



## OPINION

on 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" department with a candidate **Dr. Yassen Kirov Paunski**

**Reviewer:** Prof. Dr. Siya Lozanova, member of the scientific jury, according to Order No. 81/ 30.09.2025 of the Director of the Institute of Robotics-BAS

### 1. Introductory words

Dr. Yassen Paunski is the only candidate in the announced competition for the "Associated Professor" academic position and has submitted all the required documents within the statutory deadline. According to the candidate's statement of compliance of the materials with the minimum national requirements for the academic position of " Associated Professor ", it is clearly seen that Dr. Paunski covers the required number of points under the relevant groups of criteria. 23 scientific papers , registered in global and Bulgarian databases, were submitted for the peer-review competition. All of them are original and are outside the dissertation works . A monographic work is presented - Y. Paunski "Power and actuator systems for mobile robots", Robotic Publ, 2025. The achieved contributions and results of Dr. Paunski in the publications are from his work in research tasks and projects of IR-BAS. I will especially note his participation in two National Centers of competence in IR-BAS. His professional competencies cover the most intensively developing scientific and technological field of robotics. The application of robotic systems in biology, medicine and education are some of the current areas of this strategic area. A key emphasis in the scientific and applied results of Dr. Y. Paunski is the assistance through robotic devices to people with specific needs. The candidate has competently oriented himself in the need to upgrade electronic components and elements for the purposes of service work. Of particular importance for the competition is the monographic work of Dr. Paunski, which contains his most important achievements and results. I will note that this scientific book in itself is completely sufficient for Dr. Paunski's participation in the competition for "Associated Professor". I will dwell on it separately, since it contains many original ideas and solutions for sensors, electronics and robotics.



## 2. On the monography

The monograph "Power and Actuator Systems for Mobile Robots" is a comprehensive, detailed and systematic scientific study. It analyzes, evaluates and proposes improvements in the field of power and drive systems for mobile robots. The high professional level of this work is the result of the contributions achieved by Dr. Y. Paunski. The book is 130 pages long and contains an extensive bibliography of 80 sources, which contributes to the authority and scientific depth of the presented material. The goals and scope of the study are clearly and consistently defined, and the issues are formulated from a unified point of view. The main goal of the book is to optimize and increase the reliability and autonomy of power 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 issues, and they are not one or two, but practically cover the entire field of robotics and sensorics. 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 analyzed, as well as industry standards and charging interfaces. For now, there is no relevant research and summary of solutions and future trends on this topic. In the field of propulsion, wheeled, walking and hybrid movement systems are described in detail. It also contains a comparative analysis of the well-known robots Pepper, Spot and Care-O-bot 4. Original approaches for autonomous energy management and self-configuring propulsion platforms are considered. At the same time, future trends, challenges and breakthroughs in this rapidly developing field of knowledge are identified and predicted. In fact, the monographic work collects all innovative ideas, solutions, contributions created by the candidate. In this aspect, it is completely sufficient for his creative status in the competition.

Of particular importance in the contributions of Dr. Y. Paunski are green hydrogen technologies with applicability in service robots operating in field conditions when there is no mains power supply. Within the framework of a won project under the PVU, a collaborative robot powered by a hydrogen fuel cell was implemented, useful in healthcare and in serving people with specific needs. Another area of contributions in Paunski's work is the means of digital accessibility for students - sensory support and application of various types of sensor systems, devices and components. I also appreciate the implementation of mobile service robots with battery power for medical purposes as an important contribution. An original hybrid energy system has been developed that combines a hydrogen fuel cell with a lithium-ion battery. All this upgrades the operational capacity of service robots in unstructured environments. Y. Paunski has developed, together with colleagues from the National Laboratory of Robotics and Artificial Intelligence, the 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 with possibilities for upgrading and adaptation in diverse environments.

### **3. Main scientific and applied scientific contributions**

I will present my version of the contributions and results in the works of Dr. Y. Paunski. The format in which he presented them is correct and objectively reflects what the candidate has done.

#### **3.1. Scientific contributions and results**

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 first specialty in the country "Robot Programmer". This contribution has important didactic significance, as it supports 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.

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 strongest results of the candidate.

#### **3.2 Scientific - applied contributions and results**

3. An integrated system for managing and charging lithium-ion batteries in service robots has been developed. The platform includes two control units: the first is for the battery (BMS), and the second is an intelligent charging unit with a USB-C input. This configuration ensures reliable operation of the battery in different modes. A platform has been developed through a communication interface, allowing real-time monitoring of the robot's energy consumption.

4. 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 and are multi-purpose. The robots have a built-in interface and provide versatility in applications.

5. A power supply system for service robots based on hydrogen fuel cells has been designed and verified. This innovative solution is key in robotics, ensuring 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.

6. The logistics robot "Spartakus" has been designed and implemented, distinguished by its original architecture and high adaptability. The development has four-wheel drive (4WD), which increases energy efficiency and reliability on various surfaces. This robot is based on the ROS system. The load capacity is impressive, which is up to 100 kg. This development was presented at the fifth edition of the National Forum "Science for Business" – 2025 and made a strong impression on the visitors.

7. A tribometer for measuring extremely small friction forces (of the order of mN) between moving surfaces has been created and tested. The development allows for the study of the parameters of contact lenses and moisturizing gels used in ophthalmology. In this medical context, the original development of an elbow prosthesis based on electromyographic (EMG) signals from active arm muscles is in progress. A signal filtration algorithm has been created that increases the noise immunity and reliability of the prosthesis' functioning.

7 citations of the candidate's publications were noted.

In general, I define the contributions of Y. Paunski as the formulation and substantiation of new scientific ideas, the proof of significantly new aspects in the field of robotics and control with new means, the creation of original methods and constructions for educational purposes, and there are also numerous confirming facts.

#### **4. Some recommendations**

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 works as patent applications for inventions to the national patent office.

#### **FINAL CONCLUSION**

**Based on the above, the contributions and results achieved, I propose to the Scientific Jury to make a positive decision on the election of Dr. Yassen Kirov Paunski as "Associated Professor", and to recommend to the 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, NLRAl laboratory of the Institute of Robotics at the Bulgarian Academy of Sciences.**

Sofia

04.11.2025

Reviewer:



Prof. Dr. Siya Lozanova