

## REVIEW

of the dissertation work for awarding the educational and scientific degree "doctor"

Professional Field 5.3 "Communication and Computer Technic"

Scientific specialty "Communication networks and systems"

Author of the dissertation: Krasimir Zhivkov Terziev

Topic: "Modern satellite communication systems and innovative methods for increasing their efficiency"

Scientific supervisor: Prof. Dr. Dimitar Karastoyanov

Reviewer: Prof. Dr. Rumen Ivanov Trifonov, TU - Sofia

Reason: Order No. 25/29.01.2024 of the Director of IICT-BAS

The presented dissertation has a volume of 171 pages, structured in an Introduction, 4 chapters, contributions, Topics for future work, a list of publications on the topic, and used literature. There are 7 publications on the subject of the dissertation. The list of used literature contains 100 titles of literature and Internet sources.

### **1. Relevance of the problem developed in the dissertation**

The dissertation concerns the design of the ground antenna part of a satellite communication system. The measurements of the parameters of the designed system are presented in the dissertation. The development in the dissertation work is the basis for the implementation of specialized communication elements of a satellite communications system using LEO satellites (Low Earth Orbit) - satellites in a low orbit.

The contribution of the dissertation work is expressed in the design, construction and evaluation of the parameters of the antenna system. The presented measurements, analyses, and comparisons of the designed and developed system show that it has better technological parameters than the existing systems. This ensures higher quality and increases the reliability of communication links.

I positively assess the thematic focus of the dissertation - designing a real technical system and evaluating its functional qualities. The research in the dissertation has a scientific and applied nature. The topicality of the developed topic is indisputable. The obtained results give grounds for a positive assessment of the candidate's qualifications.

### **2. Degree of knowledge of the state of the problem and creative interpretation of the literary material**

The dissertation work aims to design a ground subsystem for satellite communications for low-orbit satellites. The object of the study is the ground part of a satellite communication system.

The solved tasks in the dissertation work are:

Overview and analysis of the development of satellite communication systems and their main technological components.

Design of the technological infrastructure of a ground station for low-orbit satellites and assessment of technological parameters of the designed ground station.

Developments from the dissertation have been practically implemented in a built ground station for satellite communications.

Chapter 1 provides an analytical overview of satellite telecommunication systems. After a historical overview and application areas, the development of satellite technologies and the introduction of low-earth orbit networks are described

Chapter 2 examines Issues in the Design and Operation of Satellite Communication Systems. An analysis of the structure and technical problems to be solved in communication systems for low-orbit satellites is made.

Chapter 3 is devoted to the Design of the Antenna Part of a Low Earth Orbit Satellite Communication System. Target technological parameters are defined and a minimum set of technical elements is selected.

In Chapter 4, an evaluation and comparison of the technological parameters of the designed ground station is made. The obtained results are compared with available antenna systems to prove that better technological properties and characteristics of the designed and developed antenna system have been achieved.

### **3. Correspondence of the chosen research methodology and the set goal and tasks of the dissertation with the contributions achieved**

The PhD candidate demonstrates a good knowledge of the structure, organization, and functioning of satellite communications systems for low-orbit satellites. This is the result of a completed design and development process for the ground part of a technological antenna subsystem.

I positively assess the candidate's qualifications for the field of design, development, and testing of technical parameters of an essential technical part of low-orbit satellite communication systems. The results demonstrate the achieved high professional training of the doctoral student in the field of designing systems for satellite communications.

### **4. Scientific and/or scientific-applied contributions of the dissertation work**

Research and development in the dissertation work is not limited to design, but also to the construction of an essential part of such a system, in this case, the terrestrial antenna subsystem. Measurement, analysis, and comparison of the technological parameters of the development and evaluation by comparison with existing solutions have been made.

I positively assess the results of the doctoral student's research. I accept the declared contributions as sufficient for dissertation work. They can be grouped like this:

An analytical overview of satellite communications is made and the technological functions that must be performed by ground stations are defined.



A satellite communications ground station for low-orbit satellites has been designed and an antenna system for the ground station has been developed.

The antenna part has been evaluated through experiments, achieving higher technological parameters than an existing prototype and its use in a real satellite communication system.

Results of the dissertation work have been applied in the implementation and development of a project for an antenna system "OS-LEO 1" in frequency band S, intended for communication with satellite platforms in low earth orbit.

The PhD student can independently carry out research activities, and develop and build complex systems.

I accept that the results achieved are mainly the personal work of the candidate.

#### **5. Assessment of compliance with the minimum national requirements and with the additional requirements under Point. 1a, par. 2 of the Regulations for Implementation of the Law on the Development of the Academic Staff in Bulgaria,**

I evaluate the presented publications as corresponding to the topic and content of the dissertation work. 7 publications are presented. One of the publications was presented as a report at an International Conference Abroad (ICECCME) and indexed in SCOPUS. One publication was made in a Journal in our country (Problems of Engineering Cybernetics and Robotics). The remaining 5 publications were presented at scientific conferences in our country (International Scientific and Technical Conference Automation of Discrete Production (ADP), International Conference ROBOTICS, AUTOMATION AND MECHATRONICS - (RAM). There are also 2 more accepted publications at the RAM Conference.

The presented publications fulfill the requirements for the defense of the educational and scientific degree "doctor". I appreciate that the presented publications give a positive certificate for the PhD student for the obtained results.

According to the Regulation for the fulfillment of the minimum national requirements for receiving the ESD "Doctor" in professional direction 5.3. "Communication networks and systems" requires the presence of at least 30 points under Indicator Group G. The presented publications satisfy this requirement: scientific publications in refereed journals with scientific review or in edited collective volumes" - more than 93 points, and there is also a refereed publication in SCOPUS. Two of the dissertation publications are independent.

The reviewer did not find any plagiarism in the dissertation.

#### **6. Evaluation of the compliance of the auto-abstract with the dissertation**

The abstract in terms of form and content meets the requirements and presents the complete and accurate content of the dissertation.

#### **7. Significance of the research and applied contributions of the dissertation work**

Doctoral student Krasimir Terziev demonstrates skills and knowledge for analysis and evaluation of technical parameters of subsystems that have a place in the composition of

ground stations for satellite communication. They are aimed at finding solutions to increase the technological parameters of an antenna subsystem. The practical usefulness of the research consists of the construction of an antenna subsystem, and the technical characteristics have been studied and measured. Practical use of the developed antenna subsystem is declared.

I believe that the dissertation research is useful and has led to potentially pragmatic results such as finding solutions to increase the technical parameters of the ground communication part of a satellite communication system.

## 8. Recommendations and critical remarks

I positively evaluate my presented dissertation work. It is evident from its content that the doctoral student has conducted independent research work.

I have no comments regarding the content of the dissertation work.

As a recommendation, I believe that the doctoral student should present more of his results at international conferences and in refereed scientific journals.

I believe that the doctoral student Krasimir Zhivkov Terziev shows experience and qualifications for conducting independent research in the field of design and development of elements of a ground system for satellite communication.

## CONCLUSION

I positively evaluate the scientific-applied and applied contributions made in the dissertation work of Krasimir Zhivkov Terziev. I believe that the requirements of the Law on the Development of the Academic Staff in Bulgaria and the Regulations for its implementation, as well as the specific requirements of IICT-BAS, are fulfilled in the presented dissertation work. This gives me the reason to give a positive assessment of the presented dissertation work and to recommend to the Scientific Jury to award Krasimir Zhivkov Terziev **the educational and scientific degree "doctor"** in professional field 5.3 "Communication and computer technic", scientific specialty "Communication networks and systems"

14.02.2024

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