

OPINION REPORT

from Prof. Dobromir Pressyanov, Ph.D., D.Sc.,

Faculty of Physics, Sofia University "St. Kliment Ohridski"

member of a scientific jury at the Medical University of Varna, according to an order № P-109-338/5.08.2022 r. of the Rector of Medical University of Varna

regarding a dissertation submitted for acquisition of the educational and scientific degree "doctor" entitled „Innovative breast phantoms for studying image quality in modern mammographic techniques“ of Yanka Ivanova Baneva, with scientific supervisors: Prof. Dr. Boyan Balev, MD and Assoc. Prof. Dr. Eng. Kristina Bliznakova

Biographical data: Yanka Baneva graduated in 2002 in Shoumen University "Konstantin Preslavski" with a bachelor's degree in physics. In 2010, she received a master's degree in Medical Radiation Physics and Technology from Plovdiv University "Paisii Hilendarski". In 2021, she acquired a specialty in Medical Sanitary Physics. Since 2008, she has been working as an assistant professor at the Department of Physics and Biophysics of the Medical University of Varna. Enrolled as a doctoral student in an independent form of study with Order No. P-109-365 of 20.06.2018 in scientific direction 4.1. Physical Sciences, Doctoral Program Medical Physics.

Relevance of the topic: I find the topic of the dissertation to be relevant. Ensuring and improving quality in the use of ionizing radiation in medical diagnostic and therapy is a permanently important task for medical physics and technology. To address it properly it is needed to use so-called "phantoms" and innovative approaches in this direction can have important scientific and practical value.

General characteristics of the dissertation and scientific contributions: The dissertation is laid out on 105 pages, in 9 chapters and a bibliography containing 133 literary sources. Lists of figures, tables, abbreviations and designations, as well as a list of publications for the dissertation, are given separately. Chapter 1 provides an extensive overview of the problem of breast cancer, as well as the main physical methods used to diagnose this disease. In chapter 2, the aim of the dissertation is formulated, aimed at creating, validating and using innovative computer phantoms to study the image quality of modern mammographic techniques, such as tomosynthesis and contrast-enhanced mammography. Chapter 3 looks at mammary models in X-ray examination, and chapter 4 - the methods used in the thesis - essentially software platforms for creating computer models/phantoms of the mammary gland. The results obtained in the dissertation are contained in chapters 5, 6 and 7. Chapter 5 is devoted to the development and use of computer models of the breast for tomosynthesis. This chapter is one of the central ones in the dissertation. In it, computer-simulated and experimentally obtained X-ray images of a mammary

gland phantom in both planar mode and tomosynthesis mode were obtained and compared, and validation of the computer model was done. Chapter 6 examines the influence of the X-ray radiation spectra used in mammography on the quality of mammographic images. Chapter 7 examines computer models used for mammography with contrast agents. It has been shown that the heterogeneous phantom can be used as a reference tool for information on the necessary iodine concentration to be applied during the diagnostic procedure to obtain significant contrast enhancement in the study area. Chapter 8 contains the conclusions of the research in the dissertation.

Scientific publications related to the dissertation: The results of the dissertation are reflected in 6 publications, but two of them are abstracts of scientific conference reports. Two of the publications are in journals indexed with IF/SJR: *Physica Medica* (IF=3.119, quartile Q2) and *Folia Medica* (SJR = 0.2, quartile Q4), and one is in a conference proceedings published by a prestigious international publisher (Springer). Results have also been presented at five scientific conferences. No data is given on the citations of the scientific publications by other authors, but a search in the scientific databases on the Internet shows that such are available.

Personal contribution: In four of the publications to the dissertation, incl. in the one with the highest international rating, Baneva is the leading author. This fact clearly indicates her personal contribution.

Critical notes:

- I think that the thesis summary could be shorter (with a total volume of the dissertation of 105 pages, the volume of the thesis summary is 78 pages).
- Some errors and terminological inconsistencies are noticed in the text: For example, formula 5.1 is said to be used to calculate the transmitted photons. In fact, the formula in question is one of the main ones in dosimetry and relates the air kerma to the energy fluence, which, however, only for mono-energy radiation (the one used in mammography examinations is not exactly like that) is equal to $E\Phi$, as written in the formula (i.e. energy (E) by the photon fluence (Φ) – in the text this is wrongly called “transmitted photons”). Furthermore $(\mu_{en}/\rho)_{air}$ is not a mass attenuation coefficient as it is called in the text, but a mass energy absorption coefficient for air (in the exact formula, however, the mass energy transmission coefficient $(\mu_{tr}/\rho)_{air}$ should appear instead $(\mu_{en}/\rho)_{air}$, although in the energy range of photon radiation used for mammography the numerical values of $(\mu_{tr}/\rho)_{air}$ and $(\mu_{en}/\rho)_{air}$ are practically the same – the expression is general and valid over wide energy range).
- The authors of these publications should also be given in the list of publications on the dissertation.

Conclusion: Although the dissertation admits some criticisms, its pros far outweigh the cons. With an indisputable personal contribution of the doctoral student, important scientific and

applied results were obtained, which were published, including in indexed international journals. There are publications noticed and cited by the international scientific community. **All this gives me the reason to support the awarding of the educational and scientific degree "doctor" to Yanka Ivanova Baneva.**

8.09.2022 г.

Signature:

A handwritten signature in blue ink, appearing to be 'Ivanova', written in a cursive style with a long horizontal flourish extending to the right.