OPINION

by Prof. Dr. Stefka Fidanova- IICT-BAS
on
a dissertation for the degree of
"Doctor of Science"
in the professional field 4.6 "Informatics and Computer Science"
on the topic "Metaheuristic algorithms for identification of nonlinear dynamic systems"
by Prof. Olimpia Nikolaeva Roeva

By order No. 560/01.06.2026 of the Director of IBFMBE-BAS Prof. Tanya Pencheva on the basis of Art. 13 of the Act on the Development of the Academic Staff in the Republic of Bulgaria and by decision of the Scientific Council of IBFMBE (protocol No. 07/29.05.2026) in connection with the procedure for acquiring the scientific degree "Doctor of Sciences" in professional field 4.6 "Informatics and Computer Sciences", by Prof. Dr. Olimpia Nikolaeva Roeva with a dissertation on the topic: "Metaheuristic algorithms for identification of nonlinear dynamic systems" I am appointed as a member of the Scientific Jury.

When evaluating the dissertation work, the conditions of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADRB) and the regulations on the specific conditions in the IBFMBE for the implementation of the law are decisive, as follows:

1. The dissertation must contain scientific or applied scientific results that represent an original contribution to science. The dissertation must demonstrate that the candidate possesses in-depth theoretical knowledge in the relevant specialty and the ability to conduct independent scientific research.

2. The dissertation must be presented in a form and volume that meets the specific requirements of the primary unit. The dissertation must contain: title page; table of contents; introduction; presentation; conclusion - a summary of the results obtained with a declaration of originality; bibliography.

According to the low and the Regulations for the Specific Conditions in the IBFBME, the minimum required number of points by groups of indicators for a "Doctor of Science" in direction 4.6 "Informatics and Computer Sciences" are:

Indicator	Contents	Number of points
А	Indicator 1	50
Б	Indicator 2	100
Г	Sum of Indicators from 5 to 10	100
Д	Indicator 11	100

Additional requirements of IBFBME-BAS: 10 publications in journals with an impact factor.

Relevance
The topicality of the subject of the dissertation is indisputable. Modeling and management of bioprocesses enables their optimization and increasing their efficiency. This is a task of great computational complexity. For this purpose, intelligent algorithms and a combination of algorithms and approaches are being developed.

The aim of the dissertation is theoretical research, development and experimental validation of metaheuristic algorithms and hybrid approaches, with applications for modeling and control of bioprocesses, aimed at creating highly efficient optimization algorithms. To achieve this goal, 6 tasks have been defined.

Dissertation structure

The dissertation consists of an Introduction, 6 chapters and a conclusion. It contains 288 pages, 88 figures, 72 tables. 581 literary sources are cited.

The introduction provides a brief description of the structure of the dissertation. It states the goal and objectives for achieving it.

Chapter 1 is an overview. It describes the relevance of the problem and provides the current state of the application of metaheuristic approaches in bioprocess modeling.

Chapter 2 provides a theoretical framework for the task at hand. It describes the cultivation processes used to validate and evaluate the proposed methods and algorithms.

Chapter 3 discusses various types of metaheuristic optimization algorithms and their application to parameter identification problems in nonlinear dynamical systems.

In Chapter 4, the application of metaheuristic algorithms for determining parameters in non-linear bioprocessor models and setting PID controllers is investigated.

Chapter 5 is devoted to the construction of hybrid mrtaheuristic algorithms. In this way, the advantages of the participating algorithms are combined, while their disadvantages are reduced. A theorem for global convergence in probability is proved.

Chapter 6 discusses the application of hybrid metaheuristic algorithms for parameter optimization in parametric systems of differential equations.

The conclusion summarizes the results obtained and provides guidelines for future development of the topic. A comparison is made between the stand-alone algorithms and the hybrid ones. The effect of hybridization is studied.

Knowing the status of the problem

There is no doubt that Prof. Olympia Roeva has a deep knowledge of the scientific field. From the first three chapters it is clear that she is well acquainted with the methods for modeling cultivation processes, as well as with the various types of metaheuristic methods, their advantages and disadvantages. Prof. Roeva has presented 20 publications, of which she is the first co-author in 17. This is clear evidence of her significant contribution.

Contributions

Prof. Roeva claims 7 contributions, 5 of which are scientific and 2 are scientifically applied. I completely agree with the contributions formulated in this way and their division.

Assessment of the dissertation candidate's publications and fulfillment of the minimum national requirements and the requirements of the Institute of Biomedical Sciences and Biomedical Engineering - Bulgarian Academy of Sciences

The dissertation of Prof. Dr. Olympia Roeva is based on 20 publications, 10 of which have an impact factor (5 in Q1 of WoS, 4 in Q2 of WoS and 1 in Q3 of WoS) thus fulfilling the additional requirements of IBFBMI-BAS. She has 6 publications with an impact rank without an impact factor and another 4 referenced in Scopus without an impact factor or impact rank. According to criterion D, Prof. Roeva has 304 points out of the required 100.

The presented publications have 295 citations visible in Scopus. Thus, Prof. Olympia Roeva has 1824 points out of the required 100.

Professor Olympia Roeva significantly exceeds the minimum national requirements, the requirements of the Bulgarian Academy of Sciences and the additional requirements of the Institute of Biomedical Sciences and Biomedical Engineering-BAS for acquiring the scientific degree "Doctor of Science".

Abstract

Overall, the abstract correctly reflects the content of the dissertation.

Critical notes

I have no significant critical remarks. The dissertation is well structured, distinguished by the thoroughness of the analyses and conclusions made.

Significance of the development for science and practice

The work done in the dissertation is sufficient in terms of volume and depth of research. It is of high scientific value, and also has a clear practical application. In this sense, I find the work significant both scientifically and practically.

Personal opinion

I have known Prof. Olympia Roeva for almost 20 years. We have participated in joint projects and have had joint developments. She is distinguished by exceptional hard work, thoroughness, perseverance in work and precision in scientific research. It is no coincidence that she is in the top 2% of scientists in the world according to the Stanford University ranking. Prof. Roeva works excellently in a team, but I also wish she had independent publications.

Conclusion

As a consequence of the above, it can be stated that all the requirements of the Academic Staff Development Act (ASDA), the Regulations for its Implementation (RPA) and the Regulations on the Terms and Procedures for Acquiring Academic Degrees and Holding Academic Positions at the IBFBME-BAS have been met. I can state that the level of this dissertation and the publications related to it significantly exceed the minimum requirements.

All this gives me reason for a positive assessment and I propose to the esteemed Scientific Jury to award the scientific degree "Doctor of Science" in professional field 4.6 "Informatics and Computer Sciences" to Prof. Olimpia Nikolaeva Roeva.

01.07.2026

(Prof. DrS. Stefka Fidanova)