



Applicant: Ing. Ondřej Domanský

Title of Dissertation: Selected Practical Applications of Fractional Two-Port Systems In Immittance And Transfer Functions

Opponent: Assoc. Prof. Umut Engin AYTEN

Opponent's Department: Yildiz Technical University Electronics and Communication Engineering

Opponent Review of Doctoral Dissertation

In accordance with the Study and Examination Rules of BUT, in his/her review the opponent will mainly comment on:

- a) the topicality of the dissertation,*
- b) whether the dissertation achieved its given objective,*
- c) the problem-solving procedure and the results of the dissertation along with the concrete contribution of the doctoral student,*
- d) the significance for practical application or the progress in the field,*
- e) formal and language qualities of the dissertation,*
- f) whether the dissertation fulfils the conditions of Section 47 (4) of the Act,*
- g) whether the student proved his/her creative abilities in the given research field and whether the work does or does not comply with the standard requirements placed on the dissertations in the given field. The review is not valid without this conclusion.*

It is necessary to add a concise commentary to each of the points below.

Ad a) Topicality of the dissertation

The topic of the dissertation is very topical.

Comment: There have been many studies in the literature on fractional order circuits in recent years. These studies show the advantages of fractional order calculus in circuit applications. The importance of fractional order two-port networks has been shown with circuit applications in many articles in this dissertation.

Ad b) Objective of the dissertation

The objective of the dissertation was achieved.

Comment: The aim of the thesis is to show that advantageous structures can be obtained in fractional order circuit applications.

In this context, the first sci journal article was made with fractional order PID implementation using the RC approximation of constant phase element method. VDCC was used as the active element in this study. In this article, additions were made to the RC approximation method frequently used in the literature and it was shown that the phase-frequency characteristic could be improved by adding correction elements to the obtained RC circuit. Experimental studies were carried out together with the PCB implementation for the proposed circuit and the advantage of the proposed method was shown together with the PID circuit application.

Secondly, studies were carried out to improve the realization of higher order fractional order elements using the n-th order general emittance structure and to provide electronic tunability feature.

Thirdly and finally, the experimental verification of the reconfigurable fractional order resonator (combination of LC structure in a band pass filter) was shown with the study.

Ad c) Problem-solving procedure and the results of the dissertation and the concrete contribution of the doctoral student

The problem-solving procedure and the results of the dissertation are above average.

Comment: This situation is shown by the numerous articles given in the thesis. In most of these studies, the proposed methods are implemented in accordance with the problems and the analyses are given in detail. In addition, in most of the articles, the article is supported by experimental studies.

Ad d) Significance for practical application or progress in the field

The significance for practical application or progress in the field is above average.

Comment: Applicant's work has produced 5 sci journal articles. This reveals the importance of dissertation in terms of practical application in its field.

Ad e) Formal and language qualities of the dissertation

Formal and language qualities of the dissertation are above average.

Comment: The dissertation consists of accepted articles. The language and formal qualities of these articles are appropriate. In addition, the four chapters of the dissertation are well prepared in terms of language and form.

Ad f) The dissertation fulfils the conditions of Section 47 (4) of the Act

The dissertation fulfils the conditions of Section 47 (4)*) Act No. 111/1998 Sb. Higher Education Act: YES

*(*4) Studies are duly finished with a doctoral state exam and dissertation defence, which prove the ability and readiness to work independently in the field of research or development, or in theoretical and creative arts. The dissertation must comprise original and published results or results accepted for publication.*

Ad g) Creative abilities of the student in the given research field. Compliance with the standard requirements placed on the dissertations in the given field.

The doctoral student did prove his creative abilities in the given research field and the work does comply with the standard requirements placed on the dissertations in the given field.
Comment: Applicant has published 5 SCI articles and 15 conference papers from his work in this dissertation.

Overall evaluation:

In this dissertation, advantageous approaches are presented compared to the studies in the literature on fractional order circuit design applications. The approach suggested for CPE design and the correction elements added to the design, as well as the PID circuit designed with the VDCC active component as an application, are interesting.

In addition, studies on the design and analysis of transfer functions obtained by summing the integer order and fractional order two-port system responses were carried out in the dissertation. Four possible cases of fractional order and integer order two-port connections were analyzed analytically, with PSpice simulations and experimentally in the frequency range between 10 Hz and 1 MHz. Practical suggestions for the experimental study and also special solutions that overcome possible problems related to instability and DC offsets were given. It was presented in the dissertation that the experimental and simulation results were in good agreement with the theory.

Similarly, it is seen that it contributed to the literature with fractional order oscillator circuit designs with electronically reconfigurable and tunable features.

Opponent's questions:

I don't have any questions for Applicant.

I recommend do not recommend the dissertation for the defence.

Date: 15.10.2024

Signature:

