Fundamental field: Engineering Sciences
Specialisation: Electrical engineering

HABILITATION THESIS

Abstract

Interdisciplinary approach for sustainable development: technological and socio-economical perspectives

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The habilitation thesis proposes a brief description of the author's professional achievements with the aim of highlighting the evolution and development of her academic, scientific and professional career, in the global context of significant and current scientific achievements in the field of engineering. The interdisciplinarity of the subject allowed the reunification of research results obtained over the years and their inclusion in the field of Electrical Engineering in the qualification thesis.

The introductory part of the thesis emphasizes the relevance of the candidate's research field. This emphasizes the reasoning underlying the placement of both didactic and scientific activities within the specialized field for which the qualification is requested. In addition, the introduction outlines the motivation for undertaking this thesis and provides a concise outline of the thesis structure.

In the second part, entitled "*Scientific, professional and academic achievements*", the author reviews her professional development, highlighting the topics of interest and the directions pursued throughout her career. This section also identifies the two main research areas on which his work has focused since the public presentation of his PhD thesis entitled "*Contributions to methods for modeling and prediction of electromagnetic enterference in AC*" on 14 October 2010, to date:

1) Evaluation of electromagnetic interference problems.

2) Actions for the energy transition for decarbonisation.

The author has demonstrated significant commitment to research and science throughout her career, evidenced by her numerous publications. The publishing activity includes 4 scientific books, 1 chapter of a book, 4 didactic books, 2 course materials and more then 90 scientific papers published in various national and international journals and conference proceedings. His work has attracted significant attention within the scientific community, accumulating approximately 140 ISI and BDI citations.

Beyond her publications, the author has obtained and led several research projects, including grants obtained through national/international competitions and has also been part of the implementation team of a considerable number of national/international research projects as well as with industry. He has also played an active role in mentoring and guiding future researchers, supervising doctoral and postdoctoral research and serving on a doctoral support committee. His contributions also extend to the organization of scientific events, postgraduate professional programs and reviewer for international journals and conferences.

Also in this section, the two directions in which the author wishes to continue her research are detailed, in the form of two chapters that highlight the importance and

relevance of their scientific content and summarize the specific results of each field, carried out by the author after defending the PhD thesis.

"Evaluation of electromagnetic interference problems"

Electromagnetic compatibility (EMC) has become an important aspect of modern technological advances, as the increasing dependence on electronic devices and the integration of different energy sources have created a complex electromagnetic environment. Understanding electromagnetic interference dynamics and its impact on nearby systems is essential to ensure the reliable and efficient operation of a wide range of applications, from overhead power lines to renewable energy integration.

The influence of overhead power lines on nearby metallic structures is a prime example of the EMC importance. The global energy demand continues to grow, requireing the use of high-voltage power lines for the supply of electricity and metallic pipelines for the transport of energy carriers (liquids and gases). When these systems are in close proximity, interference can occur that induces unwanted voltages on nearby metal structures. Calculation of induced voltage levels is essential for determining the feasibility of common corridors for power lines and underground/overground metal conduits. To ensure the electrical safety of personnel, the protection of equipment and the avoidance of unwanted corrosion processes, it is necessary to carry out a detailed representation of the network topology, allowing the identification of mitigation procedures that fall within the specific safety criteria.

In addition, the trend towards an increasingly decentralized and dynamic energy landscape, with the increasing use of distributed energy sources and the shift to a more active role of the consumer, has further highlighted the need for robust EMC strategies. Consequently, EMC research plays a crucial role in supporting these advances by ensuring the reliable and efficient integration of renewable energy sources and adaptation to current and future energy use patterns.

During her doctoral program, the author of this thesis focused on the development of a mathematical model dedicated to the problems of interference between overhead power lines and underground gas pipelines, especially through magnetic coupling, and on its validation with dedicated software programs. After completing the thesis, however, he had the opportunity to use his experience in EMC, solving electromagnetic interference problems and modeling electromagnetic fields, getting involved in projects with the industrial environment. This allowed her to apply the solutions proposed in his doctoral thesis in practical studies, respectively to extend them to other problems based on the phenomenon of electromagnetic interference.

" Actions for the energy transition for decarbonization"

In the current context, the energy transition towards low carbon dioxide emissions has become a pressing global challenge, driven by the need to address climate change and reduce greenhouse gas emissions.

Consequently, energy transition is a very actual topic, driven by rapid progress and encompassing structural changes, innovation, flexibility and energy efficiency (EE). In addition, it covers several significant issues, with a key focus on the transition to sustainable models in all dimensions: technological, ecological, social, political and economic. This entails pathways to socio-economic, environmental and governance objectives driven by social change, the adoption of renewable energy sources, cleaner production and consumption practices and technological innovation.

Despite encouraging signs and efforts to back energy transition commitments, it's still not popular in many countries, and even less is understood about it. This is mainly because it demands a lot of technical and interdisciplinary know-how. As the world navigates this transition, it's crucial to pinpoint and dive into research areas that can drive the development of practical strategies and solutions to support it.

The author's participation in numerous international projects focused on the identification of barriers to the energy transition and the design of strategies, solutions and tools for energy efficiency and decarbonization, allowing her to deepen the understanding of the mechanisms that lead to these actions. This experience served as a valuable foundation for her future research endeavors.

The third part, entitled "*Career development and future plans*", focuses on the paths and opportunities for academic career development through specific actions aimed at achieving proposed future development goals. They are based on the principle that education is a basic pillar of society, the university career being characterized by a combination of teaching and research responsibilities, all adapted to meet current and future economic and social needs.

The final part of the habilitation thesis includes the bibliographic references used in the work, the list of figures and tables, as well as two appendices that include the list of publications and the list of the candidate's projects.