OPINION

by assoc. prof. Margarita Nikolaeva Terziyska, PhD University of Food Technology, Plovdiv,

of a dissertation for awarding the educational and scientific degree "Doctor" in the field of higher education 4. Natural sciences, mathematics and informatics professional field 4.6. Informatics and Computer Science doctoral program "Informatics"

Author: Miroslav Trendafilov Trankov

Topic: Application of machine learning methods in the production of textile fibers **Scientific supervisor:** Prof. Dr. Emil Hadzhikolev and Assoc. Prof. Dr. Silvia Gaftandzhieva

1. General presentation of the procedure and the doctoral student

I am approved by order No. RD-22-771/27.03.2025 of Prof. Dr. Rumen Mladenov, of the University of Plovdiv "Paisii Hilendarski", as a member of the Scientific Jury in connection with the procedure for acquiring the educational and scientific degree "doctor" in: field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.6 Informatics and Computer Science, doctoral program Informatics by Miroslav Trendafilov Trankov with a dissertation on the topic Application of machine learning methods in the production of textile fibers, scientific supervisors Prof. Dr. Emil Hadzhikolev and Assoc. Prof. Dr. Silviya Gaftandzhieva.

As a member of the Scientific Jury, I have received:

- a request to the Rector of the University to disclose the procedure for defending a dissertation;

- a CV in European format;

- protocol of the department council, related to reporting the readiness to open the procedure and preliminary discussion of the dissertation work;

- dissertation work;

- abstract in Bulgarian and English;
- list of scientific publications on the topic of the dissertation;
- copies of scientific publications;
- declaration of originality and authenticity of the attached documents;
- reference for compliance with the specific requirements of the FMI.

In evaluating the dissertation work, the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LAD), the Regulations for its Implementation (PPZRASRD), and the Regulations for the Development of the Academic Staff of the PU (PRASPU) and the specific requirements of the FMI should be taken into account. The main norms that must be observed are:

1. According to Art. 6(3) of the ZRASRB "the dissertation must contain scientific or scientifically applied results that represent an original contribution to science. The dissertation must

show that the candidate possesses in-depth theoretical knowledge in the relevant specialty and abilities for independent scientific research".

2. According to Art. 27(2) of the PPZRASRB the dissertation must be presented in a form and volume corresponding to the specific requirements of the primary unit. The dissertation must contain: title page; content; introduction; presentation; conclusion - summary of the results obtained; bibliography.

The dissertation fully meets these requirements, consisting of a title page, content, introduction, presentation in the form of four chapters with the contributions of the dissertation candidate and conclusion.

3. According to Art. 36(1) of the PRASPU, the specific requirements of the FMI at PU are that the candidate must have:

- at least 4 publications in peer-reviewed publications;

- at least 1 publication in a journal.

The doctoral student has submitted 4 publications related to the dissertation, one in a journal.

2. Relevance of the topic

The topic of the dissertation is of exceptional relevance, due to the need for digitalization and intelligent automation of production processes in industrial practice. This also applies to the textile industry, which is one of the most resource-intensive in the world. The use of machine learning methods in this area has the potential to achieve significant economic and environmental benefits, such as waste reduction, quality improvement and predictive maintenance.

3. Knowledge of the problem

The doctoral candidate demonstrates in-depth knowledge of the specifics of textile production and of modern technologies in the field of artificial intelligence and machine learning. A comprehensive review of relevant scientific literature (a total of 182 sources) has been conducted, covering both fundamental and contemporary publications in the field. About 65% of the cited sources are from the last 10 years and about 40% are from the last 5 years. This indicates a solid commitment to the most current scientific literature and confirms in-depth knowledge of modern research in the field of machine learning and its industrial applications.

4. Research methodology

The methodology chosen by the doctoral student for conducting the research corresponds to the set goal and the tasks arising from it. Python was used to build and train ML models (including libraries such as scikit-learn, TensorFlow, Keras), as well as JavaScript and HTML/CSS to build the client interface. The server logic was implemented with PHP and Node.js, allowing asynchronous processing and compatibility with real production environments. The developed system follows a client-server model, which facilitates integration with production ERP systems. A relational database modeled using ER-diagrams was used, which allows for efficient storage and retrieval of production data.

5. Characteristics and evaluation of the dissertation and contributions

The dissertation consists of an introduction, which formulates the main goal and objectives of the dissertation work, four chapters, a conclusion, a list of cited literature, a list of publications related to the dissertation, a list of contributions claimed by the dissertation candidate. Parts of the program code used to develop the software system are given in the appendix.

Chapter one serves as a theoretical foundation and a critical review. It examines the technological processes in the production of textile fibers, specific approaches to predicting production parameters and quality control. Chapter one ends with conclusions that motivate the design and development of such a software system, outline the potential for implementing intelligent systems in the textile industry.

In the second chapter, the software system is designed. The functional and non-functional requirements for it are formulated, the user roles are defined, the architecture is proposed. A selection of software technologies that will be used to implement the system is also made.

Chapter 3 describes the software implementation of the prototype – an integrated system with a modular approach.

Chapter 4 presents the experimental results of the implementation of the integrated system in real conditions in the factory "Südwolle Group – Bulsafil branch".

I accept the contributions as they are presented in the dissertation:

Scientific and applied contributions:

- 1. Proposed architecture of a software system for managing the production process in a textile fiber production factory;
- 2. Implemented software prototype of a software system for managing the production process in a textile fiber production factory.

Applied contributions:

1. Implementation of the developed prototype of a software system in the company Südwolle Group Italy – Bulsafil branch;

2. Conducted experiments to test the developed modules of the system;

3. Conducted experiments for automated generation of reports and sending notifications.

6. Evaluation of the publications and personal contribution of the doctoral student

In connection with the dissertation, the candidate has submitted 4 publications. Two of them are indexed in SCOPUS and have an impact rank. One citation has been noted. Two of the publications on the dissertation are independent, and in the others the doctoral student is the first co-author. This gives me reason to believe that his participation is significant.

7. Abstract

The abstract is well structured and correctly reflects the content of the dissertation, its goals, objectives and achieved results.

8. Recommendations for future use of dissertation contributions and results

The dissertation is well presented. It is written concisely and clearly, the presentation is logically consistent. However, I have the following questions, comments and recommendations:

- 1. Have you considered the possibility of using predictive controllers (Model Predictive Controllers MPC) based on machine learning models?
- 2. In the dissertation, several key figures (e.g. Figs. 41–43, 46, 47) use production data from 2019 and 2020. Could you explain why more recent data is missing if the system operates in a real environment?
- 3. I recommend that the doctoral student, in his future developments, upgrade the system using multidimensional machine learning models that would cover several critical indicators of the production process in parallel for example, CV%, thickness deviations, operating time and strength. This would allow for a better assessment of interdependencies and more effective optimization of the entire production cycle. In addition, deep neural networks allow for automatic feature selection and transformation through embedded learning, making them an extremely powerful tool for working with high-dimensional and poorly structured data, such as those typical of real industrial processes.

CONCLUSION

The presented dissertation fully meets the set of criteria and indicators for acquiring the educational and scientific degree "Doctor", according to the Law on the Development of the Academic Staff in the Republic of Bulgaria (LDACRB), the Regulations for its implementation and the Regulations on the conditions and procedure for acquiring scientific degrees and occupying academic positions at the "Paisiy Hilendarski" University and the Faculty of Mathematics and Informatics. My personal opinion is that the dissertation is developed at a very good level. The problem considered in it is relevant. The contributions are significant. Considering all this, I positively evaluate the dissertation work and propose to the scientific jury to award the educational and scientific degree "Doctor" to Miroslav Trendafilov Trankov in professional field 4.6 Informatics and Computer Sciences, doctoral program "Informatics".

24.04.2025

Signature:

/assoc. prof. M. Terziyska, PhD/