MINISTERUL EDUCAȚIEI ȘI CERCETĂRII

UNIVERSITATEA TEHNICĂ
DIN CLUJ-NAPOCA

Fundamental field: Engineering Sciences
Specialization: Electrical Engineering

HABILITATION THESIS
– ABSTRACT –

DESIGN OF DEVICES USED IN THE FIELD OF ELECTROMAGNETIC COMPATIBILITY

Assoc. Prof. Eng. Ec. Nicoleta-Adina GIURGIUMAN, PhD
Faculty of Electrical Engineering
Technical University of Cluj-Napoca

– Cluj-Napoca –
2024

The *Habilitation Thesis* proposes a succinctly description of the authors professional achievements in order to indicate the evolution and development of the academic, scientific and professional career, in the global context of the significant and up-to-date scientific achievements in the field of electrical engineering.

The *Habilitation Thesis* is structured in three main parts, including four chapters, references, a figures list, a tables list and the publication list.

The thesis begins with a short *Introduction* in which the author presents her *professional evolution* from which the topics of interest and the research directions approached throughout the career can be derived. Also, in this section the author mentions the three main research directions which she treated since the public presentation of her *PhD Thesis* with the title "Contributions to the improvement of filter performances for the conduction electromagnetic interferences suppression" on 10th of October 2010, until present:

- ✓ optimal design and frequency response efficiency for EMI filters;
- ✓ analysis, numerical modeling, designing and practical realization of planar devices;
- ✓ analysis and testing of electromagnetic interferences; human exposure to electromagnetic fields.

This research is found in the articles and books published by the author, and also in the topics addressed in the research activities of the research projects in which she was involved.

At the end of the first part the author highlights meeting the minimum necessary and mandatory standards for conferring teaching titles in higher education and professional research-development degrees, provided by the legislation in force, in Annex 09 of the MENCS Order, No. 6129/2016-Minimum Standards-Electrical Engineering Commission. Throughout her career, the author published approximately 166 scientific papers in ISI journals, ISI proceedings, BDI journals, BDI proceedings, non-indexed journals, and non-indexed proceedings. The published articles had a significant impact in the national and international scientific community, reaching a number of approximately eighty ISI and BDI citations. Also, she published seven scientific books, being the first author for four of them.

The author was the leader for two research projects won through a national competition and a postdoctoral scholarship in the field of the *Habilitation Thesis*. She has been part of the research team for three international research projects, nine national research projects and thirteen third-party research projects with industry.

Also, she is a reviewer for the journals *Applied Science*; *Energies*; *Sensors*; *Electronics* and *Journal of Engineering Research and Sciences*. She participated as a scientific referent in 8 PhD committees and has coordinated around 80 *Bachelor Theses / Dissertations* throughout his career.

The second part of the Habilitation Thesis, the main part, includes the author's scientific, professional, and academic achievements in the three targeted research directions. It includes three chapters which capture the most significant scientific achievements of the author.

Chapter 1 entitled *Optimal design and frequency response efficiency for EMI filters* pursues the continuation of the research carried out within the *Doctoral Thesis* elaborated by the author in the sense of developing new techniques and methods for optimizing the functional performance of high-frequency EMI filters. Thus, starting from the results obtained in her *PhD Thesis* and materialized in minimization techniques of the structural parasitic capacitance and in the losses increase at high frequency, further developed research aimed at:

- ✓ determining optimal structural configurations of EMI filters that include the minimization of their parasitic effects;
- ✓ increasing the filter performances through the improvement of the transfer function/their frequency response;

- ✓ implementing of an optimal global design capable of determining the optimal constructive geometric parameters of the EMI filters to ensure the minimization of the structural parasitic effects coordinated with the increase of the frequency response of these filters.

In *Chapter 2*, *Devices made using planar electromagnetic technology*, the author, starting from the experience acquired in the analysis and design of filters for the suppression of electromagnetic interference using planar electromagnetic technology, aims to develop and design new planar devices. Thus, the chapter begins with the presentation of the author's contribution to the analysis, numerical modeling, optimal design, practical realization, and testing of the planar inductors which will ultimately form the basis of the design of wireless power systems and planar transformers. This chapter also contains the contributions made to the analysis, numerical modeling, design and practical realization of planar antennas. For this purpose, the author presents as an example the Yagi Uda antennas for which the specific parameters are determined both numerically, using the numerical program *Ansys HFSS,* and experimentally using the *LPKF equipment* for the practical realization of the antenna and the *Vector Network Analyzer* for parameter determination. The antenna emission influence on the human head is also analyzed through numerical modeling.

Chapter 3, *Digitalization of the evaluation process of human exposure to electromagnetic fields*, includes a topic treated by the author throughout her career, namely the assessment of human exposure to electromagnetic fields. This subject is the bases of the second research project won by the author through a national competition and has as objective the digitalization of the evaluation process of human exposure to electromagnetic fields. Thus, in the first part of this chapter the author highlights the importance and the actuality of the topic addressed and presents some EMC tests made along her career in different high voltage stations across the country in collaboration with companies such as Electrogrup S.A., Energobit S.A., Electromantaj S.A., CEPROM S.A., SIEMENS Energy SRL, FDEE Electrica Distribuţie Transilvania Nord SA, Romproiect Electro SRL, and others. In the second part of the chapter the analytical module for calculating the electric and magnetic fields generated by the conductors of the overhead transmission lines (OHTL) for the transport and distribution of electrical energy is presented. This analytical module is the base of the software application EMF which allows us to determine the electric and magnetic field values in different calculation points or along the routes considered of interest, application which can be accessed also on the mobile phone. At the end of this chapter, the robotization part of the tripod used to perform the experimental measurements of the electric field and the magnetic field generated by OHTL is briefly presented.

The third part includes *Chapter 4, Career evolution and development plans*, in which the author's ideas and proposals are presented. The university career evolution and development hypothetic plans are detailed synthetically, mentioning future research directions, teaching career development plans, scientific research development plans, respectively plans for involvement in institutional activities.

The *Reference* section contains 168 bibliographic sources, including some of the author's publications.

The figures list contains 150 figures, all containing models and results of the research activities presented in the *Habilitation Thesis*.

The tables list contains 7 tables with dimensions of the models and analytical, numerical, and experimental results.

The publication list contains 7 books with ISBN and 169 scientific papers published by the author from the career debut until present.