

For the academic position of “Professor”

Professional Field: Technical Sciences, 5.1. Mechanical Engineering, scientific specialty “Robots and Manipulators”, topic: “Metrology of Mobile Robots – Methods, Models, Evaluation and Optimization of Mobile Collaborative Service Robots”;

Announced in the State Gazette, Issue No. 51/05.06.2026, p. 111;

Candidate: Nina Foteva Valchkova, Associate Professor, PhD;

Reviewer: Avgust Yordanov Ivanov, Professor, PhD;

GROUND for preparing the Review: Decision of the Scientific Council of the Institute of Robotics – Bulgarian Academy of Sciences (IR-BAS), Minutes No. 7/28.07.2026, item 1.2, and Order No. 107 of 11.08.2026 issued by the Deputy Director, Assoc. Prof. Alexander Krastev, PhD, of the Institute of Robotics at the Bulgarian Academy of Sciences, concerning the appointment of the Scientific Jury, as well as the decision of the Scientific Jury – Minutes of the first meeting of the Scientific Jury held on 12.08.2025, concerning the appointment of reviewers.

1. Brief Biographical Information

The documents and materials submitted for the competition show that the candidate completed her higher education in 1983 at the “Angel Kanchev” University in Ruse, obtaining a Master’s degree in Mechanical Engineering, with a specialization in “Mechanical Engineering Technology and Metal-Cutting Machines.” In 2013, she was awarded the educational and scientific degree “Doctor” (PhD) at the Institute of Systems Engineering and Robotics – Bulgarian Academy of Sciences (BAS), in Professional Field 5.1. Mechanical Engineering, scientific specialty “Robots and Manipulators.” From 1984 to 1989, she worked as an Assistant at the Research Institute of Robotics in Stara Zagora. From 1989 to 1991, she held the position of Assistant at ITCR–BAS, and from 1991 to 1994, she was a Senior Assistant at the Institute of Mechanics – BAS. Between 1994 and 2010, she served as Chief Assistant Professor at the Central Laboratory of Mechatronics and Instrumentation – BAS. From 2010 to 2018, she was Chief Assistant Professor at the Institute of Robotics – BAS. In 2018, she was appointed Associate Professor in the Robotics and Mechatronic Intelligent Systems Section (RaMIS) at the Institute of Robotics – BAS, where she currently also serves as Head of the Section.

2. General Description of the Submitted Materials

The candidate has submitted a dissertation for the award of the educational and scientific degree “Doctor” (PhD) entitled “Parametric Identification and Calibration of a Robot Manipulation System for the Synthesis of a Model Operator through Investigation of the Service Coefficient”; a monograph entitled “Metrology of Mobile Robots in Healthcare – Methods, Models, Evaluation and Optimization of Mobile Collaborative Service Robots”; seven scientific publications in journals and proceedings referenced

and indexed in internationally recognized scientific databases; ten scientific publications in non-indexed peer-reviewed journals or edited collective volumes; twelve citing publications in sources referenced and indexed in internationally recognized scientific databases – Scopus and Web of Science (WoS); eight citations in monographs and peer-reviewed collective volumes; and 21 citations in non-indexed publications. A list of two patent applications filed in 2026 has also been submitted, together with two utility model applications, likewise filed with the Patent Office during the current year.

According to the submitted Statement of Compliance with the Minimum National and Institutional Requirements by Groups of Indicators for the Academic Position of “Professor”, and in accordance with the rules governing appointments to academic positions at the Institute of Robotics – BAS, the results for the present competition are as follows: Indicator A – 50 points (required minimum: 50); Indicator B – 100 points (required minimum: 100); Indicator G – 220.33 points!!! ($G8.8 + 5$ points) (required minimum: 200); Indicator D – 183 points (required minimum: 100); and Indicator E – 234.53 points (required minimum: 150).

3. General Characteristics of the Candidate’s Research, Applied Research and Teaching Activities

The candidate’s research interests cover a substantial part of the scientific specialty “Robots and Manipulators”, with a clearly defined focus on collaborative and service robots, cyber-physical systems, intelligent control, and autonomous energy supply. The results of her research have applications in areas of high societal importance, including healthcare, social robotics, specialized operations, and sustainable energy technologies. The candidate demonstrates in-depth scientific and applied expertise in the fields of robotics, mechatronics, and intelligent control systems. She possesses expertise in the design, modelling, development, and experimental verification of mobile, collaborative, and service robots. Her research activities encompass multisensory perception, sensor fusion, autonomous navigation, cognitive robotic systems, and digital twins. She develops robotic systems for applications in healthcare, industry, crisis management, and intelligent infrastructure, as well as energy management systems, including the integration of hydrogen fuel cells and hybrid energy systems into mobile robotic platforms.

Teaching Activities

Assoc. Prof. Nina Valchkova, PhD, has served as the scientific supervisor of two doctoral students and of one doctoral student who successfully defended their dissertation in 2025.

Project Activities

The candidate declares participation in the following research and technological projects in Bulgaria:

- A project receiving targeted state funding under the budget subsidy “SECURITY AND DEFENCE”, pursuant to Council of Ministers Decision No. 731 of 21.10.2021; project period: 2022–2026.
- BG16RFOP002-1.005-0122-C01, “Development of a System for Personalized Diagnostics of the Physical Development of Adolescents – CADET”; project period: 2018–2020.
- Contract with the Bulgarian National Science Fund, Project KP-06-N57/8 of 16.11.2021 – “Methodology for Determining the Functional Parameters of a Mobile Collaborative Service Robot Assistant in Healthcare”, under the 2021 Competition for Funding Fundamental Scientific Research.
- Contract No. PVU-44/05.12.2024, Project BG-RRP-2.017-0011-C02 “Environmentally Friendly Collaborative Robots Powered by Green Hydrogen”, under the Recovery and Resilience Facility, Investment C2I2 “Enhancing the Innovation Capacity of the Bulgarian Academy of Sciences in the Field of Green and Digital Technologies.”
- CybSPEED: Cyber Physical Systems for PEdagogical Rehabilitation in Special Education, Marie Skłodowska-Curie – RISE.

Membership in Scientific Organizations

- Association for Computing Machinery, 2019–2022.
- Union of Automation and Informatics, 1996–2025.
- Bulgarian Robotics Society, 1989–2016.

Organizational Skills and Competences

- Head of the Robotics and Mechatronic Intelligent Systems (RaMIS) Section at the Institute of Robotics – Bulgarian Academy of Sciences.
- Chair of the Organizing Committee of the International Scientific and Technical Conference “Robotics and Mechatronics.”
- Member of the General Assembly of the Bulgarian Academy of Sciences and member of the Credentials Committee of the General Assembly of BAS.
- Considerable administrative and organizational experience in the preparation, coordination, management, and reporting of scientific projects, as well as in the organization of scientific events and international cooperation.
- Experience in establishing and managing scientific teams, allocating research activities, and effectively managing scientific resources.

4. Main Scientific and Applied Scientific Contributions

Assoc. Prof. Nina Valchkova, PhD, claims the following scientific, applied scientific, and practical contributions and creative achievements:

4.1. APPLIED SCIENTIFIC CONTRIBUTIONS in the Monograph

- Systematic analysis and classification of collaborative robots in medicine;

- Formulation of an integrated model of a mobile collaborative service robot;
- Development of a methodology for the selection and synthesis of a mobile collaborative robot;
- An approach to optimizing the structure of the mobile platform;
- Kinematic and dynamic modelling of a manipulation system with enhanced manipulability;
- A methodology for optimizing the parameters of the manipulation system;
- Design of a sensor-information system for cognitive medical robots;
- Development of a model and methods for the control of a mobile collaborative service robot;
- Experimental and simulation-based validation of the proposed models and methodologies;
- A concept for the integration of collaborative robots into modern field medical facilities.

4.2. *SCIENTIFIC CONTRIBUTIONS in the Articles Submitted for the Competition*

- 4.2.1. An original methodology for the systematic design of mobile collaborative robots for medical, social, and industrial applications has been developed. Nos. 1, 2, 5, 6, 7, 15, and 17.
- 4.2.2. An original scientific concept and methodology for the systematic design of autonomous mobile collaborative robots have been developed. Nos. 2, 3, 4, 6, 8, 9, and 10.
- 4.2.3. Original mathematical models for the parametric synthesis and optimization of mobile robotic platforms have been developed. Nos. 1, 2, 3, 9, 10, 12, and 16.
- 4.2.4. Original models and algorithms for the intelligent control of autonomous mobile collaborative robots have been developed. Nos. 2, 3, 6, 8, 10, and 13.
- 4.2.5. Original models for multisensory perception and sensor fusion in mobile robotic systems have been developed. Nos. 2, 3, 5, 6, 8, 10, 14, and 15.
- 4.2.6. Scientific models for the intelligent management of the energy subsystems of autonomous mobile robots, based on hybrid energy sources and hydrogen technologies, have been developed. Nos. 1, 2, 7, 9, 12, and 15.
- 4.2.7. Scientific models for autonomous medical robotic systems and intelligent field medical stations have been developed. Nos. 1, 2, 5, 6, 7, 11, and 15.
- 4.2.8. Scientific foundations have been developed for the design of highly mobile robots capable of operating in unstructured and high-risk environments. Nos. 2, 3, 6, 10, 13, 15, and 16.
- 4.2.9. The scientific foundations of metrological assurance, experimental verification, and digital modelling of mobile robotic systems have been further developed. Nos. 2, 9, 10, and 16.

4.3. APPLIED SCIENTIFIC CONTRIBUTIONS in the Articles Submitted for the Competition

- 4.3.1. An engineering methodology for the integrated design of mobile collaborative robotic systems has been developed. Nos. 2, 4, 9, 10, and 16.
- 4.3.2. Engineering criteria for the selection of mobile platforms have been developed. Nos. 2, 6, 9, and 10.
- 4.3.3. An engineering methodology for the selection and integration of sensor systems has been developed. Nos. 1, 2, 3, 9, and 14.
- 4.3.4. Algorithms for the intelligent control of mobile robots have been developed. Nos. 1, 3, 6, 8, 9, 10, and 14.
- 4.3.5. Engineering models for energy flow management have been developed. Nos. 4, 7, 9, and 12.
- 4.3.6. Engineering solutions for autonomous medical stations have been developed. Nos. 1, 2, 5, 6, 7, 11, 16, and 17.
- 4.3.7. Engineering solutions for highly mobile robots capable of operating in difficult terrain have been developed. Nos. 2, 3, 6, 10, 13, and 15.
- 4.3.8. Engineering models for digital twins have been developed. Nos. 2, 9, and 10.
- 4.3.9. Engineering methodologies for experimental evaluation have been developed. Nos. 2, 4, 7, 9, and 10.
- 4.3.10. Engineering solutions for the integration of robotic systems into medical practice have been developed. Nos. 1, 2, 5, 6, 7, 11, 15, 16, and 17.

4.4. PRACTICAL CONTRIBUTIONS in the Articles Submitted for the Competition

- 4.4.1. Mobile collaborative robotic platforms for medical, social, and specialized applications have been developed and experimentally validated. Nos. 1, 2, 3, 6, 7, 10, 13, and 15.
- 4.4.2. Experimental systems for multisensory perception and autonomous navigation have been implemented. Nos. 2, 3, 6, 14, and 15.
- 4.4.3. Intelligent control systems for mobile robots have been implemented. Nos. 1, 3, 5, 6, and 15.
- 4.4.4. Hybrid energy systems incorporating hydrogen fuel cells have been implemented. Nos. 4, 7, 9, and 12.
- 4.4.5. Experimental models of autonomous field medical stations have been implemented. Nos. 1, 2, 5, 6, and 15.
- 4.4.6. Highly mobile robots capable of operating in difficult terrain have been implemented for specialized operations. Nos. 1, 2, 3, 6, 9, 13, 15, and 16.
- 4.4.7. Digital models and virtual experimental environments for robotic systems have been developed. Nos. 1, 2, 3, 6, 9, 10, and 16.
- 4.4.8. The scientific results obtained have been implemented in research and educational activities. Nos. 1, 2, 3, 8, 16, and 17.

I accept, in substance, the content of the contributions presented above. I recommend that they be further refined and consolidated. In my opinion, their number is sufficient for the academic position of “Professor.” The scientific contributions presented encompass the systematic design, parametric synthesis, intelligent control, multisensory perception, energy supply, medical applications, high-mobility platforms, and metrological assurance of mobile robotic systems. Together, they form an interconnected line of research aimed at the development of autonomous and collaborative robots characterized by a high degree of safety, reliability, and energy efficiency. I would, however, like to draw attention to the inclusion of the same publication (No. 2) in almost every contribution. It is cited in all of the scientific contributions, in eight of the applied scientific contributions, and in six of the practical contributions. A similar pattern, although to a lesser extent, can also be observed with regard to the remaining articles.

5. To What Extent Are the Submitted Scientific Works and Their Contributions the Candidate’s Own Work?

Of the eighteen scientific works submitted for the present competition, four are single-authored (the monograph and publications Nos. 9, 10, and 11); in nine publications, the candidate is the first author (Nos. 1, 2, 3, 4, 6, 7, 8, 13, and 15); in two, she is the corresponding author (Nos. 5 and 12); and in three, she is a co-author (Nos. 14, 16, and 17). All of the above provides sufficient grounds for me to conclude that the submitted scientific works and the contributions contained therein are attributable to the candidate’s personal scientific work. The requirements of the National Centre for Information and Documentation (NACID) concerning compliance with the minimum national requirements under Article 2b, paragraphs 2 and 3, and the corresponding requirements under Article 2b, paragraph 5, of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), as specified in the Regulations for the Implementation of the Act (PPZRASRB), have been fulfilled for the academic position of “Professor” in Professional Field 5.1. Mechanical Engineering, scientific specialty “Robots and Manipulators.”

6. Critical Remarks and Recommendations

I have not identified any significant shortcomings in the candidate’s scientific works and have no objections regarding the submitted materials. I recommend that, when formulating the scientific contributions in future research, a more comprehensive, topic-oriented approach be adopted, bringing together the candidate’s various research developments within broader thematic areas. I encourage Assoc. Prof. Valchkova, PhD, to continue her active participation in research projects with the aim of securing additional funding for research in the scientific fields pursued by the Institute of

Robotics – BAS. I also encourage her to actively share her scientific experience and expertise with her doctoral students and colleagues at the Institute.

7. Personal Impressions and Opinion of the Reviewer

I know Assoc. Prof. Nina Foteva Valchkova, PhD, in her capacity as Chair of the General Assembly of Scientists at the Institute of Robotics – BAS, member of the General Assembly of the Bulgarian Academy of Sciences, and Head of the “Robotics and Mechatronic Intelligent Systems” Section. My impression of her is that she is a competent, energetic, and well-organized researcher and administrator. I believe that she possesses the necessary qualities as a scientist, specialist, and leader. Upon the successful completion of this competition, the Institute of Robotics “St. Apostle and Evangelist Matthew” at the Bulgarian Academy of Sciences – Sofia will gain a highly capable and well-qualified specialist, researcher, and organizer. I have not conducted any joint scientific research or co-authored any publications with Assoc. Prof. Nina Valchkova, PhD, Eng. I am not aware of any information or claims by third parties concerning authorship, scientific contributions, research results, or any other form of intellectual property relating to the materials submitted for this competition.

CONCLUSION

My overall assessment of the scientific works submitted by the candidate for the present competition is positive. The submitted monograph, seventeen scientific publications, two patent applications, two utility model applications, the scientific contributions, the candidate’s research, applied and organizational activities, as well as the wide dissemination of the research results at national and international levels, provide sufficient grounds for me to confidently and unequivocally recommend that Assoc. Prof. Nina Foteva Valchkova, PhD, Eng., be appointed to the academic position of “Professor” in Scientific Area 5. Technical Sciences, Professional Field 5.1. Mechanical Engineering, scientific specialty “Robots and Manipulators”, on the topic “Metrology of Mobile Robots – Methods, Models, Evaluation and Optimization of Mobile Collaborative Service Robots”, in the Robotics and Mechatronic Intelligent Systems (RaMIS) Section, for the needs of the Institute of Robotics “St. Apostle and Evangelist Matthew” at the Bulgarian Academy of Sciences.

Date: 18 September 2026

Signature:

/Avgust Ivanov, professor, PhD/