OPINION

by Prof. Vassil Guliashki, PhD
Institute of Information and Communication Technologies - BAS
on a dissertation thesis for awarding the educational and scientific degree **"Doctor"**
in professional direction **4.6 "Informatics and Computer Science"**
Doctoral programme „Informatics"

titled: "MODELLING AND OPTIMIZATION OF COMMUNICATION STRATEGIES IN INFORMATION PROCESS MANAGEMENT"

by GERGANA PETKOVA MATEEVA

By order № 265/31.10.2025 of the Director of the Institute of Information and Communication Technologies – Corr. Member Svetozar Margenov, D.Sc. – in connection with the procedure for acquiring the educational and scientific degree "Doctor" in the professional field 4.6 Informatics and Computer Science, Doctoral programme „Informatics" by Gergana Petkova Mateeva with a dissertation thesis titled „Modelling and optimization of communication strategies in information process management" I have been included in the Scientific Jury as a member.
As a member of the scientific jury, I received:

1. Dissertation thesis for awarding the educational and scientific degree „Doctor" in Bulgarian.
2. Abstract in Bulgarian.
3. Abstract in English.
4. Scientific publications related to the dissertation.
5. Other documents.

When evaluating the dissertation, the terms of the Law on the development of the academic staff in the Republic of Bulgaria (LDASRB), the Regulations for Implementation of LDASRB (Decree No. 26 of February 13, 2019) and the Regulations of University of Library Studies and Information Technologies for application of the Law for the development of the academic staff in the Republic of Bulgaria are decisive.

1. According to Art. 27 (1) of LDASRB "the dissertation work shall contain scientific or applied research results that represent an original contribution to science. The dissertation shall show that the candidate has profound theoretical knowledge in the respective subject, as well as their abilities of independent scientific research."
2. According to Art. 27 (2) of LDASRB the dissertation work should be presented in a form and volume corresponding to the specific requirements of the primary unit. The dissertation work should contain title page; contents; introduction; presentation; conclusion – summary of the obtained results, accompanied by declaration of originality; bibliography.

The scientific supervisor of the dissertation thesis is Prof. Dr. Tatiana Atanasova.

Relevance of the topic

The topic of the dissertation is extremely relevant in view of the role of communications in the management of information processes. The dissertation presents a new holistic hybrid framework for optimizing communication strategies in distributed digital environments with limited resources. The main contribution is in the development and validation of a synergistic combination of advanced heuristic methods, in particular DNA-inspired modification of genetic algorithms and adaptive approximation of objective functions, with a flexible architectural model that allows their effective implementation on heterogeneous mobile and IoT devices. This can significantly assist the management of companies in the industry, wishing to develop effective communication strategies and optimally manage information processes in their work.

GENERAL CHARACTERISTICS OF THE DISSERTATION THESIS

The dissertation submitted to me for opinion is in a volume of 135 pages, structured in an introduction, 3 chapters, conclusion, contributions, directions for future research, list of publications, list of noted citations, declaration of originality of the results and a bibliography of 137 sources. Its text includes 48 figures and 9 tables.

The aim of the dissertation is to develop models and methods for optimizing communication strategies in information process management.

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

1) To develop heuristic methods for optimizing communication strategies in information process management in a digital environment.

2) To propose a modification of genetic algorithms for optimizing communication strategies in information process management.

3) To propose a method for improving the efficiency of genetic algorithms for the purposes of information process management.

4) To develop models that allow effective implementation and application of the developed heuristic methods on heterogeneous mobile and IoT devices in distributed digital environments with limited resources.

5). To propose an approach for assessing the effect of the application of the developed models and methods for optimizing communication strategies for managing information flows in distributed digital environments.

The formulated aim and tasks have scientific and scientific-applicational potential for research and application in the field of informatics, information systems and technologies.

The dissertation has resulted in **7 publications**, which are in proceedings of reports from international scientific conferences. 6 of them are also indexed in Scopus. All publications are co-authored, but in 6 of them Gergana Mateeva is the first author. So far, they have received 22 citations. The publications presented give reason to assume that the study has the necessary publicity.

CONTRIBUTIONS

The contributions are grouped into three main categories:

1. Methodological Contribution: Two new approaches have been developed to improve the performance of genetic algorithms in network environments:

- DNA-inspired modification of a genetic algorithm: A new representation using paired chromosomes with inverted bits has been proposed and validated. This method improves the

exploration of the search space and maintains population diversity, providing more robust solutions to complex optimization problems compared to standard GAs.

- Adaptive method for approximating computationally expensive objective functions: A new technique using Lagrange polynomials to approximate time-consuming objective functions has been developed. This approach significantly reduces computational and communication traffic, making the application of GA feasible on devices with limited resources. The adaptive nature of the approximation set represents a self-optimizing mechanism within the algorithm itself.

2. Architectural Contribution: A new architectural model has been created for the practical implementation of computationally intensive optimization algorithms (such as GA) on heterogeneous mobile and IoT devices with limited resources. The novelty of this architecture lies in the synergistic combination of:

o Asynchronous communication protocols: The model minimizes the need for frequent synchronization between the central server and clients, mitigating the "slowest client" problem often encountered in distributed systems.

o Modular and buffered data management: The specific use of mechanisms such as Android Content Providers serves as a generalized model for separating user interaction from background computations, ensuring system responsiveness and efficient local data processing. This joint design of algorithm and architecture is a significant contribution to the field of Edge AI and distributed intelligence.

3. Applied Contribution: A comprehensive application model for intelligent monitoring and data processing in the field of smart agriculture has been developed and validated through the Smart Livestock Project. The validation is multifaceted, using:

o Quantitative performance metrics: Rigorous evaluation using standard metrics such as mean absolute error (MAE) and root mean square error (RMSE) to demonstrate the predictive accuracy and effectiveness of the optimization algorithms.

o Qualitative strategic analysis: A SWOT analysis has been performed that contextualizes the strengths and weaknesses of the system and validates its design solutions against key challenges in the domain such as data quality, interoperability, and resource constraints.

It can be assumed that the presented results sufficiently cover the scope of the set goals and objectives.

The abstract in Bulgarian, 45 pages long, presents the dissertation work.

The abstract in English, 48 pages long, presents the dissertation work.

CRITICAL NOTES

1) The order of the chapters in the dissertation is a bit confusing. After the overview chapter, the proposed communication strategy models should be considered and then the methods for heuristic optimization of communication strategies should be presented. That is, the places of Chapter 2 and Chapter 3 should be swapped.

2) Parts of Chapter 2 and Chapter 3 can be moved to the overview Chapter 1 (for example, section 2.4, sections 3.5, 3.6, 3.7 and 3.8).

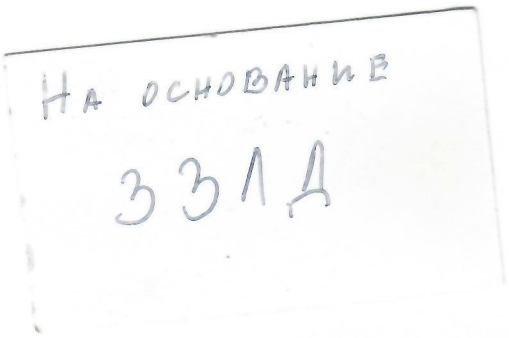
3) Before the presented graphics in Figures 2.5-2.8 and 2.12-2.14, data on the tested tasks should be given and, if it is possible, their formulation should be presented in analytical form.

4) The validation of the overall proposed hybrid framework for optimization of communication strategies on an applied model for intelligent monitoring and data processing in the field of smart agriculture should be described in detail.

5) The dissertation has some expressions that could be improved stylistically, as well as a small number of spelling errors. In addition, the titles of the tables should be placed above the tables, not below them.

FINAL COMPLEX ASSESSMENT

The technical remarks made do not belittle the contributions of the dissertation. I believe that the presented dissertation work meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria. The achieved results give me reason to propose to the esteemed Scientific Council to grant the educational and scientific degree "Doctor" to **Gergana Petkova Mateeva** in the professional field - 4.6 Informatics and Computer Sciences, doctoral program - "Informatics".



24.11.2025 г.

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