

# **R E V I E W**

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## **CONCERNING**

Announced competition for the occupation of an academic position: "professor" in the field of Higher Education 5. Technical sciences, professional direction 5.2. Electrical engineering, electronics and automation, specialty "Biomedical engineering and technologies" for the needs of the Department of Medical Equipment, Electronic and Information Technologies in Health Care, announced in the State Gazette, issue 102, December 23, 2022.

Pursuant to the Order of the Rector of the University of Medicine - Varna No. R-109-143 of 23.02.2023 and the decision of the first meeting of the Scientific Jury, held on 06.03.2023, I am appointed to prepare an official review as an internal member of Medical University Varna.

Associate Professor Kristina Bliznakova, Medical University - Varna is the only candidate in the announced competition for the acquisition of the academic position "Professor" for the needs of the Department of Medical Equipment, Electronic and Information Technologies in Health Care at the Faculty of Public Health. All the documents specified in the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Rules for its Application and the Rules for the Development of the Academic Staff of the University of Medicine - Varna are presented.

## **BIOGRAPHICAL DATA**

Kristina Bliznakova was born in 1973 in the town of Shumen, Shumen region. She graduated in Electronic Engineering and Microelectronics at the Technical University - Varna in 1996. In the period 1996-1998 she participated in the master's program in Biomedical Engineering at the University of Patras, Greece. In 1998, she received a master's degree in Biomedical Engineering and the

same year continued her doctoral dissertation in the same field. In 2003, she successfully defended her thesis on "Study and development of software simulation for x-ray imaging", University of Patras, Patras, Greece. Her dissertation concludes with a method for creating anthropomorphic computer models of the breast for X-ray technology. In the period from 2004 to 2012, she was leading a scientific group on Monte Carlo simulations at the University of Patras. In 2012, she won Marie Curie Career Integration Grants (PCIG09-GA-2011-293846) for reintegration in Bulgaria with the topic "Design of a new three-dimensional method for detecting breast cancer based on phase-contrast technology" (2012 - 2016). Since 2016, she has been appointed as an associate professor in the Department of Software and Internet Technologies at the Technical University of Varna, and since 2019 she has been a member of the Department of "Medical Equipment, Electronic and Information Technologies in Health Care" at the Medical University of Varna

## EDUCATIONAL AND TEACHING ACTIVITY

Prof. Kristina Bliznakova has fifteen years of teaching experience in the field of Biomedical Engineering and Technologies. She gave lectures and laboratory exercises, and she was a supervisor of graduates and doctoral students at three universities: University of Patras, Greece; Technical University of Varna; Medical University of Varna. Prof. Bliznakova's teaching activities include training in Bulgarian, English and Greek. Academic subjects taught by the candidate include:

<b>Period until 2013 - University of Patras, Greece</b>
<ul style="list-style-type: none"> <li>• <i>Biomedical Image Processing</i> from the master's course <u>Informatics in Life Sciences</u>, University of Patras, Greece, 2010 - 2012</li> <li>• <i>Monte Carlo Application in Biomedical Research</i>, European Master Program <u>Biomedical Engineering</u>, University of Patras, Greece, 2009 - 2011</li> </ul>
<b>Period from 2013 to 2019 - Technical University of Varna</b>
<ul style="list-style-type: none"> <li>• leading teacher of the disciplines at Technical University of Varna, OCS "Bachelor" and OCS "Master" <ul style="list-style-type: none"> <li>○ "Discrete Structures"</li> <li>○ "Logic and Automata"</li> <li>○ "Basic Programming II"</li> <li>○ "C/C++/C# Programming"</li> </ul> </li> <li>• leading the laboratory exercises <ul style="list-style-type: none"> <li>○ "Analysis and Synthesis of Electronic Circuits"</li> <li>○ "Computer Simulation in Electronics"</li> <li>○ "Biomedical Signal Processing"</li> <li>○ "Object Oriented Programming Part 1"</li> </ul> </li> </ul>



### Period from 2019 to 2023 - Medical University of Varna

- leading teacher of the disciplines at Medical University-Varna
  - "Radiological Physics"
  - "X-ray technique, other imaging techniques"
  - "Programming in C++"
  - "Programming"
  - "Introduction to C/C++ Programming"
  - "Applied Simulation Products in Health and Healthcare"
- teacher in the disciplines
  - "Digital Technologies for Health"
  - "Innovations and Technologies in Healthcare"

At the University of Patras, Greece, Prof. Bliznakova was a direct mentor of four successfully defended doctoral students and seven master's degree students. Under her guidance, at the Technical University of Varna and the Medical University of Varna, so far, doctoral students have successfully defended: 1; Master's graduates: 5 and Bachelor's graduates: 12.

### RESEARCH ACTIVITY

Prof. Kristina Bliznakova has an extremely rich scientific and research activity.

To participate in the competition, the candidate submits a total of 38 peer-reviewed publications, of which 36 are in English and 2 in Bulgarian, reflecting the candidate's research activities in the period 2016 - 2022 and divided by category. Additionally, 5 peer-reviewed publications in English and referenced in the international SCOPUS database are presented, beyond the minimum science-metric requirements.

To cover the minimum science-metric indicators in Group B, 11 peer-reviewed scientific publications in English, referenced in the international SCOPUS database, were selected with a total of 143.84 points, equivalent to a habilitation thesis on the topic: "Models, methods and techniques for imaging of the mammary gland".

To cover the minimum science-metric indicators in Group D, a total of 26 peer-reviewed scientific publications (25 in English, 1 in Bulgarian) and a published book chapter with a total number of 229.28 points were selected, of which 16 are referenced in the international SCOPUS database.

Scientific publications from Group B (Group B4) referenced in the international SCOPUS database	11
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<b>Scientific publications from Group G</b>	<b>27</b>
Scientific publications from <b>Group G7</b> referenced in the international database <b>SCOPUS</b>	16
Scientific publications from <b>Group G8</b>	10
Scientific publications from <b>Group G9</b> referenced in the international database <b>SCOPUS</b>	1
<b>Scientific publications, beyond the minimum science-metric requirements, referenced in the international database SCOPUS</b>	<b>5</b>

The scientific research work and the development of the presented scientific publications (Group B and Group D) of the candidate were carried out in co-authorship with other authors, as follows:

<b>Co-authorship in scientific publications</b>	<b>Number of publications</b>
Scientific publications - independent author	3
Scientific publications with one co-author	2
Scientific publications with two co-authors	7
Scientific publications with three co-authors	5
Scientific publications with four co-authors	4
Scientific publications with five co-authors	3
Scientific publications with six co-authors	6
Scientific publications with seven co-authors	3
Scientific publications with eight co-authors	2
Scientific publications with nine co-authors	-
Scientific publications with ten or more co-authors	3

Order of the candidate among the authors in the scientific publications (Group B and Group D) is as follows:

<b>Order of the candidate among the authors in the scientific publications</b>	<b>Number of publications</b>
First author in scientific publications	10
Second author in scientific publications	8
Third author in scientific publications	11
Fourth author in scientific publications	4
Fifth author in scientific publications	2
Sixth author in scientific publications	1



<b>Seventh author in scientific publications</b>	-
<b>Eighth author in scientific publications</b>	1
<b>Ninth author in scientific publications</b>	1
<b>Tenth author in scientific publications</b>	-

List of citations of the candidate's scientific publications submitted for participation in the competition:

- in SCOPUS database: from independent authors: 91 /total: 265
  - Scientific publications, Group C: 68 / 198
  - Scientific publications, Group D: 23 / 67
  
- in Google Scholar: by independent authors: 136 / total:341
  - Scientific Publications, Group C: 98 / 243
  - Scientific Publications, Group D: 38 / 98

The candidate's scientific works are directly related to the main development priorities of the Department of Medical Equipment, Electronic and Information Technologies in Health Care, and in particular to the development of the "Biomedical Techniques and Technologies" specialty.

Prof. Bliznakova publishes her scientific works abroad in prestigious scientific journals such as, Physica Medica, Medical Physics, Physics in Medicine and Biology, Plos ONE.

## **SCIENTIFIC CONTRIBUTIONS**

Computer modeling of the mammary gland and simulations in the field of imaging diagnostics of the mammary gland occupy a central place in the candidate's scientific works. The development of a computer model of the mammary gland for testing and optimization of digital mammography are the subject of her dissertation work completed in 2003 at the University of Patras, Greece. For 20 years, her research activity has been focused in the field of modeling, simulations and experimental testing and optimization of existing and new methods for screening and diagnosis of the mammary gland, and the results of each developed model and the corresponding simulation have been validated, tested and optimized with experimental work, on specific prototype X-ray setups.

The classification of anthropomorphic computer and physical models of the mammary gland and tumor formations proposed by Prof. Bliznakova has a real scientific-theoretical and applied contribution (B4-01, G7-07, G8-03, G9-01). Systematized presentation of the methods of their preparation is important for researchers developing such models for imaging and educational purposes.



A new method for creating an anthropomorphic computer model of the mammary gland for radiological purposes (B4-02) has been developed, and by applying it to patient images obtained through a specialized computed tomography scanner, the largest database of 150 digital mammary gland models without lesions. To obtain computer models of irregularly shaped tumor formations, methods based on tomosynthesis and computed tomography of the breast and obtained by mathematical description have been developed (B4-06, G8-05, G8-09, G8-04, B4-03). All of them have a scientific and scientific-applied contribution. The generated mammary tumor models were collected and annotated in a unique database (B4-03, D8-03), which is an applied contribution.

For the realization of these innovative developments, European projects (G8-08) were developed and successfully implemented, which lead to an increase in the research and innovation capacity of researchers from Bulgaria in the field of computer modeling of mammary gland tumor formations, which has a scientific and scientific and applied contribution. These developments contribute to the creation and introduction of new, attractive methods for conducting training in the field of X-ray technology (G7-06, G7-15, G8-03), which has an extremely applied nature. It is convincingly demonstrated how scientific research results are implemented in the training of students in medical specialties and the training of experts in medical physics and biomedical engineering. A model for the implementation of research projects during a pandemic has been developed and implemented (G7-04).

The process of creating a physical anthropomorphic phantom for radiology applications is time-consuming and involves a monetary investment. A new computer approach was developed to study the available 3D materials for the production of a four-component anthropomorphic breast phantom (G7-01). The contribution of the proposed approach is scientifically applied and significant to biomedical engineers and medical physicists, who can use the approach to test various materials as substitutes for human body tissues, thereby reducing material and time costs associated with manufacturing of the corresponding anthropomorphic radiological phantoms.

An experimental study was carried out which materials, including for 3D printing, are suitable for creating anthropomorphic radiological phantoms (B4-04, B4-05, D7-02, D8-01, D8-10). The developed method has a scientific and scientific-applied contribution in the field of X-ray technology, the established dependencies are used to develop anthropomorphic models for quality control in radiology and for new dosimetric approaches. It is demonstrated for the first time that ABS combined with resin-based materials is a good combination to create a phantom suitable for phase-contrast studies, with ABS being a good surrogate for adipose tissue, while resins well approximate the phase effects of glandular tissue. The proposed new method for studying X-ray refractive indices of 3D printing materials (B4-04) also belongs to this field. They are used for the purpose of preparing physical models of the mammary gland for phase-contrast diagnostics, which is a scientific and scientific-applied contribution.



The scientific works dedicated to the approaches to creating a physical radiological model of a mammary gland with an inkjet printer (G7-02, G8-02 ) have a scientific and scientific-applied contribution. The results are relevant in the design of physical radiological anthropomorphic breast models, saving time for the preparation of new calibration phantoms and tests with this contrast agent.

A scientific, scientific-applied and applied contribution is represented by the developed methods for printing physical radiological phantoms of the mammary gland and lesions (G8-06, G8-07, G8-10, G7-05, G7-12, G7-14, G7-16). The anatomical and radiological realism of the anthropomorphic physical models of the mammary gland, together with the possibility of unlimited exposure during important diagnostic tasks, make them a key tool of every radiology and radiology department.

An important achievement in this field with a scientific-applied contribution is the new approach to create a physical mammary radiological phantom based on patient images from a specialized computed tomography (G7-13). The major advantage of the approach is the elimination of the need for prior segmentation of the breast tissue.

The scientific works related to models, methods and techniques for screening and diagnosis of the mammary gland, lung, including new software platforms, supporting the evaluation of the proposed methods, have a scientific and scientific-applied contribution. Algorithms for mammary gland tomosynthesis (B4-11), methods and related techniques for mammary gland phase-contrast tomosynthesis (B4-07, B4-08, B4-10) have been implemented. This field also includes research related to a new technique for lung diagnostics using a dark field (G7-11), with a scientific contribution.

Prof. Bliznakova is the author and co-author of a number of software applications that are used in a number of virtual clinical trials related to the mammary gland (B4-09, G7-09, G7-03, G7-10), with which they are scientifically applied and applied contribution.

In addition to the field of the mammary gland, Associate Professor Bliznakova is also involved in research in other areas of medicine. An innovative software platform for stroke (G7-08) has been implemented, which has an applied contribution and reflects all the characteristics necessary for the analysis of strokes in Varna.

## **CONCLUSION**

The scientific research activity of Assoc. Prof. Eng. Kristina Bliznakova is based on 30 years of experience in computer modeling, simulations and validations of methods for screening and diagnosis of the mammary gland, as well as methods

for realizing physical models of the mammary gland intended for virtual clinical research, practical validation and testing of proposed X-ray based screening and diagnostic methods. Her scientific works in this field impress with their thoroughness and practical applications.

Together with 15 years of teaching experience at the University of Patras, Technical University of Varna, Medical University of Varna and her active research and project activities, they give me the reason to suggest to the scientific jury to vote positively for her election to the academic position "Professor".

Varna  
05/05/2023

Prof. Dr. Nikola Kolev, MD

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A handwritten signature in blue ink, consisting of several fluid, overlapping loops and strokes, positioned to the right of the name and above the dotted line.