# OPINION

by Prof. Dr. Vladimir Monov

member of the Scientific Jury according to Order No. 328-1/06.12.2023

of the Director of the Institute of Information and Communication Technologies - BAS

**ABOUT**

dissertation work for obtaining the educational and scientific degree **"doctor"**

Author of the dissertation: **Eng. Krasimir Georgiev Markov**

Dissertation topic: **"Intelligent methods for study and implementation of hardware solutions"**

Field of higher education: **5. "Technical sciences"**

Professional direction: **5.3. "Communication and computer technology"**

Doctoral program: **"Computer systems, complexes and networks"**

Scientific supervisor: **Cor. Member of BAS Lyubka Atanasova Ďukovska**

**General characteristics of the dissertation work**

The dissertation has a volume of 133 pages and consists of an Introduction, 3 chapters, Conclusion-summary of the obtained results, Appendices and Bibliography. The list of bibliographic sources contains 108 titles, including sources from Bulgarian and foreign authors, as well as Internet sites. The list of publications on the topic of the dissertation consists of 6 publications. Six scientific-applied and applied results of the dissertation are formulated. Directions for future research are indicated. A Declaration of originality of the obtained results and a Certificate of fulfillment of the minimum requirements of IICT for the acquisition of the educational and scientific degree "doctor" are attached.

The abstract has a volume of 37 pages in Bulgarian and English and it essentially reflects the goals set, the results obtained and the contributions of the dissertation work.

**Relevance of the problem developed in the dissertation in scientific and scientific-applied terms.**

The dissertation work is dedicated to the problems related to the design and development of technical tools for distributed systems for wireless collection, transmission and management of data

and information flows. Modern systems of this type are distinguished by the increasingly widespread introduction and use of new communication technologies, intelligent methods and artificial intelligence for the purpose of efficient information processing, high-speed data exchange and expansion of the system's scope. The need for the development and practical application of new technological solutions in this field undoubtedly determines the current nature of the dissertation research and the usefulness of the obtained results in a scientific and scientific-applied sense.

**Degree of knowledge of the state of the problem and creative interpretation of literature material**

In Chapter 1 of the dissertation, a literature review and in-depth analysis of radio frequency identification methods is made as a basic technological approach for automatic identification of objects and wireless data communication in distributed systems. The principles of operation, frequency ranges and hardware components of radio frequency identification systems are discussed in detail. Chapter 2 explores and analyzes the possibilities for integrating intelligent methods and using artificial neural networks. A methodology has been developed for radio frequency identification using a neural network in a system for wireless collection and management of information flows. The overview material of the dissertation shows an in-depth knowledge of the matter and current problems in the field, as well as the possible approaches to their solution.

**Correspondence of the chosen research methodology and the set goal with the achieved results**

The main goal of the dissertation is to investigate and implement hardware solutions based on intelligent methods for collecting, processing and managing information. For this purpose, an innovative approach was appropriately chosen and used, integrating the technology of radio frequency identification with the capabilities of artificial neural networks to increase the reliability and efficiency of wireless communication. The methodology of the conducted research includes frequency analysis, time analysis, modulation and filtering of signals, use of technical methods of noise suppression by filtering. Experimental studies and simulations have been carried out in the MATLAB environment, as well as tests in working conditions of the developed hardware components. The obtained results show that the doctoral student has successfully used the chosen research apparatus to achieve the goals of the dissertation and obtain new results with a scientific-applied and practical contribution.

**Dissertation Contributions**

Essentially, the contributions of the dissertation work are of a scientific-applied nature and can be summarized as follows.

- A wireless communication approach integrating radio frequency identification technology and artificial neural network apparatus in distributed systems is proposed. The connections and interactions between them have been established in order to increase the intelligence and functionality of the system.
- A distributed system architecture has been developed in accordance with the NFC (Near Frequency Communication) standard for wireless collection, transfer and management of data at close distances.
- A method for signal amplitude modulation and demodulation in wireless communication systems has been developed using an artificial neural network of the type of multilayer perceptron.
- Original hardware components for collecting, processing and managing information flows have been implemented and tested in working conditions:
    - o Payment terminal for processing payments with bank cards and electronic payment methods;
    - o Contactless smart card reading device.

**Assessment of the PhD student's publications and personal contributions**

Six publications on the dissertation are presented, of which five are self-authored and one is co-authored. All publications are in English, issued in the period 2020-2023. No data on observed citations are presented. Dissertation publications reflect the essential parts and main results of the conducted research. By their nature and volume, they satisfy and exceed the normative requirements for acquiring the educational and scientific degree "doctor". With the published works, the results of the dissertation have become available to the scientific community in the subject under consideration.

Acquaintance with the dissertation and the publications on the dissertation topic gives me grounds to consider that the dissertation work and the contributions to it are the personal work of the doctoral student. I am not aware of any plagiarism.

**Opinion, recommendations and remarks**

In general, the dissertation work is distinguished by a thorough analysis of the problems stated, as well as the use of an appropriate research approach and technical tools for their solution. As a result, original scientific and applied results and useful practical solutions have been proposed in the field of systems for wireless collection, transfer and management of data and information flows. The obtained results fully correspond to the set goal and tasks of the dissertation work.

I have no substantive critical comments on the dissertation and the presented results. Of an editorial nature, I have the following remark.

The contributions of the dissertation work are not sufficiently precisely formulated. In the texts describing the contributions, with the exception of contribution 6, the analysis and research carried out are mainly indicated without specific results. In these texts, the emphasis should be mainly on the obtained results as a consequence of the research and their contribution to the solution of the considered problems.

This remark reflects a technical omission and does not address the value of the results in the dissertation. My recommendation to the PhD student is to continue his scientific research work and find a wider practical application of the hardware devices that he has developed.

**CONCLUSION**

I positively assess the work done and the results obtained in the dissertation. The dissertation meets all the requirements of the Law for development of the academic staff in the Republic of Bulgaria, the Regulations for its implementation, as well as the specific conditions for acquiring scientific degrees and occupying academic positions at the Institute of Information and Communication Technologies. I strongly suggest to the respected Scientific Jury to give Eng. Krasimir Georgiev Markov the educational and scientific degree "doctor" in the Field of higher education 5. "Technical sciences", Professional direction 5.3. "Communication and computer technology".

Sofia,
29.01.2024