



REVIEW

for a competition for the academic position of "**Associated Professor**" in the field of higher education 5. Technical Sciences; Professional field 5.1. "Mechanical Engineering", scientific specialty "Robots and Manipulators" (Electronic control and power systems in service robotics), announced in "State Gazette", No. 61/29.07.2025, for the needs of the "RiMIS" section with candidate **Dr. Yassen Kirov Paunski**.

Reviewer: Academician Chavdar Roumenin, member of the scientific jury, according to Order No. 81/ 30.09.2025 of the Director of the Institute of Robotics at Bulgarian Academy of Sciences

The candidate in the competition for the academic position "Associate Professor" Dr. Yassen Paunski has submitted all materials required by the Law as an application to the Director of the Institute; CV; copies of the diploma for the educational and scientific degree "doctor", lists of scientific works in specialized scientific publications; separate copies of the scientific publications and of the summaries for participation in the competition; author's reference for citations of his works; author's reference for scientific and scientific-applied contributions; reference for participation in scientific and educational projects; reference for compliance of the candidate's materials with the minimum requirements for candidates for the academic position "Associated Professor", etc.

1. Antechamber and in general phenomenology of materials

In the competition, only one candidate, Dr. Yassen Paunski, submitted regular documents within the legal deadline. Since 2017, he has been an employee of the Institute of Robotics at Bulgarian Academy of Sciences as an assistant and chief assistant. In 2018, Y. Paunski defended his PhD thesis in the thematic area of electronic systems in robotics. His professional competencies are in the scope of robotics, mechatronics and physical foundations of sensors, electronic and microelectronic devices, and programming. 23 scientific papers registered in global

and national databases were submitted for review for the competition . All of them are outside his dissertation works . For me, his monographic work is also significant, Y. Paunski "Power and Actuator Systems for Mobile Robots", Robotic Publishing, 2025, ISBN: 978-619-93266-1-9 . The contributions and results achieved by Dr. Paunski in the publications are a result of his participation in scientific topics and research projects of IR-BAS. I will especially note his participation in two National Centers of Competence of IR-BAS. According to the candidate's statement of compliance of the materials with the minimum national requirements for the academic position "Associated Professor", it is clearly seen that Dr. Paunski covers the required number of points for the relevant indicators.

His creative efforts encompass the fastest growing scientific and technological field - robotics. The application of robots in biology, education and medicine are some of the most modern sub-areas of this strategic area. Despite the record number of publications on this topic, patents for inventions, record funding from companies and state structures, there are still questions that have not been sufficiently resolved. This is where the scientific and applied results of Dr. Y. Paunski are located. For example, despite the obvious need, assistance for people with specific needs at this stage is unsatisfactory. The candidate has correctly oriented himself in the need to improve and upgrade electronic components and systems in robotic complexes with elements of artificial intelligence. For me, the candidate's monography, which concentrates his most significant achievements and results, is of key importance. I will note right away that this scientific book in itself is completely sufficient for Dr. Paunski to participate in the competition for "Associated Professor". I will dwell on it separately, since it is a reservoir of numerous ideas and solutions for specialized electronics and robotics.

2. About the monography

The development of modern technologies, regardless of their specificity, necessarily leads to robotic systems with elements of artificial intelligence. According to recent statistics from the world - famous journal "Science" , publications related to robotics have increased more than 15 times in recent years. The trend of applied and protected patents for inventions in this important strategic area is no less similar. In Bulgaria, about 30% of patents are directly related to

robotic platforms and sensors. Despite the relevance and key role of this intensively developing direction, I would like to note that there is no integrated information that would adequately guide designers, scientists, engineers to enter the innovative field of robotics in a short time. In this aspect, the monograph "Power and actuator systems for mobile robots" represents a comprehensive, detailed and systematic scientific study. It analyzes, evaluates and suggests improvements in the field of power and drive systems for mobile service robots. The high level of this work is the result mostly of the original solutions achieved by Paunski .

The objectives and scope of the research are clearly and consistently defined, which supports the formulated and well-structured approach to the problems considered. The main goal of the book is to optimize and increase the reliability and autonomy of power supply and drive systems in mobile robots. Both existing technologies and the possibilities for their improvement and upgrading have been carefully analyzed. An important merit of the candidate is the correctly posed unresolved questions, and they are not one or two, but practically cover robotics and sensorics in their entirety. The monograph substantiates the importance of robotics, placing it in the context of the broader field of knowledge and automation of processes, including those with elements of artificial intelligence. The most important thing for me is that the original achievements achieved in the National Laboratory of Robotics and Artificial Intelligence at the Institute of Robotics at the Bulgarian Academy of Sciences, carried out by the team with the key participation of Dr. Paunski, are presented. The knowledge presented on service robots substantiates in detail the different types of mobility, operating environments and levels of autonomy. Different energy sources such as lithium-ion batteries, fuel cells, supercapacitors and energy harvesting technologies are presented, as well as industry standards and charging interfaces. Currently, there is no relevant research and summary of solutions and future trends on this topic. In the field of propulsion, wheeled, walking and hybrid locomotion systems are described in detail, with an emphasis on control strategies for different types of motors. It also contains a comparative analysis of real robots such as Pepper, Spot and Care-O-bot 4, which allows for a practical comparison of different methodological approaches. Practical cases and methods for overcoming real-world technical challenges are included . Y. Paunski competently guides the reader to emerging technologies and innovations

that shape the future of mobile robotics. Original approaches for autonomous energy management and self-configuring propulsion platforms are examined. At the same time, future trends, challenges, and breakthroughs in this rapidly developing field of knowledge are identified and predicted .

The monograph makes a significant contribution to both theoretical knowledge in the field of mobile robots and to the practical application of scientific research. This makes it a valuable resource for specialists, researchers, and students . I appreciate this work as an event in the academic community.

3. Characteristic results of the candidate's innovation activity

The candidate's results from the presented scientific papers are in the field of collaborative systems, medical robotics and sensorics. They also include service activities in healthcare, education, user interfaces, voice commands, etc. with application in hospitals. Y. Paunski's contribution to the design and testing of service robots for security and maintaining security in the work environment, as well as for medical purposes, is significant. In managing the energy systems of mobile service robots, I consider the duration of operation and especially energy efficiency to be particularly important.

A number of Dr. Y. Paunski's articles examine green hydrogen technologies in service robots operating in field conditions when there is no mains power supply. Within the framework of a won PVU project, a collaborative robot powered by a hydrogen fuel cell was implemented, which is particularly useful in healthcare and in serving people with special needs. Another area of contribution in Paunsky's work is publications on digital accessibility tools for learners - sensory support and application of various types of conversion systems, devices and components. The candidate has achieved beneficial results in mobile battery-powered service robots for the purposes of the social ecosystem. The problem of powering service robots in pilot mode at high power supplies is also discussed. An original hybrid energy system has been developed that combines a hydrogen fuel cell with a lithium-ion battery. A sensor architecture is used to distribute the energy flow between the fuel cell and the battery. All of this builds on the operational capacity of service robots in unstructured environments.

Dr. Y. Paunski, together with colleagues from the National Laboratory of Robotics and Artificial Intelligence, offers an application for the created educational service robots Bebot and Maxibot for the purposes of STEM education and social pedagogy. The robots created are modular and open-access, which makes them flexible in configuration and allows for upgrading and adaptation in diverse environments.

In co-authorship, the candidate proposed the implementation of innovative approaches for constructing intelligent robotic systems that improve the mobility of people with specific needs, such as the AnRI system - an anthropomorphic robot with artificial intelligence. Other innovations, in which Paunski is a participant, are related to the creation of the transport and logistics robot "Spartakus", optimizing reliable movement of loads up to the unconventional 100 kg. This innovation was presented at the fifth edition of the National Forum "Science for Business" - 2025 and made an exceptional impression on the visitors. 7 citations of the candidate's publications were noted.

4. Main scientific and applied scientific contributions

I will present my point of view on the contributions and results contained in the works of Dr. Y. Paunski. I accept the contributions and results formulated by the candidate in the publications submitted for the competition. In a certain aspect, my assessments differ from his interpretation.

4.1. Scientific contributions

1. A new educational specialty in robotics has been implemented. Y. Paunski is a key implementer of the educational standard (DOS), as well as the curriculum, syllabus and examination program for the country's first specialty "Robot Programmer". This contribution has important didactic significance, as it is an achievement in the digitalization of the national education system and helps train specialists, of whom we now have a dire need - engineers, programmers, computer specialists, competent to develop and program robotic systems. Such a specialty already exists in some schools in the USA and Japan.

2. A platform for controlling mobile service robots with low latency using mobile and wireless (Wi-Fi) networks has been developed. This ensures effective

operation in remote and hard-to-reach areas and in unstructured environments. For this purpose, the latest generation networks (4G and 5G) and high-speed wireless Internet have been used. An approach for metrology of the speed and latency of the communication channel has been implemented. In my opinion, this is one of the most innovative results of the candidate .

4.2 Scientific and applied contributions

3. An integrated system for managing and charging lithium-ion batteries in mobile service robots has been developed. The platform includes two blocks: the first is for battery management (BMS), and the second is an intelligent charging block with a USB-C input. This architecture ensures reliable operation of the battery in different modes. Through a standardized communication interface, a system has been developed that allows real-time monitoring of the robot's energy consumption.

4. A power supply system for service robots based on hydrogen fuel cells has been implemented. This original solution is a strategy in robotics that ensures reliable energy supply. The use of green hydrogen as a carrier allows robots to be environmentally friendly, autonomous, and to function for a long period of time. These results are a bridge between robotics and energy technologies.

5. A series of service robots for education and social pedagogy has been designed and implemented. They are formed through a modular architecture with open access, which allows the construction of control systems with multi-purpose purposes. The robots have a built-in interface and provide versatility in applications.

6. The logistics robot "Spartak" has been designed and implemented, featuring an innovative architecture and high adaptability. The development has four-wheel drive (4WD) with hub motors, which increases energy efficiency and reliability when used on various surfaces. This robot is based on the ROS system. I will allow myself to repeat - the load capacity is impressive, which is up to 100 kg .

7. A scientific instrument has been created and verified – a tribometer for measuring extremely small friction forces (of the order of mN) between moving surfaces. The development allows for the study of the parameters of contact lenses and moisturizing gels used in ophthalmology.

8. A control system for an original elbow prosthesis has been developed, based on electromyographic (EMG) signals from the active muscles of the hand. A signal filtration algorithm has been created, which increases the noise immunity and reliability of the prosthesis' functioning. I highly appreciate the fact that the elbow prosthesis is prepared for patenting, given the innovative solutions obtained.

In general, I define the candidate's contributions as formulating and substantiating new scientific concepts, proving with new means significantly new aspects in the field of robotics and sensorics, creating original methods and constructions for the purposes of real and virtual education, with numerous confirming facts also available.

5. Reviewer's final assessment

Dr. Y. Paunski has a deep knowledge of the complex and multi-profile interdisciplinary field of service robotics, and its sensorics and electronic circuitry. I repeat, for me his monographic work is of key role. I declare that I have no joint publications with the candidate, nor any financial relationships. I am not aware of any incorrect attitude towards intellectual property.

I recommend that Dr. Paunski formulate and submit the innovative solutions contained in his creative patrimony as patent applications for inventions to the national patent office.

6. FINAL CONCLUSION

Based on the above, the contributions and results achieved, I take the liberty to propose to the Scientific Jury to make a positive decision on the election of Dr. Yassen Kirov Paunski as "Associated Professor" , and to propose to the esteemed Scientific Council of the Institute of Robotics that he be elected to occupy the academic position of "Associated Professor" in the professional field 5.1. Mechanical Engineering (Electronic Control and Power Systems in Service Robotics) in the "RiMIS" department, NLRAI laboratory of the Institute of Robotics at the Bulgarian Academy of Sciences.

Sofia

25.10.2025

Reviewer:


Chavdar Roumenin