

August 22th, 2024, Ostrava, Czech Republic

Review of PhD thesis

Thesis title: Implementation of a Partially Autonomous Expert System for Analysis of Biomedical Data and its Application for Diagnostic Purposes

Author of the thesis: Mgr Magda Žolubak

Institution: Opole University of Technology

Doctoral Study Programme: Automatyka, Elektronika, Elektrotechnika I Technologie Kosmiczne

Thesis Supervisor: dr hab. inż. Mariusz Pelc, University of Opole

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Reviewer: prof. Petr Bilik, Ph.D., Faculty of Electrical Engineering and Computer Science, VSB - Technical University of Ostrava, Czech Republic

This review of PhD thesis has been carried out in response to dr hab. inż. Andrzej Waindok, (Head of Scientific Council for the Discipline) letter from 20th of June 2024.

Scope of the thesis:

This PhD theses seeks to create a semi-autonomous system for the analysis of electroencephalography signals utilizing machine learning techniques. The goal is to improve both the accuracy and efficiency of medical diagnoses by partially automating the signal analysis process. The research emphasizes developing models to examine issues related to short-term memory, high stress levels, and abnormal slow brain waves. Furthermore, the PhD theses includes the implementation of an analytical method within a program designed around decision-making strategies.

The elaborated topic of the PhD theses is actual, interesting and useful for the development of science and also for technical practice.

Originality:

The proposed research is new, as no similar experiments employing the described methods have been identified in the existing articles.

In this thesis, the PhD candidate has demonstrated a solid understanding of the research process. The PhD candidate has effectively developed and addressed a challenging research question, provided and tested hypotheses.

Structure and format of the thesis:

The PhD thesis is written in English and consists of 103 pages, excluding pages with supporting information. The total number of pages is 154. The number of references is 104.

The PhD thesis is organized into 6 chapters and structured into two primary sections: an empirical part, which outlines the research methodology and the application of the developed techniques to real-world data, and a theoretical part, which surveys the current knowledge on the analysis and processing of biological signals for diagnostic use. The first chapter (Introduction) provides a concise introduction to the topic, presents the main thesis along with supporting arguments, and outlines the content of the subsequent chapters. The second chapter (Theoretical Background) covers the human nervous system, as well as brain activities as learning and cognitive processes. The third chapter (Research Methodology) details brain signals measurement techniques and gives an overview of the signal processing methods employed and expert systems. The fourth chapter (Conducted Experiments) discusses the data acquisition, analysis and markers for diagnostic purposes. The fifth chapter (Results) presents the results obtained by research. The sixth chapter (Conclusion) offers conclusions and outlines plans for future research.

The work does not have a completely clear structure and a clear description of the individual topics described. Why does the PhD thesis not include a list of the author's registered achievements and publications at the end?

Formal corrections:

I read the PhD thesis carefully and found several typos. Graphic representation of the results is in some places not clear a number of figures lack sufficient explanation of the meaning in the text, or even the meaning of figures is not obvious.

There are 2 source codes in C in the attachments (pages 117-134). What is it good for? Why isn't the function structure of the code presented in a suitable graphical form, e.g. UML, instead?

Questions:

1. What is the main achievement of the thesis?
2. What is the efficiency of the proposed method for particular experiments?
3. How many participants took part in the studies? What were the inclusion and exclusion criteria?
4. Did the author register signals or used data from the open data-sets?

Statement:

The reviewed PhD thesis represents an adequate achievement in the development of technical sciences. I recommend that the thesis could be the subject of a public defense in the field of "Automatyka, Elektronika, Elektrotechnika I Technologie Kosmiczne" for the degree of the title of Doctor of Philosophy.

prof. Ing. Petr Bilík, Ph.D.