MINISTRY OF EDUCATION AND RESEARCH

TECHNICAL UNIVERSITY
OF CLUJ-NAPOCA, ROMANIA

Fundamental field: Engineering Sciences
Specialisation: Electrical Engineering

HABILITATION THESIS
– ABSTRACT –

FROM PLANAR SPIRAL INDUCTORS TO WIRELESS POWER TRANSFER SYSTEMS, ANTENNAS AND FILTERS

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– Cluj-Napoca –
2022

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The Habilitation Thesis with the title ''From Planar Spiral Inductors to Wireless Power Transfer Systems, Antennas and Filters" synthetizes the research activities results conducted by the author from the defense of the PHD Thesis with the title "Contribution to Analysis, Modelling and Optimal Design of Spiral Inductors from Micrometre Integrate Circuits" on 12 July 2012, till now, in the Electrical Engineering Domain.

The Habilitation Thesis is structured in three main parts, including the five chapters, the references, the list of figures, the list of tables and the list of publications.

Part I of the Habilitation Thesis includes Chapter I, Introduction, which details the professional evolution of the author, the research domains, and fields that she has treated and the proof of the fulfilment of the minimum necessary and mandatory standards for conferring the teaching titles in higher education and the research - development professional degrees, provided in the legislation in force, in Annex 09 of the MENCS Order, Nr. 6129/2016-Minimum Standards Electrical Engineering Committee.

The research domains approached in her the research activities are: high frequency device analysis; numerical modelling of the electromagnetic field; optimal design of electrical devices; micro and nanotechnologies; spiral inductors made in planar electromagnetic technology at micro and nanometric dimensions; algorithms for calculating the electrical parameters; device optimization algorithms; microcircuits; electrical and electronic circuits; wireless power transfer systems; antennas; filters; electromagnetism; electromagnetic compatibility. These can be found in published articles and books, as well as in the research projects in which she has been and is involved.

During her professional career, she has published approximately one hundred and forty scientific papers in ISI journals, ISI proceedings, BDI journals, BDI proceedings, non-indexed journals, and non-indexed proceedings. The published articles have had a significant impact on the national and international scientific community, totalling approximately eighty ISI and BDI citations. She also published seven scientific books, at four of these she is the first author.

The author was the leader of two research projects won through national competition and of a postdoctoral fellowship in the field of the Habilitation Thesis. She has been part of the research team for four international projects, seven national research projects and eleven third-party research projects with industry.

The author's international appreciation and recognition is also demonstrated by the fact that she is: Reviewer Board Member of Sensors Journal by MDPI, Topical Advisory Panel Member of the Electronics Journal by MDPI, Rosalind Member of London Journals Press and Member of International Scientific Committees at conferences of great prestige in the domain, participating in more than fifty such events during her career. She is also the reviewer of the Sensors Journal, Energies Journal, Applied Science Journal, Symmetry Journal, Electronic Materials Journal, Electronics Journal, Mathematics Journal by MDPI and COMPEL: The International Journal for Computation and Mathematics in Electrical and Electronic Engineering.

The Part II of the Habilitation Thesis, the main part, includes the scientific, professional, and academic achievements of the author, in the three research directions. It contains three chapters, which capture the most significant scientific achievements of the author.

Thus, Chapter 2, Spiral Inductors Made in Planar Electromagnetic Technology, is the one in which the monolayer planar inductors are treated in the first part and multilayer in the second part. They are approached from the design, modelling and analysis stages to the optimization, practical realization, verification, and testing stages. Several sets of monolayer and multilayer planar spiral inductors are designed and are analysed at low and high

frequency. Their parameters are extracted analytically, numerically, and experimentally. Various studies are performed to analyse the inductance variation in terms of the descriptive geometric parameters and of the frequency, using software programs developed by the author and also commercial software programs. Various optimization techniques are applied to obtain the optimal configurations and structures of the planar inductors in order to make them practical. Using the equipment from the practical realization line of the printed circuits purchased from the budgets of the research projects, of which she was the leader, the monolayer and multilayer planar spiral inductors of millimetre and micrometric dimensions are built. These are then experimentally tested, verified, and validated, and finally subjected to electromagnetic compatibility tests.

Chapter 3, Wireless Power Transfer Systems, introduces the first devices developed using spiral inductors made in planar electromagnetic technology. To do this, we first design, model, optimize, and then build, verify, test, and validate some prototypes of wireless power transfer systems. Thus, in the first phase, a wireless power transfer system with millimetre dimensions is made. The planar inductors are designed and subjected to optimization techniques to obtain the optimal configurations required for the two inductors, which will make up the wireless power transfer system. An electronic control circuit is designed, then the prototype of the wireless system is mounted and tested with different test bodies (LEDs and bands of LED) to demonstrate its functionality. Starting from this wireless power transfer system, a similar system is then designed for the pacemaker. The necessary studies and analyses are started because the dimensions of the coils are reduced to the order of micrometres. Therefore, before their practical construction, the inductors and the wireless power transfer system are analysed and simulated by means of three-dimensional numerical modelling. Various variation studies, which are required for optimization, are analysed by numerical modelling. Thus, each prototype built is preceded by a depth analysis by modelling and functional simulation, so that the built devices to be the optimal ones also in terms of their expected performance.

In Chapter 4, Antennas and Filters, the range of devices subject to analysis in scientific research activities expands. In the first part of the chapter are covered the planar antennas. Planar antennas are designed and analysed by high frequency numerical modelling. Antenna-specific parameters are extracted, and a variety of analyses are performed to determine the influence of the parameters on their performance, the influence of different types of tissues on the parameters and last but not least the influence of antenna emissions on the human body. These antennas are designed and optimized for practical realization and experimental testing. Therefore, using the same planar technology is aimed at building planar antennas.
In the second part of the chapter, the filters made in planar electromagnetic technology are analysed. The applicability domain of planar inductors expands, and they are used here as part of planar filters. Various types of filters are designed, analysed, subjected to optimization techniques, and practically made.

In the chapters of Part II are presented concretely the research activities undertaken by the author from the defense of the PHD Thesis until present. Even from the title of the Habilitation Thesis, "From Planar Spiral Inductors to Wireless Power Transfer Systems, Antennas and Filters", it is confirmed the continuity of research activities and the title describes, briefly, clearly, and concisely, the main concerns of the author, which started from planar components and have reached the development of concrete applications in the field of microcircuits.

Part III contains Chapter 5, Plans for Evolution and Development of the Career, which presents the author's ideas and proposals in this regard. The hypothetical plans for the

evolution and development of the university career are synthetically detailed, mentioning the future research directions, the plans for the development of the didactic career, the plans for the development of the scientific research, respectively the plans for involvement in institutional activities.

The References section is the one in which one hundred and forty-six bibliographic sources appear, seventy-seven of them being self-publications as author/co-author.

The List of Figures contains one hundred and sixteen figures, all containing models and results of the research activities presented in the Habilitation Thesis.

The List of Tables comprises eleven tables with model's dimensions and analytical, numerical, and experimental results.

The List of Publication consist of seven books with ISBN and one hundred and thirty-nine scientific papers published by the author from her career debut until now.