

OPINION**by Eng. Ivan Panayotov Bodurov, PhD****Associate Professor in the Department of Physics at the Faculty of Physics and Technology,
University of Plovdiv "Paisii Hilendarski"**of a dissertation for the award of the educational and scientific degree of **"Doctor"**

in: field of a higher education 4. Natural Sciences, Mathematics and Informatics,

Professional Field: 4. 1. Physical Sciences,

Doctoral Program: Physics of Wave Processes

Author: Maryam Viqar**Title:** Deep Learning Models for Vascular Image Reconstruction and Analysis in Swept-Source Optical Coherence Tomography**Scientific supervisors:** Assoc. Prof. Violeta Madzharova, Ph.D. (IOMT-BAS, Bulgaria), Prof. D.Sc. Elena Stoykova (IOMT-BAS, Bulgaria), Erdem Sahin, Ph.D. (Tampere University, Finland) and Prof. Atanas Gotchev, Ph.D. (Tampere University, Finland)**1. General introduction of the procedure and the Ph.D. student**

By Order No. PD-15-749 of October 8, 2025, of the Director of the Institute of Optical Materials and Technologies "Acad. Yordan Malinovski" at the Bulgarian Academy of Sciences, I have been appointed as a member of the scientific jury to ensure the procedure for the defense of a dissertation on the topic „Deep Learning Models for Vascular Image Reconstruction and Analysis in Swept-Source Optical Coherence Tomography” for the obtaining of the educational and scientific degree “Doctor” in: field of higher education 4. Natural Sciences, Mathematics and Informatics, professional direction 4. 1. Physical Sciences, doctoral program Physics of Wave Processes. The author of the dissertation is Maryam Viqar, a full-time doctoral student at the Institute of Optical Materials and Technologies, with scientific supervisors Assoc. Prof. Violeta Madzharova, Ph.D. (IOMT-BAS, Bulgaria), Prof. Elena Stoykova, D.Sc. (IOMT-BAS, Bulgaria), Dr. Erdem Sahin (University of Tampere, Finland) and Prof. Atanas Gotchev, Ph.D. (University of Tampere, Finland). The set of materials on paper and electronic media presented by M.Sc. Maryam Viqar complies with Article 17. (1) of the Regulations on the conditions and procedure for obtaining scientific degrees and academic staff development at the Institute of Optical Materials and Technologies at the Bulgarian Academy of Sciences and includes the following documents:

- Request to the Scientific Council of the Institute of Optical Materials and Technologies for the initiation of a procedure for the defense of a dissertation;

- Doctoral dissertation;
- Europass CV in Bulgarian and in English;
- Master's degree diploma and certificate from National Center for Information and Documentation (NACID) for a recognized Master's degree diploma;
- Synopsis of the Ph.D. Thesis in Bulgarian and in English;
- List of the publications included in the Ph.D. thesis;
- Abstracts of the publications included in the Ph.D. thesis;
- Report on compliance with the minimum requirements in Annex 1, based on the IOMT template;
- List of citations;
- A declaration by the doctoral student and supervisors regarding the originality and authenticity of the dissertation for the Doctoral Degree.

The author has appended a list of 11 publications, 4 of which are included in the dissertation.

2. Relevance of the topic

The topic of the dissertation research, entitled „Deep Learning Models for Vascular Image Reconstruction and Analysis in Swept-Source Optical Coherence Tomography” reveals a strong interdisciplinary focus in the field of biomedical imaging diagnostics and computational physics.

The topic of the dissertation is relevant because it deals with real, complex technical and clinical challenges simultaneously. It does not simply apply existing deep learning (DL) methods, but innovatively adapts and optimizes them to make SS-OCT diagnostics faster, more accessible, and more informative. The focus on developing DL models with low computational complexity (minimum number of parameters) is extremely relevant. In the field of artificial intelligence, there is a strong drive towards so-called "edge AI", where complex algorithms can be executed quickly on limited resources. Success in this area means that the developed tools can be integrated directly into clinical OCT devices, rather than requiring powerful external computers, which increases their practical applicability.

3. Knowledge of the problem

The author demonstrates in-depth knowledge of the subject matter. The literary review is extensive, critical, and contains contemporary sources. It is clear that the author has analyzed not only theoretical propositions, but also practical applications and technological solutions.

4. Research methodology

This dissertation investigates variable wavelength optical coherence tomography (SS-OCT) as a promising imaging method for assessing soft vascular structures such as veins and analyzing their

mechanical characteristics. The synergy between OCT and deep learning methods demonstrates significant potential for a reliable reconstruction framework capable of addressing the research questions outlined above. The methods developed in this dissertation show high efficiency and performance, thus contributing to the development of modern methods in the field of OCT.

5. Characteristics and evaluation of the dissertation and contributions

The dissertation has volume of 186 pages and contains 33 figures, 12 tables, and 150 cited specialized literature sources. It consists of five chapters, including an introductory chapter that justifies the relevance of the work, main contributions, a list of publications and presentations related to the dissertation, a list of citations of the author's publications, and a bibliography of sources. The dissertation is scientifically sound, methodologically justified, and practically applicable. The content is analytical, with precise conclusions and clearly formulated summaries. Each section leads to the next with logical consistency. The reliability of the material used is guaranteed through experimental verification and modern analysis.

6. Assessment of the Publications and the PhD Student's Personal Contribution

All articles presented are co-authored, with the doctoral student listed first. This undoubtedly demonstrates the significance of her personal contribution. The significance and relevance of the publications is also confirmed by the citations.

PhD student Maryam Viqar has participated in international scientific forums and events with 8 oral and 6 poster presentations, which have led to an increase in her knowledge and experience in the relevant scientific field.

7. Synopsis of the dissertation

The synopsis is presented in Bulgarian and English and corresponds to the content of the dissertation, including the most significant results, illustrated with appropriate graphs, spectra, and photographs. It has been prepared in accordance with the requirements of the relevant regulations and reflects the main results achieved in the dissertation.

CONCLUSION

The dissertation contains scientific, applied scientific, and applied results that represent an original contribution to science and meet the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria, the Regulations for the Implementation of the Law on the Development of Academic Staff in the Republic of Bulgaria, and the Regulations on the Conditions and Procedures for Obtaining Scientific Degrees and Holding Academic Positions at the Institute of Optical materials and technologies at the Bulgarian Academy of Sciences.

The dissertation shows that MSc Maryam Viqar possesses in-depth theoretical knowledge and professional skills in the scientific field of Wave Process Physics, demonstrating qualities and skills for conducting independent scientific research.

For the reasons stated above, I confidently give my **positive evaluation** of the conducted research and **recommend to the esteemed scientific jury to award the educational and scientific degree of "Doctor"** to Maryam Viqar in the field of higher education 4. Natural Sciences, Mathematics, and Informatics, professional field 4. 1. Physical Sciences, Doctoral program in Physics of Wave Processes.

01.12.2025

Reviewer:

(signature)

Assoc. Prof. Ivan Bodurov, Ph.D.