MINISTRY OF EDUCATION AND RESEARCH

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Fundamental field Engineering Sciences
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# HABILITATION THESIS
## – ABSTRACT –

***Electronic power converters for sustainable electrical energy conversion applications***

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The habilitation thesis is structured to highlight the author's areas of research interest, with the concrete indication of some projects, directions, researches and results. Thus, as indicated in the title of the thesis *Electronic power converters for sustainable electrical energy conversion applications*, the research fields are closely related to electronics and electrical engineering with applicability especially in energy conversion systems. In the organization of the thesis, the research carried out after the doctoral thesis defense in June 2012 was considered, focusing on the fields of power quality, renewable energies, DC grids, respectively research in education and extra-curricular academic activities.

Chapter 1 is focused on the field of electronic lighting mainly from the perspective of the power quality of the electrical energy used, as well as applications of active power factor correction using a new electronic structure. The quality of electricity in lighting systems is an important aspect in development, as it is one of the main consumers of electricity worldwide. Also, the number of devices is very high while the individual installed power is small. Hence, it is easy to neglect the importance of the quality of electricity at the individual level, while the effect at the macro level is significant. Some electronic structures are otherwise proposed for LED lighting where the researches are especially correlated on the quality of the electrical energy consumed in correspondence with the resulting optical performances. A new converter structure is also proposed for active power factor correction by using a direct current converter as an intermediate power conversion stage.

Renewable sources are indispensable in the current context of how energy is used, so chapter 2 illustrates some proposals for electronic solutions for the conversion of energy from photovoltaic panels. The analyses are structured according to the power levels, with the identification of the performances and basic characteristics usually followed at an electronic converter: efficiency, current ripple, conversion factor, cost, reliability. An electronic power converter structure is proposed that includes a multitude of useful features in the field of electronic energy conversion from renewable sources.

The problem of DC grids is followed carefully in the field of electrical engineering because we can encounter one of the paradigms of technological development: the loads are mainly electronically controlled, thus they appear for the power system as DC consumers, while the transport and distribution networks of electricity are in alternating current. If we add the fact that renewable energy can also be produced directly in DC, it is identified that the successive stages of conversion introduce losses that we can be avoided through certain reorganizations of the electricity grids. Chapter 3 is the one through which the research in the field of DC grids and hybrid networks are represented in a practical, pragmatic way and with complete implementation solutions. A concept of power distribution without having a certain pre-defined grid voltage level is also introduced. Thus, the concept of a variable direct voltage network is presented concisely in correspondence with its level decision algorithm to maximize the global energy conversion efficiency in the respective structure.

At the end of the presentation of research activities and their results, chapter 4 proceeded to exemplify some actions in the field of didactic research by developing an experimental laboratory stand in the field of power electronics. Some aspects of the activity within the student project SOLIS, which aims to develop solar electric vehicles with participation in international competitions, are also detailed. The didactic objective of this extra-curricular project is to offer meritorious students project-based learning activities through which they can develop and even pursue careers in the field of research and development.

In chapter 5, the evolution and development plan of the university career is exposed. This is based on three main pillars: current research topics and the research team, academic

and industrial partnerships, respectively the quality of the didactic activities. Concrete ways and actions to implement the plan are exemplified on each individual topic.