



OPINION

on the competition for the academic position of "Associate Professor" in professional field 5.2. Electrical Engineering, Electronics, and Automation, scientific specialty "Automated Information Processing and Control Systems (Integration of data from sensor networks)," for the needs of the Laboratory "Unmanned Robotic Systems" at IR-BAS – Sofia, announced in the State Gazette No. 85 dated October 10, 2023.

with a sole candidate: Assist. prof. Dr. Eng. **Alexander Kirilov Alexandrov**

Member of the scientific jury: **Prof. Dr. Siya Lozanova**, IR-BAS

1. Thematic Focus and Materials for the Competition

The distinctive feature of the scientific research activities of Dr. Eng. A. Alexandrov is determined by his professional involvement in the field of wireless sensor networks and systems. This scientific-technological direction is particularly promising with the development of artificial intelligence. The transmission of reality-appropriate information and the related architectures, algorithms, and protocols are key components in robotic platforms. The candidate's broad scientific style stands out and is confirmed in a significant part of his research activities, which align with the trends in sensor development, both hardware and software. Such comprehensive solutions form the basis of automation, control, and unmanned aerial vehicles. An important trend in the development of these studies is decision-making under conditions of uncertainty in data from the environment, especially assessing risk situations in safeguarding critical infrastructure. A crucial assumption is that wireless sensor networks are currently one of the important technologies in robotics and mechatronics.

To participate in the competition for the academic position of "Associate Professor," A. Alexandrov has submitted an independent monographic work on the topic "Wireless Sensor Systems. Architecture and Communication Protocols," with a volume of 258 pages, published in 2023, along with 7 separate research papers. They are mainly published in journals with Impact Factor and fall into Q3 and Q4 quartiles. According to officially presented documents by co-authors in these publications, the candidate's creative contribution to intellectual property distribution is 88%. My interpretation of this fact is that practically independent studies have been presented. Therefore, the number of 7 papers is sufficient for the "Associate Professor" competition. Attached is a list of 6 citations from his

publications, primarily in authoritative scientific journals, mostly from Springer. The competition participant holds the educational and scientific degree of "Doctor" in the field of sensor networks and systems. On the other hand, my check, according to the requirements of the ZRSRB, shows that Dr. A. Alexandrov meets the criteria for participating in the competition. From independent sources, I also found that he has participated in projects, but relevant documents are missing. Therefore, I am unable to assess this activity. However, in its entirety, the materials presented by the candidate are sufficient in quality and thematic focus for participation in the "Associate Professor" competition.

2. Basic Scientific and Applied Contributions, Significance

I have summarized the more substantial and structurally defining results and contributions of Alexandrov's activity in the following way:

2.1. A model for parallel information processing from sensor nodes has been formulated and developed, relying on generalized sensor networks. This approach describes the integration of data from sensor elements prepared for extensive operations. Additionally, an architecture and methodology for multi-criteria optimization have been developed. Based on these, energy-efficient communications can be implemented between sensor configurations and corresponding cluster heads in wireless sensor networks.

2.2. An original adaptive method for managing a wireless sensor node through machine learning, modeled on a multilayer perceptron, has been proposed. This new approach generates solutions that optimize resource usage and extend the functioning of wireless sensor modules with a local energy source.

2.3. A new QoS-based technology for energy optimization of the Zig-Bee communication protocol has been proposed. The original algorithm uses a combination of upgraded link quality indicators (LQI) and parameters for received signal strength as critical parameters. Experimental studies have been conducted for transmitting data from a wireless sensor module.

2.4. A new hybrid method to enhance the accuracy in positioning mobile devices with Bluetooth Low Energy (BLE) has been developed. It is based on an optimized combination of algorithms that consider the strength of the received digital signal. The results are based on an extended Kalman filter and the Fraser-Potter equation. Additionally, an algorithm has been developed that reinforces machine learning to optimize the power management process during data transmission. This extends the battery in wireless sensor modules.

The achieved scientific and applied results of Dr. A. Alexandrov generally involve formulating and justifying scientific problems in existing fields and

theories. This forms a promising range of scientific-practical models, algorithms, and architectures in Big Data systems. The contributions and results contained in his monographic work are also significant, similar to those in the presented publications. Also important for the IT sector is the proposed approach and algorithm for dynamically changing synchronization intervals in wireless sensor networks. Specifically, the significance of the achieved contributions to practice lies in the improvement and enhancement of wireless sensor networks and systems applicable to unmanned robotic devices.

3. Critical Notes, Recommendations, and Others

My main remark concerning Dr. A. Alexandrov is related to the deviation from the commonly accepted format of his documents. His CV lacks information about his date of birth, which should be sought somewhere in the diplomas. Additionally, information about his monographic work, which is crucial for the competition, appears somewhat buried in other details. It should have been highlighted, as it provides the background for the requirements of the National Agency for Evaluation and Accreditation (NAEA). As a recommendation, I would suggest that, part of the results, specifically 2.3, related to experimental verification, could be redefined as a useful model.

I declare that I have no joint publications with the candidate, no financial relationships with him, or other aspects that could be a subject of conflict of interest.

CONCLUSION

Based on the presented works, their scientific content, and originality, I believe that the candidate meets the high requirements typical for the Institute of Robotics at the Bulgarian Academy of Sciences (IR-BAS) for the position of "Associate Professor." As a result of the above, I recommend to the Honorable Scientific Jury that **Assist. prof. Dr. Eng. Alexander Kirilov Alexandrov be appointed to the academic position of "Associate Professor" in the professional field 5.2. Electrical Engineering, Electronics, and Automation, scientific specialty "Automated Information Processing and Control Systems (integration of data from sensor networks)" for the needs of IR-BAS.**

05.02.2024
Sofia

Prof. Dr. Siya Lozanova