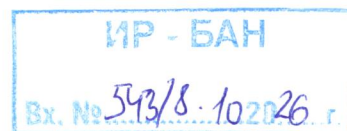


REVIEW



for a competition for the academic position of “Professor”
Field of Higher Education 5. Technical Sciences,
Professional Field 5.1. Mechanical Engineering,
Scientific Specialty “Robots and Manipulators”,
announced in the State Gazette, Issue No. 51 of 05 June 2026
Candidate: Assoc. Prof. Dr. Eng. Nina Foteva Valchkova

Reviewer: Prof. DSc Eng. Ivo Malakov,
Department of Automation of Discrete Production, Technical University of Sofia

1. General Information and Biographical Data

The announcement of the competition was published in the State Gazette, Issue No. 51 of 05 June 2026, for the needs of the “Robotic and Mechatronic Intelligent Systems (RMIS)” Department at the Institute of Robotics – Bulgarian Academy of Sciences (BAS). Only one candidate submitted documents for the announced competition – Assoc. Prof. Dr. Eng. Nina Foteva Valchkova.

Assoc. Prof. Dr. Eng. Nina Foteva Valchkova obtained a Master’s degree in 1983 in “Manufacturing Engineering and Metal-Cutting Machines” at Angel Kanchev University of Ruse. In 2013, she defended her doctoral dissertation in the scientific specialty “Robots and Manipulators” at the Institute of Systems Engineering and Robotics – BAS. She began her professional career in 1983 at the Research Institute of Robotics – Stara Zagora as a design engineer, and from 1987 she was a Research Associate, Grade III, at the same institute. Since 1989, the candidate has worked in various units of the Bulgarian Academy of Sciences and has extensive professional and research experience in robotics, mechatronics, instrumentation, and intelligent systems. Assoc. Prof. Valchkova also has substantial administrative and organizational experience: she performs management functions in the RMIS Department, participates in various bodies of BAS as a member of the General Assembly and the Mandate Committee of BAS, and supervises research projects and doctoral students. Since 18 March 2018, she has held the academic position of Associate Professor at the Institute of Robotics – BAS.

2. General Description of the Submitted Materials and Assessment of Compliance with the Minimum National Requirements

The submitted set of documents complies with the list of documents required under the procedure for awarding the academic position of “Professor”, pursuant to the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Internal Rules for the Development of the Academic Staff of BAS, and the Institute of Robotics at BAS. It contains the materials necessary for evaluating the candidate’s academic and scientific development: curriculum vitae; documents certifying the acquired educational and scientific degree “Doctor” and the academic position “Associate Professor”; lists of publications; habilitation monograph; summaries of the works; a statement of the original

scientific, scientific-applied, and applied contributions; a list of citations; scientometric reports; and tables demonstrating compliance with the minimum national requirements.

The scientific output is thematically related to the announced competition. The main areas are mobile and collaborative robotics, service robots for healthcare, intelligent control and sensor fusion, high-mobility mobile platforms, energy systems with hydrogen fuel cells, autonomous field medical stations, and metrological assessment and verification of robotic systems.

For participation in the competition, Assoc. Prof. Valchkova has submitted 18 scientific works, of which:

- one sole-authored monograph under Indicator C3, "Habilitation work – monograph": Valchkova, N. "Metrology of Mobile Robots in Healthcare. Methods, Models, Assessment and Optimization of Mobile Collaborative Service Robots", Sofia, Prof. Marin Drinov Publishing House of the Bulgarian Academy of Sciences, 2026, ISBN 978-619-245-613-9;
- 7 scientific publications under Indicator D7, "Scientific publication in outlets that are referenced and indexed in internationally recognized scientific information databases";
- 10 scientific publications under Indicator D8, "Scientific publication in non-referenced peer-reviewed journals or in edited collective volumes";

Of the total 18 scientific works, 4 are sole-authored; in 9 the candidate is the first author; and in 5 she is the second co-author. In the absence of contribution-allocation protocols, I assess the contributions of the co-authors in the joint publications as equal.

The publications do not duplicate articles or conference papers used in the procedures for the educational and scientific degree "Doctor" or for the academic positions of "Chief Assistant Professor" and "Associate Professor".

A list of citations of the scientific publications submitted for the competition has been provided. I do not accept citations in a dissertation, as they do not meet the requirements of the ADASRB and the Rules for its Implementation.

The candidate has also submitted a report on her research and applied activities.

A summary of the minimum national requirements by groups of indicators for the academic position of "Professor" in Field 5. Technical Sciences, Professional Field 5.1 Mechanical Engineering, together with the supporting evidence submitted by the candidate, is presented in the table below:

Group of indicators	Minimum national requirements	Points declared by the candidate by group of indicators	Excess over minimum
A	50	50	0
Б	-	-	-
B	100	100	0
Г	200	225,33	25,33
Д	100	151	51
Е	150	234,53	84,53

Analysis of the data in the last column of the table shows that the minimum requirements of the ADASRB, the Rules for its Implementation, as well as the Internal Rules for the Development of the Academic Staff of BAS and the Institute of Robotics at BAS for holding the academic position of "Professor" have been exceeded in all groups of indicators.

3. General Characteristics of the Candidate's Research and Scientific-Applied Activities

In these areas, the candidate's activity is active and successful. She works across a broad range of thematic fields, and the scientific works in these areas may be systematized as follows:

I. Medical and Social Robotics

The publications "Hybrid Intelligent Systems in Medicine – Automated Medical Station" and "Feasibility of the Cyber-Physical Nurse" develop concepts for robotic support of medical services. The former integrates a mobile collaborative service robot into an automated medical station, while the latter examines the possibility of broader application of a cyber-physical "nurse", including aspects of patient interaction. This area also includes developments concerning the implementation of collaborative robots in field medical stations and in pedagogical rehabilitation and special education.

II. Mobile Platforms, Dynamics, and High Mobility

"Parametric Analysis of a Collaborative Robotic Mobile Platform for Healthcare Application" analyzes velocities, accelerations, lateral motion, deceleration, and stopping with the aim of optimizing control. The publication "An Approach to Developing an Optimal Model of the Mobile Platform of a Collaborative Robot" proposes a methodology for selecting a drive system according to stability, maneuverability, energy efficiency, and intended application. The developments related to Roby 1 demonstrate the application of a tracked platform with a triangular track configuration for movement in unstructured environments and for overcoming obstacles and stairs.

III. Intelligent Control, Sensor Systems, and Sensor Fusion

The publication on intelligent control and sensor fusion for a tracked mobile collaborative robot develops an architecture based on a heterogeneous operational sensor system for robots, ROS, and a specialized graphical interface. The work "Sensory System for Controlling Robot's Motion" proposes a simulation model of a differential-drive robot, a methodology for calculating the distance travelled, and a Dead Reckoning algorithm. These results support the research line in autonomous navigation and safe interaction.

IV. Energy Systems and Green Hydrogen

A significant place is occupied by publications on hydrogen fuel-cell power supply. The work "Methodology for Optimizing the Parameters of a Collaborative Service Robot Powered by a Hydrogen Fuel Cell" combines a mobile platform, a seven-degree-of-freedom manipulator, sensor fusion, and a hybrid architecture with a PEM fuel cell (PEMFC – Proton Exchange Membrane Fuel Cell), and examines WBC (Whole-Body Control) and an EMS (Energy Management System) with multi-criteria optimization. Comparative studies of power-supply types analyze autonomy, environmental performance, and the applicability of hydrogen systems in medical environments.

V. Autonomous Field Medical Stations

The publication "Optimization of the Energy Subsystem in the Construction of Modern Field Medical Stations" proposes a modular framework combining renewable energy sources, telemedicine, and robotic subsystems. The work on implementing collaborative robots in field medical stations complements the concept with robotic logistics and operation under crisis conditions. These works connect robotics, energy autonomy, and medical infrastructure.

VI. Manipulation Systems and Kinematic Sensitivity

The publication "Analysis of the Kinematic Sensitivity of a Gripper in Robotics" examines the influence of small changes in geometric parameters, joint coordinates, contact points, and manufacturing inaccuracies on the position, orientation, and force behavior of the gripping mechanism, including the relationship with singularities, underactuation, and compliance.

VII. Ethical and Social Aspects

In this area, the research focuses on ethical aspects of implementing collaborative robots in the education of disadvantaged people. This broadens the engineering profile through analysis of the impact on learners, social workers, and psychologists, and raises questions concerning the regulation of human–robot interaction.

I assess the research and scientific-applied work of Assoc. Prof. Dr. Nina Valchkova as corresponding to the level required for the academic position sought, on the following grounds:

- The candidate has submitted for participation in the competition the sole-authored monograph "Metrology of Mobile Robots in Healthcare. Methods, Models, Assessment and Optimization of Mobile Collaborative Service Robots", Sofia, Prof. Marin Drinov Publishing House of the Bulgarian Academy of Sciences, 2026, ISBN 978-619-245-613-9. The work was reviewed by Academician Chavdar Rumenin and Prof. Siya Lozanova.

The monograph constitutes a comprehensive study of the design, modelling, control, sensor and energy provision, and metrological assessment of mobile collaborative service robots for medical applications. Its structure logically traces the transition from analysis of collaborative robots and their medical tasks to the selection and optimization of the mobile platform, modelling, Whole-Body Control, sensor systems, energy subsystems, and integration into automated field medical stations.

An essential quality of the work is its systems approach. The robot is considered as an integrated cyber-physical system in which the mechanical design, kinematics and dynamics, sensor system, control algorithms, energy provision, and human interaction are mutually interdependent. The metrological aspect is developed through procedures for measurement, assessment, testing, and experimental verification of functional characteristics.

The monograph concludes with the application of the methods discussed to modern field medical stations, followed by clearly identified contributions and a conclusion. Thus, the principal habilitation work directly corresponds to the topic of the competition and integrates a significant part of the candidate's research activity following her habilitation.

- Seventeen scientific works have been submitted, of which 7 are published in outlets referenced and indexed in internationally recognized scientific information databases. A

large part of the results in these works stems from the candidate's work on research projects and from her long-standing implementation activities in problem areas relevant to science and industry. To solve the tasks set and achieve the corresponding objectives, she uses a broad range of established contemporary tools and methods.

The scientific works of Assoc. Prof. Dr. Nina Valchkova are known and valued within the scientific community. Evidence of this is the number of citations in the internationally recognized Scopus database – 12 (excluding self-citations), while the candidate's h-index is 2.

- Project activity is a strong aspect of the candidate's academic profile. The submitted materials document participation in national projects, leadership of a national project, and leadership of a project under the Recovery and Resilience Facility. Particularly directly related to the topic of the competition are Project KP-06-H57/8 "Methodology for Determining the Functional Parameters of a Mobile Collaborative Service Robot Assistant in Healthcare" and BG-RRP-2.017-0011-C02 "Eco-Friendly Collaborative Robots Powered by Green Hydrogen".

As a result of active research and applied work at the Institute of Robotics – BAS, significant financial resources have been attracted. According to the submitted report, the funds attracted under the two projects led by the candidate amount respectively to BGN 152,000 and BGN 420,647.85. This is a significant indicator of the candidate's ability to formulate competitive research tasks, organize teams, and secure resources for experimental research work.

- The candidate is a co-author of applications for 2 patents and 2 utility models.
- The supervision of a doctoral student who successfully defended a dissertation, as well as work with other doctoral students and young researchers, demonstrates participation in the training of scientific personnel and in ensuring continuity in the field of mobile and collaborative robotics.

5. Main Scientific and Scientific-Applied Contributions

The scientific works submitted by the candidate for participation in the competition contain a number of scientific, scientific-applied, and applied contributions. The main ones are:

- Scientific contributions: a systems methodology for the design of mobile collaborative robots has been developed and tested; additionally, a methodology for developing models for parametric synthesis and optimization; approaches to intelligent control and multisensory perception; a methodology for energy provision and management of energy flows; and a methodology for metrological assurance and experimental verification have been developed.

- Scientific-applied contributions: engineering methodologies for integrated design and criteria for selecting wheeled, tracked, omnidirectional, and hybrid platforms have been proposed; procedures for the selection and integration of LiDAR, RGB/Depth cameras, an inertial measurement unit (IMU), GPS sensors, encoders, and ultrasonic sensors; algorithms for autonomous movement and safe interaction; models for managing battery, fuel-cell, and hybrid energy systems; and solutions for autonomous medical stations and high-mobility robots.

- Applied contributions: experimentally implemented mobile collaborative platforms; multisensor systems for localization and navigation; intelligent control systems; hybrid energy systems with hydrogen fuel cells; models of autonomous field medical stations; high-mobility robots for medical, rescue, and specialized operations; digital models; and virtual experimental environments.

The contributions may be assigned to the groups concerning the demonstration, by new means, of significant new aspects of existing scientific fields, problems, theories, and hypotheses; the creation of new classifications, methods, designs, and technologies; and the obtaining of confirmatory facts.

6. Significance of the Contributions to Science and Practice

I consider that the scientific and scientific-applied contributions contained in the candidate's works are current and significant for the development and enrichment of research in the thematic areas in which she works. They correspond to the professional field and the scientific specialty "Robots and Manipulators" for which the competition for Professor has been announced. The submitted works are also relevant to practice and possess the necessary degree of applicability. The results may find application in areas of high societal importance – healthcare, social robotics, specialized operations, and sustainable energy technologies.

7. Critical Remarks and Recommendations

I have no substantial remarks or recommendations regarding the materials submitted by the candidate for participation in the competition. My main remark concerns the submitted statement of contributions. The claimed contributions are highly differentiated. They need to be systematized, edited, and summarized. In addition, some publications contain repetitions of text and figures and uncorrected technical errors.

I recommend that Assoc. Prof. Valchkova concentrate her research activity in a smaller number of thematic areas and intensify her work with doctoral students.

8. Personal Impressions and Opinion of the Reviewer

On the basis of the scientific output submitted for participation in the present competition and my many years of personal impressions of the candidate's research, scientific-applied, and organizational activities, I consider her to be a highly qualified and erudite scientist, demanding in her own work, who enjoys well-deserved authority among specialists in Bulgaria and abroad. I positively assess her responsibility, capacity for work, and ability both to work in a team and to solve research tasks independently.

CONCLUSION

Based on my review of the materials submitted for the competition, the relevance and significance of the scientific, scientific-applied, and applied contributions achieved, my positive assessments of the candidate's research, scientific-applied, and organizational activities, and compliance with the requirements of the ADASRB, the Rules for its Implementation, and the Internal Rules for the Development of the Academic Staff of BAS and the Institute of Robotics at

BAS, I recommend that the Scientific Jury propose to the Scientific Council of the Institute of Robotics at BAS that Assoc. Prof. Dr. Eng. Nina Foteva Valchkova be appointed to the academic position of "Professor" in Professional Field 5.1 Mechanical Engineering, specialty "Robots and Manipulators".

Date: 02 October 2026

REVIEWER:.....

(Prof. DSc Eng. I. Malakov)