

OPINION

by Prof. DSc. Ivan Ganchev Garvanov

member of the Scientific Jury, appointed by an Order of the Director of IICT-BAS
with No 176/29.06.2026

Subject: **Diellza Shani Berisha's dissertation** on "Optimization Strategies and Algorithms for Solving Health System Problems During a Pandemic", presented for the acquisition of the educational and scientific degree "DOCTOR" in the scientific field "Natural Sciences, Mathematics and Informatics", Professional field 4.6 "Informatics and Computer Science" under the Doctoral Program "Informatics", at the Institute of Information and Communication Technologies of the Bulgarian Academy of Sciences, with supervisor: Prof. PhD. Vasil Georgiev Gulyashki.

1. Information about the procedure

At the first meeting of the Scientific Jury, I was selected to write an opinion and received the following documents:

- Dissertation in English;
- abstract in English;
- a list of published scientific publications on the topic of the dissertation;
- other documents related to the defense of the dissertation.

2. Relevance, purpose and tasks of the dissertation

The COVID-19 pandemic has clearly shown that managing large-scale health crises goes beyond purely clinical medicine and epidemiology. It is a complex, multi-criteria and dynamic problem for optimization and decision support in conditions of

high uncertainty, scarcity of resources, delays in information flows and logistical constraints.

Dielza Shani Berisha's dissertation is extremely relevant as it is positioned at the intersection between epidemiological modeling, operations research, machine learning and computer simulation. The research focuses on the development of scalable and robust (sustainable) algorithmic frameworks that are applicable in real time, with a focus on health environments with limited resources and a fragmented database (such as the case of the Republic of Kosovo under consideration).

The aim of the dissertation is to develop and evaluate an integrated hybrid framework for decision support that combines epidemiological forecasting, optimization-based resource allocation, and simulation of discrete events to improve health system performance during a pandemic.

To achieve this goal, the dissertation addresses the following tasks:

1. Analysis of healthcare modelling during a pandemic, including epidemiological forecasting, optimisation of health operations, hospital capacity planning, logistics coordination, equitable distribution and simulation support for decision-making.
2. Identify key methodological and practical gaps in existing approaches, paying particular attention to model fragmentation, data uncertainty, computational scalability, parity constraints and applicability in resource-limited health systems.
3. Design an integrated hybrid decision support framework that links SEIR-based epidemiological modeling, demand estimation supported by k-nearest neighbors, linear programming with mixed integers, and simulation of discrete events in one coherent workflow.

4. Defining the allocation of resources in healthcare as an optimization problem that takes into account demand, capacity, hospital utilization, transfer feasibility and minimization of shortages under pandemic pressure.

5. Defining a case study on COVID-19 in Kosovo through the preparation of epidemiological, demographic and health capacity indicators at the municipal level, suitable for computer experiments.

6. Evaluation of the proposed framework through experimental scenarios, including baseline demand, peak load conditions, coordinated allocation, and optimized configurations for hospital work.

7. Evaluate the solutions of the integrated framework using key performance indicators such as forecast accuracy, demand in hospitals and intensive care units, utilization, wait times, unmet demand and operational improvement.

8. Testing the proposed approach to support pandemic decision-making in a healthcare environment with limited resources.

3. General characteristics of the dissertation

The provided Dissertation consists of 188 pages formatted in an introduction, four chapters, a conclusion, a bibliography and appendices (Appendix A and B) with additional pre-processing matrices and scripts in MATLAB.

The first chapter of the dissertation makes an in-depth literature review and definition of research niches. In this chapter, the PhD student demonstrates an in-depth knowledge of the state of the problem.

The second chapter of the dissertation examines the proposed methodology and architecture of a hybrid system. This chapter represents the theoretical core of the dissertation. Dielza Berisha offers an original Integrated Hybrid Decision Support Framework (IHDSF).

Sustainable models for network allocation of resources and simulation stress tests have been implemented, taking into account the factor of equity in access to healthcare.

5. Abstract

The presented abstract reliably reflects the content of the dissertation and corresponds to the requirements of the Law on Abstract Abstract and Abstract. From the attached declaration of originality of the presented results, as well as from the presented publications on the dissertation, it can be judged that the described results are original and personal work of the doctoral student.

6. Assessment of compliance with minimum national requirements

PhD student Dielsa Berisha has tested parts of her dissertation in four scientific publications in English. In one of the publications, she is an independent author. Three of the articles are indexed in Scopus, and one of them has SJR.

According to the minimum national requirements for obtaining a PhD degree in the professional field 4.6. "Informatics and Computer Science", defined in Art. 2b, para. 2 and 3 of the Law on the Prevention of Corruption and Corruption and respectively under Art. 24, para. 1 of the Regulations for the Implementation of the Law on the Implementation of the Law on the Implementation of the Dissertation Act, at least 30 points are required for the indicators from Group D. The presented publications on the dissertation form a total sum of the points for the indicators from Group D equal to 66 points, which exceeds the required minimum of 30 points.

7. Notes and recommendations

Some of the results presented in the dissertation have not been reflected in the publications of the dissertation and my recommendation is that they be published.

8. Final due diligence

I believe that the presented dissertation meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for the Implementation of the Law on the Implementation of the Law on Academic Studies and the Regulations for the Acquisition of Scientific Degrees at IICT-BAS. The results achieved give me grounds to give a positive assessment with full conviction and I recommend to the honorable Scientific Jury to award the educational and scientific degree "Doctor" to **Dielza Shani Berisha** in the professional field – 4.6. "Informatics and Computer Science", PhD program – "Informatics".

20.07.2026

Sofia. Sofia

