

STATEMENT REPORT

under the procedure for defending a dissertation on the topic:
***„Software Product for the Implementation of Generalized Net Models
and Its Applications“***
for the award of educational and scientific degree “Doctor”

by candidate: Angel Ivanov Dimitriev,

In the Scientific field: **4. Natural Sciences, Mathematics and Informatics**

Professional direction: **4.6. “Informatics and Computer Sciences”**,

Doctoral program: **“Informatics”**,

Institute of Biophysics and Biomedical Engineering (IBPhBME) - BAS.

The statement report has been prepared by **Prof. Daniela Ananieva Orozova, DCs - Trakia University** – Stara Zagora, as a member of the scientific jury for the defence of this PhD thesis according to Order № 231/ 24.03.2026 г. by the Director of IBPhBME – BAS on the basis of Art. 4, para. 2 of the Act on the Development of the Academic Staff in the Republic of Bulgaria.

In the evaluation of the dissertation, the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Regulation on the Implementation of ADASRB (RIDASRB, Council of Ministers Decree No. 26 of 13 February 2019), and the Regulations on the specific conditions of IBPhBME – BAS for the implementation of the law have been applied:

Pursuant to Art. 27, para. 1 of RIDASRB, “the dissertation must contain scientific or scientific-applied results that represent an original contribution to science. The dissertation must demonstrate that the candidate possesses in-depth theoretical knowledge in the respective specialty and the capacity for independent scientific research.”

According to Art. 27, para. 2 of RIDASRB, “the dissertation must be presented in a form and volume corresponding to the specific requirements of the primary unit. The dissertation must contain: a title page; an introduction; a presentation; a conclusion – summary of the obtained results with a declaration of originality; a bibliography.”

The minimum requirements by groups of indicators for acquiring the educational and scientific degree “Doctor” pursuant to RIDASRB have been met.

1. General characteristics of the dissertation and the materials presented

The author of the dissertation is Angel Ivanov Dimitriev – a part-time doctoral student at the Institute of Biomedical Engineering and Biomedical Sciences – Bulgarian Academy of Sciences. The supervisors of the dissertation are: Acad. DSc. Krassimir Atanassov and Assoc. Prof. Nora Angelova.

Angel Dimitriev's dissertation on the topic "Software Product for the Implementation of Generalized Net Models and Its Applications" is 182 pages long and includes: introduction (p. 6), four main chapters (p. 7–168), conclusion (p. 169–170), author's reference (p. 171–172), list of publications on the dissertation (p. 173), bibliography (p. 174–181) and declaration of originality (p. 182). The bibliography contains 104 titles and covers fundamental and modern sources from the theory of generalized nets and applications. The goal is formulated: "the creation of the OnlineGN software system - a web-based simulator that combines the theoretical foundations of GN with modern web technologies" (p. 6 of the dissertation).

2. Scientific and applied contributions of the candidate, contained in the submitted dissertation and the publications to it, included in the procedure

The dissertation is aimed at solving key problems in the field of practical use of the apparatus of generalized networks. It provides contributions in a scientific and scientifically applied aspect. I accept the reference for the contributions described by the doctoral student on pages 171 and 172 in the dissertation as correctly formulated and corresponding to the research work performed.

Algorithms for visualization and implementation of generalized nets (GNs) have been developed: an algorithm for automatically drawing GNs based on their abstract description, eliminating the need for manual setting of coordinates, and an algorithm for converting vector images (SVG) of GNs into TeX format by identifying graphic primitives and transforming coordinates.

A new parallel variant of the Towers of Hanoi problem is formalized, allowing simultaneous movement of $k \geq 2$ rings, showing how parallel processing can reduce the time to solve an exponential problem. An original GN model of parallel Towers of Hanoi is created, using ρ -tokens for objects and χ -tokens for resources. The applicability of the formalism is proven through simulations in the OnlineGN environment, demonstrating effective management of competing processes and logical constraints.

A new software product for GN has been created, which builds on the existing software products by offering significantly more capabilities. A comprehensive and flexible solution has been implemented, consistent with modern software standards and the needs of the research community - the OnlineGN project. An interactive interface has been developed for changing each component of the GN in the simulator, as well as for tracking details of the network implementation. Functionality for exporting from SVG to TeX has been implemented, which optimizes the preparation of graphic materials for academic publications. Through a series of simulations of classical tasks and real production scenarios, the dissertation proves the applicability and effectiveness of the developed software tool.

A methodology for describing deterministic and non-deterministic state machines using GN has been developed, allowing for the capture of parallel computational paths. GN models of real technological processes in an oil refinery have been developed, including the production of gas, polymer and heavy oil products. Representatives of LUKOIL Neftochim Burgas AD, familiar with the program implementation of these models, express the opinion that these are truly useful models for the processes of planning and implementing the work process in the plant.

3. Approbation of the results

The results of the dissertation research are presented in 5 scientific publications on the topic of the dissertation from 2023 to 2026. The publications are in English, with 4 publications being co-authored and 1 being independent.

The scientific works meet the minimum national requirements (under Art. 2b, para. 2 and 3 of the Act on the Development of the Academic Staff) and, respectively, the Regulations of the Institute of Biomedical Sciences and Biomedical Sciences - Bulgarian Academy of Sciences for the implementation of the law for the acquisition of the educational and scientific degree "Doctor" in the scientific field and professional direction of the procedure.

4. Abstract

The abstracts are prepared in Bulgarian and English and present the main results, contributions and conclusions of the dissertation. The content of the abstracts corresponds to the content of the dissertation.

5. Questions and recommendations for the doctoral student

I pose the following questions to the doctoral student:

- Why is a final transition necessary when modelling automata using GN?
- What is the reason for the lack of integration of GN files from other simulators?
- What kind of GN does the algorithm work well for? Is manual work necessary for large GN models?

I recommend to the doctoral student that in the future the operators that convert a given GN to one of the extended GN be implemented.


6. Conclusion

The dissertation work of Angel Ivanov Dimitriev contains scientific and applied scientific results that represent an original contribution to science, and meets the requirements of the Act on the Development of Academic Staff in the Republic of Bulgaria, the Regulations for its implementation and the Regulations of IBPhBME - BAS.

Angel Ivanov Dimitriev possesses in-depth theoretical knowledge in the field of modeling real processes, the theory and practical use of the apparatus of generalized nets, as well as the ability to independently conduct large-scale scientific research.

Due to the above, I confidently give my **positive assessment** of the research presented by the dissertation discussed above, the abstract, results, and contributions, and I strongly **recommend the scientific jury to award the educational and scientific degree “Doctor” to Angel Ivanov Dimitriev in the Scientific field 4. Natural sciences, mathematics and informatics, Professional field 4.6. Informatics and computer science, Doctoral program “Informatics”**.

03.05.2026. г.

Signature: 
(Prof. Daniela Orozova, DCs.)