МЕДИЦИНСКИ УНИВЕРСИТЕТ - ВАРНА "Проф. д-р Параскев Стоянов"

Ул."Марин Дринов" 55, Варна 9002, България Тел. : 052/ 65 00 57, Факс: 052/ 65 00 19 e-mail: uni@mu-varna.bg, www.mu-varna.bg



MEDICAL UNIVERSITY - VARNA "Prof. Dr. Paraskev Stoyanov"

55, Marin Drinov Str., 9002 Varna, Bulgaria Tel.: +359 52/ 65 00 57, Fax: + 359 52/ 65 00 19 e-mail: uni@mu-varna.bg, www.mu-varna.bg

Fund "Nauka" Project № 21021 Resume – Competition-Based Session 2021: "An innovative method for quality control of X-ray systems" Project leader: Prof. eng. Kristina Stanimirova Bliznakova, PhD

The purpose of this research is to develop a methodology for quality control of X-ray machines, which methodology will be approved and implemented after the end of the project.

The specific research project tasks are:

- 1. Study of existing models and methods used for quality control for X-ray systems.
- 2. Development of a computational phantom for quality control of X-ray systems.
- 3. Manufacturing of a physical phantom for quality control of X-ray systems.
- 4. Development of a methodology for weekly quality control of the X-ray systems.
- 5. Validation of the physical phantom.
- 6. Testing the methodology for quality control in a pilot study.
- 7. Analysis of the research results.
- 8. Dissemination of the obtained results.

Methods:

The computer model will be created by using an in-house validated software applications for modeling of 3D objects and simulating X-ray images. The physical model will be manufactured with 3D printing; the measurements will be performed on two X-ray systems, and the results will be entered into specialized software. The analysis will be carried out on the statistical platform R, and the results will be summarized in two publications, two conference papers, one doctoral dissertation and two dissertations.

Expected results:

A novel methodology for quality control of X-ray diagnostic devices with a validated physical model. The methodology will be a prerequisite for improving the image quality of X-ray systems, and the data collected from the pilot study will allow the comparison with data of research teams which perform quality control in other European hospitals.

Achieved results:

Three main phantoms were created and used to evaluate the quality of the X-ray images. Two of the phantoms are dedicated to periodic checks of X-ray radiography equipment, and the third is for a computed tomography. The three phantoms were first created as computational phantoms, then converted to STL format and printed using 3D printers and suitable materials. All phantoms have been successfully validated.

A methodology has been developed for the implementation of weekly quality control of X-ray radiography equipment. The ability of X-ray technicians to perform weekly quality control as part of routine duties, including dose estimation for a specific imaging protocol and providing image quality assessment, was successfully demonstrated. Results from one of the phantoms, used in the four-week study, revealed a malfunction of the X-ray radiography machine. This demonstrates the applicability of the created phantom in real conditions.

A C# X-ray quality control software application was developed and used to populate the weekly test data.

As a result of the pilot studies and the dosimeter purchased thanks to the funding, an agreement is to be concluded with the IAEA to join a project on the "remote methodology" of X-ray equipment. The measurements will last for one year, and the aggregated data will be sent at the end of 2024 for inclusion in processing and comparison with other countries. Also pending is the submission of the article "*Design and use of Exploration of Customized Phantom for Regular Tests of Radiography Apparatus*", which will be published after revision by the representatives of the IAEA.

The CT phantom has been positively evaluated for its applicability for bone density assessment in patients undergoing CT imaging and is currently being used in clinical trials.

Finally, the PhD student Yanka Baneva successfully defended her doctorate in 2022, students Vanessa-Meri Valkova and Adelina Doycheva successfully defended their theses and received the *Master's degree in Information Technologies in Health and Healthcare* in 2023. Vanessa-Meri Valkova won III place in the competition "Best thesis" of the Varna Scientific and Technical Unions.