OPINION

Prof. Evdokia Nikolaeva Sotirova, PhD
University "Prof. Dr. Asen Zlatarov"- Burgas

of a dissertation for obtaining the educational and scientific degree of "Doctor"
in the field of higher education: 4. Natural sciences, professional direction by professional field
4.6. Informatics and Computer Science

PhD Student: **Petar Rumenov Zhivkov**
Topic: **Modeling the state of air quality based on health and economic aspects**
Scientific Supervisor: **Prof. D.Sc. Stefka Fidanova**

1. General Overview of the Procedure and the Doctoral Candidate

The materials presented by Petar Rumenov Zhivkov comply with the Regulations for the Conditions and Procedures for Acquiring Scientific Degrees and Holding Academic Positions at the Bulgarian Academy of Sciences (BAS).

Petar Rumenov Zhivkov is born on February 27, 1990 in Sofia. In 2013, he graduated with a Master's degree in "Building Construction" from the University of Architecture, Civil Engineering, and Geodesy (Diploma No. 42144/2013). By Order No. 351/30.12.2019 of the Director of the Institute of Information and Communication Technologies (IICT) at BAS, he was enrolled in a full-time PhD program in the professional field (PF) 4.6 Informatics and Computer Science, under the supervision of Assoc. Prof. Vera Angelova, section "Intelligent Systems".

By Order No. 31/15.02.2021 of the Director of IICT at BAS, the doctoral candidate's supervisor was changed to Prof. D.Sc. Stefka Fidanova, section "Parallel Algorithms". By Order No. 371/23.12.2022 of the Director of IICT at BAS, Petar Rumenov Zhivkov was withdrawn from the full-time doctoral program with the right to defend his dissertation.

2. General Evaluation of the Dissertation Research

Relevance of the Topic

The dissertation focuses on air quality, specifically on fine particulate matter (PM) as a significant pollutant. Considering that air pollution has a serious impact on public health, the economy, and the environment, I find the research highly relevant. PM has been identified as a major factor contributing to respiratory diseases, especially in large cities across our country. In this regard, the work demonstrates a high level of applicability.

Understanding of the Problem

Petar Rumenov Zhivkov demonstrates depth and competence in addressing the issues related to the research. He exhibits not only theoretical knowledge but also the ability to apply it in practical investigations. This serves as a foundation for the competent realization of the objectives set in the dissertation, the formulation and evaluation of the problems, as well as the presentation and justification of the conducted studies, analyses, and obtained results.

Research Methodology

I find the methodology employed by the doctoral candidate to achieve the stated objective and the corresponding tasks to be well-founded and appropriate for studying the impact of fine particulate matter (PM) on acute illnesses and proposing effective strategies to mitigate their negative effects. A multidisciplinary approach has been applied, including a systematic review of existing research, quantitative analysis, and statistical modeling.

Characteristics and Evaluation of the Dissertation

The dissertation of Petar Rumenov Zhivkov consists of 115 pages and is structured into six chapters (93 pages): Introduction, Impact of PM, Calibration, Bicycle Route, Software Development, Conclusion, Bibliography (13 pages), and lists of tables and figures. The bibliography includes 108 references, of which 19 are from the last 5 years (18%) and 66 from the last 10 years (60%).

The dissertation is well-structured. *Chapter 1* introduces the topic, the aim of the dissertation, and the research methodology. The exposition in *Chapter 2* confirms that elevated levels of PM in the air lead to a significant increase in acute morbidity. Additionally, it highlights that the use of low-cost sensors, complementing data from official air quality monitoring stations, results in more accurate analyses. The two-stage methodology proposed in *Chapter 3*, which includes anomaly detection via unsupervised learning, demonstrates that a combined approach is more accurate and reliable. The software tool developed in *Chapter 4* for selecting optimal cycling routes—minimizing inhaled PM dosage for cyclists—is highly useful. The results obtained emphasize that multimodal street planning with low speeds and no physical barriers is more sustainable and effective than traditional cycling infrastructure, particularly in the context of air pollution and traffic in Sofia. *Chapter 5* presents a scalable modular software system for collecting and processing data from various sources and IoT devices. Of particular importance is the system's ability to generate air pollution maps for a mobile application. *Chapter 6* summarizes the results and contributions of the author.

I consider the research precise and aligned with the set tasks, presented in a clear and professional scientific style.

3. Assessment of Publications and the Candidate's Contribution

The results of Petar Rumenov Zhivkov's research are summarized in four scientific works in English, two of which are refereed and indexed in globally recognized scientific databases. One of these is in a journal with an SJR index (*Studies in Computational Intelligence*), and another was presented at the Conference on Computer Science and Intelligence Systems (FedCSIS). In three publications, the doctoral candidate is the first author, and one publication is authored solely by him. All publications are directly related to the dissertation topic.

With these publications, the candidate has accumulated 32 points, meeting the minimum requirements of IICT.

A review in Scopus shows that Petar Zhivkov has a total of seven publications (two sole-authored) and an h-index of 2, excluding self-citations from all authors. This demonstrates that the candidate can conduct independent research and highlights his significant contributions to the scientific field.

4. Contributions and Significance of the Research

The contributions of Petar Rumenov Zhivkov's dissertation are both scientific-applied and practical, as outlined on pages 98 and 99 of the dissertation.

The obtained scientific-applied and practical results are original and fully correspond to the objectives set in the dissertation.

5. Abstract

The abstract, spanning 55 pages, is well-structured and accurately reflects the dissertation's structure, results, and conclusions.

6. Questions and Recommendations

I have the following question for the doctoral candidate:

When using data from low-cost sensors and "conventional" instruments, the data is mixed. Have any studies been conducted to determine the influence coefficient of these two types of data on the final result?

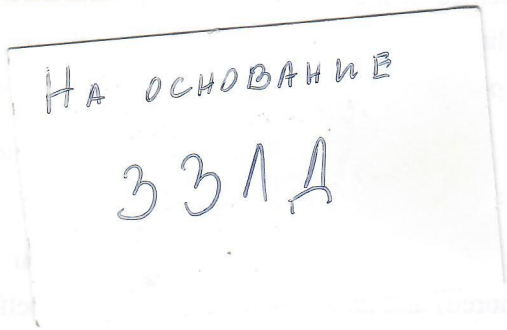
7. Conclusion

My assessment of the dissertation, abstract, publications, and scientific activity of Petar Rumenov Zhivkov is entirely positive. The dissertation contains scientific-applied and practical results that represent an original contribution to science and demonstrate that the candidate has deep theoretical knowledge, the ability for critical analysis, and the capacity to conduct independent research.

The dissertation fully complies with the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation, as well as the

criteria of the Rules for Acquiring Academic Degrees and Positions at the Bulgarian Academy of Sciences.

This gives me reason to confidently recommend to the esteemed members of the Scientific Jury to award Petar Rumenov Zhivkov the educational and scientific degree of "Doctor" in professional field 4.6 "Informatics and Computer Science."



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