REVIEW

by Dr. Eng. Borislav Hristov Milenkov - associate professor at the University of Food Technology

(date of birth, first name, last name, last name - academic major at the university or scientific organization)

of dissertation for award ofeducational and scientificdoctorate degree

by: field of higher education 5. Technical sciences;

professional direction: 5.3. Communication and computer technology;

doctoral program: "Automation of fields from the non-material sphere (medicine, education, science, administrative activity, etc.).

Author: Phys. Engineer Svetoslav Genchev Hadjigenchev

Topic: "Geoelectric Resistivity Telemetry System in Seismogenic Zones"

Supervisor: Associate Professor, Dr. Eng. Slavi Yasenov Lyubomirov

(academic degree, bachelor's degree, first name, last name, last name - university or scientific organization)

1. General description of the presented materials

By order No. PD-21-123 dated 19.01.2024 of the Rector of Plovdiv University "Paisiy Hilendarski" (PU), I have been appointed as a member of the scientific jury to ensure a procedure for the defense of a dissertation on the topic: "System for telemetry of geoelectrical resistance in seismogenic zones" for the acquisition of the educational and scientific degree "doctor" in the field of higher education: 5. Technical sciences; professional direction 5.3. Communication and computer technology;doctoral program"Automation of areas from the non-material sphere (medicine, education, science, administrative activity, etc.)". The author of the dissertation work is Phys. Eng. Svetoslav Genchev Hadjigenchev - PhD student in full-time training at the "EKIT" department with scientific supervisor Assoc. d- Dr. Slavi Yasenov Lyubomirov from PU "Paisiy Hilendarski" - Plovdiv.

The set of paper materials presented by the doctoral student Svetoslav Hadzhigenchev is in accordance with Article 36 (1) of the Rules for the Development of the Academic Staff of the PU, includes the following documents:

– request to the Rector of the PU to disclose the procedure for the defense of a dissertation work;

- CV in European format;
- transcript-excerpt from the Minutes of the Departmental Council at the EKIT department (PU), No. 58 of 15.12.2023, item 1 Preliminary discussion of the dissertation work of Svetoslav Genchev Hadjigenchev;
- dissertation work;
- abstract in Bulgarian and in English in a volume of 32 pages;
- list of scientific publications on the subject of the dissertation - 5 items;
- copies of scientific publications;
- declaration of originality and authenticity of the attached documents;

The doctoral student has attached 5 publications on the topic of the dissertation. Of these, 4 (four) are independent and one is co-authored with the supervisor.

I accept all the attached papers because I think they fully cover the PhD student's research work in developing the topic.

2. Brief biographical data of the PhD student

The Ph.D. student in Phys. Eng. Svetoslav Hadjigenchev was enrolled by order No. P33-572/04.02.2020 of the Rector of "Pisii Hilendarski" PU. The training period is set from 01.03.2020 to 01.03.2023.

At a departmental council held on 15.11.2023, after hearing the doctoral student, the public defense procedure was initiated.

3. Actuality of the topic and appropriateness of the set goals and tasks

Modern systems for telemetry of geoelectrical resistance in seismogenic zones provide new opportunities to expand the volume and informativeness of the received data and achieve a higher level in the knowledge of earthquake preparation processes.

Considering that Bulgaria is located in a region affected by earthquakes of different magnitudes, it is extremely important to predict an upcoming earthquake. In his dissertation, the doctoral student pointed out that strong earthquakes (with magnitude > 5) are rarer, but at the same time more destructive.

4. Knowing the problem

In the literature review, the PhD student reviewed the state of the art in earthquake prediction research and explored existing technologies and modern methods in recording geoelectrical resistivity changes in earthquake preparedness.

From the literature review, I come to the conclusion that the doctoral student is well acquainted with the various studies done over the years on the problem. Various studies conducted in five countries of the world, such as the Eurasian Plate, Japan and the USA, are reviewed. The cited literary sources and the achieved results are proof of the good knowledge of the problem and its solution.

5. Research methodology

The Ph.D. student in Phys. Eng. Svetoslav Hadjigenchev approaches methodically correctly in conducting his research. The chosen research methodology allows achieving the set goal and obtaining an adequate answer to the tasks solved in the dissertation work. An apparatus was designed to measure variations in geoelectrical resistance. A simulation study of the receive line voltage amplifier at different amplitudes of interfering signals and at different values of the input filter capacitor was performed in the Multisim environment. The frequency response of the amplifier path is simulated.

The nature of the disturbing signals is determined. Their amplitudes were evaluated, relative to the amplitude of the useful signal at the specific geometry of the installation and power of the current source in the supply line. A separate module for measuring meteorological parameters has been designed. The apparatus for measuring the variations of the geoelectrical resistance is realized following the latest innovative achievements of receiving, processing, transmission and registration of sensor data.

In the first chapter of the dissertation, a study of the accumulated experience in registering changes in geoelectrical resistance in connection with the preparation of earthquakes is presented.

In the second chapter of the dissertation, an apparatus for measuring the variations of the geoelectrical resistance is designed.

The nature of the disturbing signals is determined. Their amplitudes were evaluated, relative to the amplitude of the useful signal at the specific geometry of the installation and power of the current source in the supply line.

The third chapter of the dissertation describes the hardware implementation of the apparatus for measuring variations in geoelectrical resistance and measuring meteorological parameters, and shows the first results of its work. The data obtained from the registration of the geoelectrical resistance and meteorological parameters for an eight-month period are shown together with the recorded earthquakes with a magnitude greater than 2.5 and epicentral distances up to 100 km from the installation. A cross-correlation was performed with temperature and precipitation. The influence of

drying on the contact resistance of the electrodes, and from there on the magnitude of the operating current and the measured geoelectrical resistance, was investigated. The equipment is installed in the land of the village of Dunevo, region Smolyan

In the fourth chapter of the dissertation, two possible options for the implementation of the transmission, storage and visualization of the data received from the equipment for measuring the geoelectrical resistance are considered.

Appropriate modules were selected and programmed to transfer the data from the field part of the equipment to a Thingspeak channel – a cloud platform with the possibility of storing, processing and visualizing the received data.

6. Characterization and evaluation of the dissertation work

The dissertation is structured in an introduction and four chapters, each ending with a conclusion. At the end of the dissertation (p. 141) a summary of all conclusions is made.

The dissertation has proposed guidelines for future research in the area of the problem under consideration.

The attached bibliography contains 70 sources, of which only 5 are not in English. There are also two sections to the used literature - "Used information sheets" - 20 each, and "Used Internet resources" - 16 items.

The dissertation ends with 5 appendices.

4 scientific-applied and equally applied contributions are presented.

At the beginning of the dissertation work, a table with the used abbreviations is displayed, which allows an easier understanding of the specific terms and designations used.

7. Contributions and significance of the development for science and practice

The reviewer has no objections to the claims made by the doctoral student about the contributions. I accept the contributions of the dissertation as scientific-applied and applied.

Scientific and applied are:

1. The existing methods, techniques and means in the field of recording the changes in the geoelectrical resistance in connection with the preparation of earthquakes have been studied and systematized.

2. An analysis of the possible sources of noise, the ways of their reduction and the results of the observations of variations of the apparent resistance in the process of preparing for earthquakes was made.

3. The anomaly registered by the author when measuring the apparent resistance in the area of the town of Strazhitsa, after the destructive earthquake of 07.12.1986, is shown and analyzed.

4. The effect of drying on the contact resistance of the electrodes was investigated, resp. of the operating current value and the measured geoelectrical resistance.

The applicable ones are:

1. Equipment for measuring the variations of geoelectrical resistance and meteorological parameters has been implemented.

2. Modules for calibration and verification of the equipment for measuring variations of the geoelectrical resistance have been implemented. An estimate of the error of the measurements was made.

3. Data obtained from the geoelectrical resistivity register and meteorological parameters for an eight-month period are presented, together with recorded earthquakes of magnitude greater than 2.5 on the Richter scale and epicentral distances up to 100 km.

4. The software enables registration, transmission, processing, storage and visualization of the received sensor data in a cloud platform.

8. Evaluation of publications on the dissertation work

The Ph.D. student in Phys. Eng. Svetoslav Hadzhigenchev has presented five publications on the dissertation work, of which 4 (four) are independent and one is co-authored with the scientific supervisor. The publications reflect the essence of the work and a large degree of independence of the author. The article, co-authored with the scientific supervisor, was published in a collection of reports from the National Scientific Conference with International Participation "Education, Science, Society", University Publishing House "Paisii Hilendarski".

Two of the articles were published in Scientific works of the Union of Scientists in Bulgaria - Smolyan. The remaining articles were published in Scientific works of the Union of Scientists in Bulgaria - Plovdiv.

They reflect the research in the dissertation work and coincide with it in terms of subject matter. This shows that the results of the dissertation research have become available to the scientific community.

9. Personal participation of the doctoral student

From the dissertation submitted for review and the publications attached to it, it is clear that the doctoral student independently designed and implemented hardware for measuring the variations of geoelectrical resistance and meteorological parameters. He wrote a program in the MATLAB environ-

ment to process the data from the station and visualize it in real time. This shows that the dissertation student acquired during his studies the skills to independently solve scientific and practically oriented tasks.

10. Abstract

The abstract submitted for review (in Bulgarian and English languages) is 32 pages long, fully and accurately reflecting the main results described in the dissertation itself. The review of the abstract of the dissertation shows full compliance with the requirements for its preparation, as well as the adequacy of reflecting the main points and contributions of the dissertation.

11. Critical remarks and recommendations

The work would only benefit if, in some places, more detailed explanations were given for the determination of some parameters, for specific conditions of conducting the experiments and reasons for the selection of the elements in the proposed schematic solutions.

The remarks made in no way belittle the research activity carried out in a significant volume, but can only be considered as recommendations, especially for the future scientific activity of the doctoral student.

12. Personal impressions

I do not personally know the doctoral student in physics. Eng. Svetoslav Hadjigenchev, but I positively assess the results of his developments, included in the scientific publications, as well as the accumulated knowledge and experience.

I don't have any posts in common with him and I'm not a related person, within the meaning of the law.

13. Recommendations for future use of dissertation contributions and results

I have the following notes on the evaluated materials presented in the competition, which do not diminish the significance of the results obtained, but can rather be considered as recommendations for the future creative activity of the physicist. Eng. Svetoslav Hadjigenchev.

I recommend that more scientific publications be made in reputable journals with an impact factor or rank.

CONCLUSION

The dissertation contains scientific-applied and applied results, which represent an original contribution to science and meet the requirements of the Law on the Development of the Academic

Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of ZRASRB and the relevant Regulations of PU "Paisiy Hilendarski" ".

The dissertation shows that the Ph.D. student in Phys. Eng. Svetoslav Hadjigenchev has in-depth theoretical knowledge and professional skills in the scientific specialty "Automation of fields from the intangible sphere (medicine, education, science, administrative activity, etc.)" by demonstrating qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my positive assessment of the conducted research, presented by the above-reviewed dissertation work, abstract, achieved results and contributions, and I propose to the honorable scientific jury to award the educational and scientific degree "doctor" to Phys. Eng. Svetoslav Hadzhigenchev in the field of higher education: 5. Technical sciences, professional direction 5.3. Communication and computer technology, doctoral program "Automation of fields from the intangible sphere (medicine, education, science, administrative activity, etc.)

15/02/2024 Reviewer: .....

(Assoc. Dr. Eng. Borislav Milenkov)