

REVIEW

by **Sotir Ivanov Sotirov PhD - Associate Professor at the University of Plovdiv "Paisii Hilendarski"**

of a dissertation for awarding the educational and scientific degree "**Doctor**"

by: field of higher education. 5 Technical Sciences,
professional field. 5.2 Electrical Engineering, Electronics and Automation, PhD program
"Electronization (by branches and groups of scientific specialties)"

Author: *Eng. Angel Hristov Chekichev*

Topic: **"REMOTE LABORATORY OF ELECTRONIC MEASURING EQUIPMENT"**

Supervisor: **Prof. Eng. Rumen Kostadinov Popov, PhD**

1. General description of the materials presented

By Order No PD-22-1398 of 16-07-2026 of the Rector of the University of Plovdiv "Paisii Hilendarski" (Plovdiv) I am appointed as a member of the scientific jury for providing a procedure for defending a dissertation on the topic

"REMOTE LABORATORY OF ELECTRONIC MEASURING EQUIPMENT"

for the acquisition of the educational and scientific degree "Doctor" in: field of higher education 5 Technical Sciences, professional field 5.2 Electrical Engineering, Electronics and Automation, PhD program "Electronization (by branches and groups of scientific specialties)".

The author of the dissertation is *Eng. Angel Hristov Chekichev* – PhD student at the Department of Electric Power Engineering and Communications, with scientific supervisor Prof. Dr. Eng. Rumen Kostadinov Popov from the University of Plovdiv "Paisii Hilendarski".

The set of materials on paper presented by *Eng. Angel Hristov Chekichev* **is in** accordance with Art. 36. (1) of the Regulations for the Development of the Academic Staff of the University of Plovdiv, includes the following documents:

- an application to the Rector of the University of Plovdiv for the opening of a procedure for defending a dissertation; – CV in European format;
 - Minutes of the Departmental Council related to the reporting of the readiness to open a procedure and to the preliminary discussion of the dissertation; – dissertation;
 - Abstract;
 - list of scientific publications on the topic of the dissertation;
 - copies of scientific publications;
 - a list of registered citations;
 - a declaration of originality and authenticity of the attached documents;
 - a reference for compliance with the specific requirements of the respective faculty (only for PhD students enrolled before 04.05.2018);
- The PhD student has attached five publications.

2. Brief biographical information about the PhD student

Angel Hristov Chekichev has a consistent development of his education in the engineering, technical and pedagogical fields. In 2009, he acquired a Professional Bachelor's degree, and subsequently completed master's programs in three different fields. In 2012, he received a Master's degree in Communication Equipment and Technologies from the Technical University of Varna, in 2021 he graduated with a degree in Physics in Secondary School at the University of Plovdiv "Paisii Hilendarski", and in 2024 he acquired an engineering qualification in "Eco-technological Systems in Industry" at the same university.

His professional experience includes work as a teacher at Ivan Vazov FLH – Smolyan, as well as as a "Computer Analyst, Software Support" at the Department of Electric Power Engineering and

Communications. At the time of the review, the PhD student holds the academic position of "Assistant" in the same department.

3. Relevance of the topics and appropriateness of the goals and objectives set

The problems developed in the dissertation are relevant in scientific and applied scientific terms, as it is related to the development of virtual and distance laboratory environments for engineering training. The need to combine real measurements, computer simulations and virtual measuring instruments is especially significant in the training in "Electronic Measuring Equipment", where practical work with real electronic circuits and measuring equipment is an essential element of the preparation of students. The relevance of the development is determined not only by the development of distance learning, but also by the trends for digitalization and modernization of laboratory infrastructure.

4. Knowledge of the problem

The PhD student demonstrates a good knowledge of the state of the problem under study and modern approaches to building virtual and remote laboratory environments. The literature review covers the main areas related to virtual and distance learning, virtual laboratories, measurement systems and the use of modern software tools. A total of 126 literature sources were used in the dissertation, of which 26 are Internet addresses, and most of the literature sources are from the last ten years.

The bibliographic material is analyzed in view of the possibilities and limitations of existing solutions. On this basis, the PhD student argues the need to develop an integrated laboratory environment combining simulation models, virtual measuring instruments and real experimental objects.

5. Research methodology

The chosen research methodology is suitable for achieving the set goal and for solving the formulated tasks. It combines theoretical analysis, computer simulation, development and experimental research of real electronic circuits, as well as the use of virtual measuring instruments in a LabVIEW environment. An opportunity has been created for comparison of theoretical, simulation and experimental results, which allows verification of the developed models and assessment of the reliability of the results obtained. The implemented experimental verification confirms the adequacy of the chosen methodology. Therefore, it can be assumed that the methodology used provides the necessary scientific and experimental basis for achieving the set goal and for obtaining justified answers to the tasks set in the dissertation.

6. Characteristics and evaluation of the dissertation

The dissertation is developed in a volume of 232 pages and includes 142 figures and 6 tables. It is structured in an introduction, five main chapters, general conclusions, applied and applied contributions, a list of used designations and abbreviations, a list of the author's publications and seven appendices. The appendices include tables and characteristics of a Butterward filter, technical data for the RealTek ALC269, flowcharts of the developed functional generator, control code for the channels of the system and pictures of the implemented hardware system. Three laboratory exercises for the study of a bandpass filter and a top detector, a low-pass Chebyshev filter and a low-pass polynomial Butterward filter are also presented.

In Chapter One, an analysis of distance and virtual laboratories as a means of modernizing engineering education is made. The need to create a remote laboratory in the discipline "Electronic Measuring Technology" at the Faculty of Physics and Technology of the University of Plovdiv "Paisii Hilendarski" is substantiated, with a view to overcoming the limitations of traditional laboratories related to access to equipment, resources and maintenance costs.

The possibilities of distance and virtual laboratories for combining theoretical and practical training, simulation and research of real measurement processes and development of practical and analytical skills of students are considered. Their potential for integrating modern technologies into the educational process, for interaction between education and research and for closer correspondence between students' preparation and the needs of the industry is emphasized.

In the second chapter, the methodological basis of the study related to the development of a remote laboratory in "Electronic Measuring Equipment" is presented. The basic principles and methods for designing active filters are considered, analyzing the Butterward approximations, the location of the poles and the characteristics of filters of different order. Circuit solutions of active filters are also considered and basic requirements for the selection of elements in order to achieve the specified frequency characteristics are formulated. The principle of operation of the top detector and its possibilities for application in measuring systems are also analyzed.

The third chapter is devoted to the design, simulation study and experimental implementation of the main hardware and virtual modules of the developed laboratory environment. The design and implementation of Butterward and Chebyshev filters, a band filter and a top detector, as well as the creation of corresponding simulation models are considered. A virtual instrument in LabVIEW has been developed, including a functional generator, an oscilloscope and spectral analysis. In this way, the functionality of the system is expanded through capabilities for generation, measurement, visualization and spectral analysis of signals.

The fourth chapter presents the results of the experimental studies, including data validation, configuration and adjustment of the experimental system and analysis of the obtained characteristics. During the study of the implemented analog filters, the theoretical, simulation and experimental results are compared. The validation performed shows that the developed measurement system provides the necessary reliability and reproducibility of the results. The experimental studies confirm the main theoretical regularities for the studied filters. A comparison is made between the results of the simulation modeling in Multisim and the experimentally obtained characteristics. The results obtained demonstrate the practical applicability of the developed system for experimental research and comparative evaluation of various filter structures.

The fifth chapter summarizes the main results of the theoretical, methodological and experimental research carried out in the dissertation and formulates the conclusions and contributions arising from the development. The main result of the dissertation is the development and practical implementation of the concept of virtual and remote laboratory in "Electronic Measuring Equipment". The conclusions formulated in the dissertation are generally in accordance with the set goal and objectives. They reflect the main stages of the research – analysis of the existing state of virtual and remote laboratories, development of a methodology, creation of hardware and software components, integration of individual modules, experimental verification and development of methodological materials. A total of ten contributions are formulated in the dissertation, which are divided into two groups – applied and applied.

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

A total of 10 contributions are formulated in the dissertation, presented in the categories "Applied Science" and "Applied". I accept the content and the classification of the contributions in essence.

At the same time, when evaluating the formulated contributions, a significant methodological remark can be made. Some of these contributions are formulated at a very specific technical and implementation level and by their nature represent developed tools, practical implementations or results of applied activity, rather than independent scientific contributions. For example, the development of a virtual measuring complex, the creation of specific functional schemes and the

development of laboratory exercises have undoubted practical value, but it is necessary to clearly distinguish them from methodological and scientific-applied results.

Therefore, it would be appropriate for the final presentation of the dissertation to formulate the contributions more compactly and with a clearer distinction between methodological/scientifically applied result and specific technical or practical implementation. This would increase the precision of the formulations and would allow to more clearly highlight the scientific novelty of the development, without reducing the significance of its applied results. This remark is mainly editorial and methodological and does not cast doubt on the actual results achieved. The developed system, the implemented hardware and software modules, the simulation models and the experimental verification show a significant amount of independently performed work and the practical applicability of the results obtained.

8. Evaluation of the publications of the dissertation

The PhD student has submitted a list of five publications in connection with the dissertation. In all publications, he is the first author, 3 of which have a team of 3 authors, and 2 are independent publications. It is noteworthy that in all publications the PhD student occupies a leading position, which indicates a significant personal contribution to the implementation of research.

9. Personal participation of the PhD student(s)

From the analysis of the dissertation and the presented publications related to it, it is established that the PhD student has a clear and substantial personal participation in the development and implementation of research tasks. This is also confirmed by the authorship of the scientific publications – the PhD student is the first author of three of the publications presented at the international scientific forums ICERI in 2021 and 2022, and in two of the publications published in 2024, he is the sole author. On this basis, I believe that the PhD student has a significant participation in all the main stages of the dissertation research – from the analysis of existing solutions and the development of the methodology to the practical implementation, experimental verification and analysis of the results obtained.

10. Abstract

The abstract submitted under the procedure is 32 pages long and is presented at the Bulgarian and English. The materials presented in the abstract summarize the most significant results achieved in the dissertation.

11. Critical remarks and recommendations

With regard to the presentation of the information in the dissertation, I can noted the existence of technical errors, some of which are:

- The figures presented on p. 161 figures have no markings.
- In some figures presented in Chapter 4, the physical quantities along the coordinate axes are indicated, but their units of measurement are missing. It is recommended that the units of measurement of all physical quantities presented be explicitly marked on the coordinate axes.

12. Personal impressions

I know the PhD student as a good colleague and conscientious lecturer at the Faculty of Physics and Technology.

13. Recommendations for the future use of dissertation contributions and results

The dissertation was developed at a good scientific and applied level and the set goals and objectives were met. The results obtained have practical applicability in the development of remote and virtual laboratories for training in electronic measuring equipment. However, some recommendations can be made with a view to future development and wider use of the scientific applied results obtained. First of all, it is recommended that the developed virtual laboratory be expanded with additional experimental modules, including different types of electronic measuring systems and electronic circuits, which would increase its applicability in training in a wide range of disciplines. It would also be useful to expand the range of virtual meters and the possibilities for interaction of the learner with the real measuring equipment.

CONCLUSION

The dissertation ***contains scientific, applied and applied results that represent an original contribution to science*** and meet **all the** requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (RASRA), the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the relevant Regulations of the University of Plovdiv "Paisii Hilendarski".

The dissertation shows that the PhD student *Angel Hristov Chekichev*. **has** in-depth theoretical knowledge and professional skills in the scientific specialty Electronization (by branches and groups of scientific specialties), **demonstrating** qualities and skills for independent scientific research.

In view of the above, I confidently give my **positive assessment** of the conducted research, presented by the above-reviewed dissertation, abstract, achieved results and contributions, and propose **to the honorable scientific jury to award the educational and scientific degree of "Doctor"** to *Angel Hristov Chekichev* in the field of higher education 5. Technical Sciences, professional field 5.2 Electrical Engineering, Electronics and Automation, PhD program Electronization (by branches and groups of scientific specialties).

17.09. 2026 d.

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Reviewer:
(signature)
/Assoc. Prof. Sotir Sotirov, PhD/