high-performance systems for modelling stability processes in Cohen-Gossbegr type neural networks", I am appointed a member of the Scientific jury.

For the evaluation of the dissertation paper, the conditions of the Act on Development of Academic Staff in the Republic of Bulgaria (ADASRB), the Regulation on the Implementation of the Development of Academic Staff in Republic Act (RIDASRBA) (Decree № 202 of 10.09.2010, amend and suppl. SG 15/19 February 2019) and the Rules on the University "Prof. d-r Asen Zlatarov" for implementation of the law are defined and will therefore be accurately transmitted:

1. Pursuant to Art. 6 (3) of the ADASRB "The dissertation paper must contain scientific and applied science results being and original contribution to science. The dissertation paper must show that the applicant got deep theoretical knowledge in the respective speciality and the capacity for independent scientific research".
2. According to Art. 27 (2) of the RIDASRBA "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: a title page, contents, introduction, presentation, conclusion – summary of the obtained results with declaration for originality, bibliography.

According to the RIDASRBA and the Rules of University "Prof. d-r Asen Zlatarov", minimum required points by groups of indicators for the educational and scientific degree "Doctor" of 5.3. "Communication and computer technique" are:

Group of indicators	Contents	Number of points
A	Indicator 1	50
D	Sum of indicators from 5 to 11	30

The **scientific supervisors** of the dissertation are: Prof. Gany Trendafilov Stamov, DSc and prof. Stanislav Denchev Simeonov, PhD.

The **aim of the dissertation** is formulated on page 5 is: "to model stability processes in Cohen-Grossberg-type neural networks with bidirectional associative memory with time-varying delays and variable impulsive perturbations, using a high-performance and parallel technique."

To achieve this goal, the following tasks have been formulated:

- To explore existing software solutions for Cohen-Grossberg type bidirectional associative memory or similar neural network model;
- To develop a mathematical model and investigate the stability conditions for a network of two neurons;
- To model the stability conditions of the considered neural network model;
- To develop and implement the classical algorithm for neural networks of the considered model;
- To implement and investigate parallel algorithms for stability conditions of an existing configuration;
- To implement a parallel algorithm based on CUDA;
- To implement a parallel algorithm based on OpenMPI;
- To examine the results and their presentation in view of their volume.

The dissertation is in the volume of 149 pages, 123 cited sources, 8 tables, 26 figures and 41 algorithms.

On page 123 are "Publications" - 4.

An analysis of the publications shows the following:

- 1 publication is in Mathematics Q2 (No. 1);
- 1 publication is from Symposium (No. 4);
- 2 publications are in Lecture Notes in Networks and Systems (NNo. 2 and 3);
- all publications are co-authored.

No citations are provided.

The conditions of the RIDASRBA and the Rules of University "Prof. d-r Asen Zlatarov" are fulfilled.

Pursuant Art. 6 (3) of the ADASRB, **"The dissertation paper must contain scientific and applied science results being an original contribution to science"**. In the dissertation paper (p. 123) are formulated results, for which it is not determined whether they constitute an original contribution to science.

In short, the **results** in the dissertation can be systematized as follows:

1. **A model** for studying qualitative properties of a Cohen-Grossberg-type impulse neural network with bidirectional associative memory with time-varying delays and variable impulse perturbations.

2. **A theorem** is provided for stability criteria also generalizing the results in Bai Chuanzhi (2008); Li Kelin and Zeng Huanglin (2009, 2010); Li Xiaodi (2009); C. Maharajan, R. Raja, Jiude Cao, C. Rajchakit and Ahmed Alsaedi (2018); Qinghua Zhou and Li Wan (2009) considering variable impulse perturbations and h-manifolds.

3. **High-performance and parallel algorithms** for studying impulse neural networks of the Cohen-Grossberg type by using GUDAS, API and OpenMPI generalized model for the software solutions.

4. **Three-step software implementation** of the Cohen-Grossberg-type neural network stability model using NVidia corporation's CUDA and OpenMPI technology on a cluster of 8 machines each with four processors.

Critical remarks:

1. There are inaccuracies and incompleteness in the bibliography. For example, there are 39 publications without pages.
2. Only 2 publications on the dissertation are included in the bibliography.
3. 40 references included in the bibliography are not cited in the dissertation.
4. There are certain inconsistencies in the abstract: the aim and tasks are repeated on pages 9-10 and on pages 13 - 14. In the dissertation it is "Chapter 1. Neural networks" (pages 7 - 41), and in the abstract it is "Literature review 1.1 Neural networks" (pp. 11 - 12). Purpose and tasks of dissertation (pp. 13 - 14). There are inferences in the abstract (p. 13), but such inferences are absent in the dissertation. There is no "Conclusion" in the abstract.
5. The "Contributions" in the abstract (pages 28 - 29), defined as scientific and scientific-practical, are given in text, style and structure different from those in Chapter 5. "Conclusion" (pages 121 - 122).
6. According to Art. 6 (3) of ASRBA "the dissertation must contain scientific or scientific-applied results", not "scientific-practical" (pages 28 - 29) of the abstract.
7. The dissertation lacks a "conclusion - summary of the obtained results" according to Art. 27(2) of RIDASRBA and art. 41(1) of the University Regulations.
8. In the dissertation (p. 123) and the abstract (p. 30 - 31), the publications are written incompletely. For example: no pages, ISSN or ISBN, etc. Publication no. 4 has no doi and is not noted where it was published.

Questions on the dissertation paper:

1. According to Art. 6(3) of ASRBA, what exactly are the "scientific or scientific-applied results that represent an original contribution to science"?

2. In the dissertation on page 122 is noted an "improved method", and in the abstract, page 29 is noted an "applied method". Where exactly in the dissertation the method is proved and described?
3. Would a software implementation of the stability model in Cohen-Grossberg neural networks be of research and/or business interest to certain users?
4. Is future research on the topic of the dissertation proposed and how is it timed with certain resource conditions?

The **abstract** is in Bulgarian, 31 pages respectively.

Conclusion

The dissertation paper meets the conditions of the ADASRB, the RIDASRBA and the Rules of University "Prof. d-r Asen Zlatarov".

I give a positive conclusion for acquisition of the educational and scientific degree "Doctor" of **Ivan Dimitrov Torlakov**.

I propose to the Scientific Jury to vote unanimously on Ivan Dimitrov Torlakov the educational and scientific degree "Doctor" on 5.3. "Communication and computer technique", Doctoral Program "Computer systems and technologies".

04.01.2023

Reviewer: ..

Подпис заличен
Чл.2 от ЗЗЛД

/Acad. Ivan P. Popchev/