



OPINION

in 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 the Institute of Robotics - Bulgarian Academy of Sciences, announced in the State Gazette No. 85 dated October 10, 2023.

with candidate: Assist. prof. Dr. Eng. Alexander Kirilov Alexandrov

Member of the scientific jury: Acad. Chavdar Roumenin, IR-BAS

Introduction

In the competition for the Associate Professor position, the only candidate, Assist. prof. Dr. A.K. Alexandrov, submitted documents within the legal deadline. The modest volume of materials he presented includes a monographic work titled "Wireless Sensor Systems. Architecture and Communication Protocols" with a volume of 258 pages, published in 2023, and 7 other scientific works. They are published in reputable journals and fall within Q3 and Q4 quartiles. The candidate's entire scientific production is related to wireless sensor networks and falls within the scope of the announced competition. A list of a total of 6 citations of Dr. A. Alexandrov's works in other publications with the heritage of the global publisher Springer is attached.

Wireless sensor networks are a fundamental component in modern communication technologies. With the development of sensing, micro, and nanosensing, an important element of its application in robotics, mechatronics, and artificial intelligence systems is the transmission and reception of big data about the environment, whether real or virtual. Despite the achieved successes, the characteristics of the primary transducers of non-electric information are insufficiently resolved. If there is an upper limit for parameters such as sensitivity, temperature stability, dynamic range of the respective non-electric influences, etc., that are recorded, the signal transmission speed is currently unlimited. Future development lies in the methodology, protocols, models, and algorithms for the control and management of wireless sensor systems. Integrating sensor data using specific algorithms is a key factor for the speed and reliability of

information. Dr. A. Alexandrov's research focuses on these and other aspects of wireless technology, covering modern communication technologies, with some of them related to quantum communication and data encryption.

Scientific-applied results and contributions of the candidate

I generally assess the contributions and results of A. Alexandrov as scientific-applied. My perspective is primarily dictated by the real possibilities of applicability under certain conditions of the obtained information. I will briefly touch upon A. Alexandrov's monographic work and then discuss the presented publications.

I. "Wireless Sensor Systems. Architecture and Communication Protocols" summarizes existing materials on the topic up to the moment but also includes original results obtained by the author. Similar literature in this context is lacking in our country, making the monograph valuable for AI and IT specialists. The issues from the theory and experiment of wireless sensor networks are covered. The basic software and hardware platforms, configurations, and network characteristics of sensor systems are professionally described. Limitations in the functioning of wireless networks are correctly analyzed. The author's results essentially build upon this issue through new software technologies in the aspect of intelligent sensor networks. An important contribution of the author is the development of communication protocols that enhance the performance of wireless sensor systems. Useful for the community is Alexandrov's proposed new method and algorithm for clustering sensor nodes based on the quality indicators of the connection. I will only note that high-precision synchronization is one of the most challenging problems in microelectronics. Further emphasis can be placed on the author's new results in the monograph, but what has been presented so far demonstrates its usefulness. Despite some incorrect assessments and descriptive data about sensors as building elements and their sensor parameters, the significance of this important research by the author is not diminished. This logically complete work, contributes to the development of communication technologies, including applicability, especially in the case of quantum twisted photons as carriers of encrypted information. In my opinion, the monograph has the qualities of a reference guide, making it useful for a broad professional audience.

II. I have summarized the more substantial results and contributions of the candidate in the presented publications as follows:

1. A novel approach based on the algorithm for weighted clustering for ad-hoc assessment of parameters in wireless sensor networks is proposed. The merging of data from primary transducers of non-electric information is described through a methodology for multicriteria optimization.

2. A Quality of Service (QoS)-based technology to optimize the Zig Bee communication protocol in terms of energy efficiency is developed. Preliminary experimental studies were conducted for data transmission from wireless sensor modules. This is considered the strongest contribution of the candidate, especially due to confirmatory results through laboratory verification.

3. A model for parallel data processing from sensor nodes based on wireless sensor networks was formulated and developed. Data integration from sensor elements prepared for extensive operations was achieved. An architecture and model for multicriteria optimization were implemented, enabling energy-efficient communications between sensor configurations and corresponding cluster heads in wireless sensor networks.

4. An original approach was proposed to enhance machine learning for optimizing the power management process during data transmission. This significantly extends the resource life of autonomous energy sources in wireless sensor modules.

I am impressed by the fact that in Alexandrov's analyses, the commonly made mistake of incorrect use of the concept of sensor information is not allowed. For clarity, the paradigm is sufficient: do radio waves or laser quantum energy packages carry sensor information, as they also contain electronic data? Electronic information includes current, voltage, frequency, and quanta, and lately, gravity has been added to these carriers. The informational signal is determined by their modulation.

Critical Notes, Recommendations:

Despite the commendable scientific-applied contributions and results of Dr. A. Alexandrov, I cannot overlook the unsatisfactory preparation of his documents. The absence of inclusion of the projects in which he participated and the lack of a suitable summary of the monograph, which is crucial in this competition, are notable shortcomings. Other similar omissions are found in his materials. Nevertheless, the achievements are at a high level.

I recommend that Dr. A. Alexandrov translates the monograph in English in the format of a reference guide and seeks a Western publisher, such as Elsevier. This would be beneficial for both him and the Institute of Robotics - Bulgarian Academy of Sciences.

I have no shared publications, financial, or other relationships with the candidate in this competition.

General Conclusion

Based on the above, I propose to the esteemed scientific jury that **Assist. prof. Dr. Eng. Alexander Kirilov Alexandrov** be appointed to 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 Institute of Robotics - Bulgarian Academy of Sciences.

01.02.2024
Sofia

Chavdar Roumenin