<div align="center">**REVIEW**</div>

by Dr., Eng. Todor Stoyanov Djamiykov, Professor at Technical University – Sofia

on dissertation for the award of the educational and scientific degree "Doctor"
5. 5 Technical Sciences professional field 5.3. Communication and computer engineering Doctoral programme "Automation of areas of the intangible sphere (medicine, education, science, administrative activity, etc.)".

Author. Mag. Sezgin Fakhri Ismail
Theme Parametric and structural optimization of telecommunication models
Scientific supervisor. Prof. Dr. Slavi Yasenov Lyubomirov, Plovdiv University "Paisii Hilendarski"

1. General description of the presented materials

By Order No. RD-21 of 24.03.2023 of the Rector of Plovdiv University "Paisii Hilendarski" (PU), I have been appointed as a member of the scientific jury for providing a procedure for the defense of a dissertation on "Parametric and structural optimization of telecommunication models" for the acquisition of the educational and scientific degree "Doctor" in the field of higher education5. Technical sciences, professional field 5.3. Communication and computer engineering, doctoral programme "Automation of areas of the intangible sphere (medicine, education, science, administrative activity, etc.)". The author of the dissertation work is Mgr. Sezgin Fakhri Ismail - a PhD student in full-time study at the Department of Electronics Communications and Computing of the Faculty of Physics and Technology with scientific supervisor Assoc. Eng. Dr. Slavi Lyubomirov University of Plovdiv "Paisii Hilendarski".

The set of paper materials submitted by Sezgin Fakhri Ismail is in accordance with Article 36 (1) of the Regulations for the Development of the Academic Staff of PU, includes the following documents: - Application to the Rector of PU for the disclosure of the procedure for the defence of the thesis;

- CV in European format;

- the minutes of the departmental council related to the reporting of the readiness for the opening of the procedure and the preliminary discussion of the dissertation;

- dissertation; - abstract; - list of scientific publications on the subject of the dissertation;

- copies of the scientific publications; - declaration of originality and authenticity of the attached documents;

- statement of compliance with the specific requirements of the faculty concerned (only for PhD students enrolled by 04.05.2018);

The PhD student has attached 1 dissertation, 1 abstract of the dissertation and 5 publications. All publications are on the dissertation.

2. Brief biographical data

The PhD student Master Sezgin Ismail graduated from Plovdiv University "Paisii HilaDarski" with basic professional skills, higher mathematics, informatics and in-formation technologies. The qualification acquired in 1997 is a teacher of ma-mathematics. In the period 2018-2019 she acquired a second professional qualification degree at the Department of Information and Teacher Development at Sofia University - Sofia. Since 1999 she has been working as a lecturer in Informatics and Information Technology.

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

The development and evolution of methods ensuring reliable transmission, processing and protection of information in telecommunication networks in order to improve their technical characteristics and increase the efficiency of their function-ing is a modern and actual scientific task. The development of new stochastic evolutionary algorithms is an actual and active direction in modern scientific research worldwide. In the implementation of this type of algorithms there are a number of problems of different types, subject to analysis, characterization, modeling and verification, which is the subject of the present work.

The emergence of new projects of increasing complexity requiring larger-scale telecommunication systems forces attention to the level and quality of work at all individual stages of the project. Last but not least, the level and performance of the design process itself. The task of optimizing designs to find the most optimal option for their implementation is difficult enough.

Taking into account the above and what is presented in the dissertation, I believe that the subject-matter is topical, new and concrete realizable tasks are set for implementation.

4. Knowledge of the problem

In the first chapter of the dissertation a thorough study of the basic parametric and structural optimization procedures of telecommunication models is made.

The existing references on the problem are reviewed and interpreted appropriately through critical analysis. The literature review covers 132 references, including electronic ones. Of these, 122 are in Latin and 10 in Cyrillic. All of them are current scientific publications and are from reputable journals, publications of international conferences. Sources from Internet sites by leading, currently prominent authors, foreign and national scientists and specialists in the field.

5. Research methodology

The chosen methodology in the dissertation corresponds to the stated aim. Known mathematical dependencies and software are used to investigate and analyze the artificial intelligence tools to estimate the structure and parameters of components and nodes of telecommunication systems. Different numerical research methods have been applied in

the Matlab environment of testing and trials of different structures and models of telecommunication systems.

Tests are conducted and presented by means of simulation of software tools and models using real coded artificial intelligence algorithm.

I believe that the chosen methodology corresponds to the set goal and capabilities that were used by the PhD student.

6. Characteristics and evaluation of the thesis

The dissertation is 183 pages long. The analytical part is developed in 145 pages, within 4 chapters. The first chapter analyses the current state of the problem. At the end of the chapter the aim of the research and the resulting 6 tasks are defined. The realization of the properly set goal and corresponding tasks is the subject of the following 3 chapters between which and achieved consistency, logical connection and methodical in the presentation of new important, concerning the prinos of the dissertation theoretical and practical solutions.

The object of study in chapter 2 is devoted to the methodology used in the research: a Monte Carlo method for conducting simulation with stochastic models. Emphasis is placed on sensitivity analysis in order to determine the input parameters that affect the uncertainty in the model output and the use of artificial intelligence methods in system identification is justified.

Based on the research in chapter two, the use of artificial intelligence in the identification of system parameters is presented in chapter three for the use of artificial intelligence methods and techniques in component state estimation in telecommunication systems. Test models of basic telecommunication devices are created in the Matlab environment, testing the created reference models by simulating and creating input-output data sets to be used in the process of identification of their parameters, as well as determining the main characteristics of the test models; creating, in the Matlab environment, procedures for implementing the selected artificial intelligence methods.

In the fourth chapter the results of the use and application of the test models in different types of telecommunication systems are presented. Tests of different systems without noise and with noise are presented using a real-coded artificial intelligence algorithm. An analysis of the significance of the factors in testing the different systems is performed.

7. Contributions and Significance of the Development for Science and Practice

The author has presented in the dissertation 3 scientific and 5 applied contributions. I accept that the work has both contributions and would summarize them as follows:

Scientific-applied:

Algorithms are proposed using numerical experiment and Monte-Carlo simulation methods to investigate the capabilities of artificial intelligence (genetic algorithm and

particle swarm PSO) for automated determination of the para-meters and structure of specific classes of modules and devices in telecommuting systems.

Procedures implementing the Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) methods have been developed and the importance of factors affecting the qualities of the considered algorithms has been investigated and a comparative analysis has been carried out.

Applied contributions:

1. Tests, by means of Monte-Carlo experiment, of a linear system without noise and with noise, using a real coded genetic algorithm, are conducted and presented.

2. Matlab codes for testing an analog band-pass filter using real coded genetic algorithm (GA) and particle swarm method (PSO), by means of Monte Carlo simulations, are created and investigated. The significance of the factors in testing the filter model were conducted and analyzed.

3. Tests of a digital frequency synthesizer model using 3rd- and 4th-order filters using real-coded Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) methods are conducted using Monte Carlo simulations.

4. Designed and investigated software tools in Matlab environment to test the cooling system model of communication equipment in structure identification, by using integer-coded genetic algorithm and swarm particle method, through planned Monte Carlo experiment. A significance analysis of the factors has been performed, and special functions implementing the procedures of the algorithms have been written for this purpose.

5. A test has been carried out in the identification of a model structure of the cooling system of communication equipment by using genetic algorithm and particle swarm method. Real data from Feedback equipment are used as input data.

8. Evaluation of the dissertation publications

A total of 5 publications have been made on the dissertation. Of them: in conferences - 3 issues, in the collection of scientific papers 2 issues. Three of the publications have been submitted to Web of Science. Two of the publications presented in collections of scientific papers are independent. In three publications the PhD student co-authored with the supervisor and colleagues from the university. In two publications the authors are three, in one four. No separation protocols from the authorship teams have been presented, more so I believe that the share of Mgr. Sezgin Ismail is significant in them.

No citations of the publications were noted.

The review of the publications shows that they cover the topics of the thesis and present the results to the scientific community. Their number is sufficient and in line with the accepted requirements.

9. Personal participation of the PhD student

The scientific and applied contributions described above appear in a rather thin volume and content of publications of the PhD student. They have been presented in renowned and well-established scientific forums in the field, which means that the results have gained the appropriate popularity and recognition in scientific circles. I believe that the doctoral student's personal involvement is evident and is undeniably confirmed by the two self-consistent publications and co-authorship with his supervisor.

10. Abstract

A careful review of the abstract to the thesis shows the presence of full compliance with the requirements for its preparation. It adequately reflects the main points and contributions of the dissertation. The abstract to the dissertation can be fully evaluated and characterized as a synthesized version of the content and main results achieved in the dissertation. It fully corresponds to the defined scientific and applied contributions contained in the full text of the dissertation.

11. Critical remarks and recommendations

All the theoretical and practical propositions in the dissertation are presented in a reasoned, correct and methodologically appropriate sequence. Nevertheless, minor editorial inaccuracies and omissions can be pointed out, some of which are:

- The length of the dissertation is unnecessarily large and should be reduced by partially reducing the introductory part and reducing the experimental results. The main results obtained are shown analyzed and commented on in an exactional way in the form of tables and comparative graphs. The illustration with time diagrams of modeled random effects gains volume but does not bring co-substantial new information.

- In the contributions presented, it is important to present which figure(s), table(s), graph(s) or mathematical expression(s) each scientific or applied contribution should be attributed to.

- Is there a study on the relationship between the state-identification error of the system model parameters and the statistical parameters of the input signals in Monte Carlo modelling? Does the error depend on the distribution law of the input quantity and the type of correlation-ion function?

- When the model of the cooling system (test model 6) is identified by the genetic algorithm and particle swarm methods, the error in the identification of system parameters is significant but constant in absolute value. No conclusion is drawn about the applicability of the methods for identification of parameters of such systems (system components) using the two methods.

I believe that these recommendations and remarks will be valuable and useful in the future scientific and publication activity of the PhD student.

12. Personal impressions

I do not know personally M. Sezgin Ismail, but my contacts with the scientific supervisor, the results of models and tests presented in the work, as well as their approbation in scientific publications give me reason to believe that he is the author of the proposed ideas and their implementation.

I have no publications in common with the PhD student.

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

The applied contributions are directly usable in practice. They can find wide application in teaching and training of students. It is too early to make a judgement about the applied ones.

CONCLUSION

The dissertation work contains scientifically applied and applied results, which represent an original contribution to science and meet all the requirements of the Law for the Development of Academic Staff in the Republic of Bulgaria (LADAB), the Regulations for the Implementation of the LADAB and the relevant Regulations of the Paisii Hilendarski University.

The dissertation thesis shows that the PhD student Mgr. Sezgin Fakhri Ismail possesses in-depth theoretical knowledge and professional skills in scientific specialty 5. Technical sciences, professional field 5.3. Communication and computer engineering, demonstrating qualities and skills for independent scientific research.

Due to the aforementioned, I confidently give my positive assessment of the research conducted, presented by the above-reviewed dissertation, abstract, results and contributions, and I propose the honorable jury to award the degree of Doctor of Education and Science to M. Sezgin Fakhri Ismail in the field of higher education: 5. Technical Sciences, professional field 5.3.

30.05. 2023 г.   Reviewer: …………………………………………

(Prof. Dr. Todor Djamiykov)