UNIVERSITATEA TEHNICĂ
DIN CLUJ-NAPOCA

Fundamental field: **Engineering Sciences**
Specialization: **Electrical Engineering**

HABILITATION THESIS
-ABSTRACT-

Energy conversion and management for wind and transport electrification applications

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The Habilitation Thesis presents and represents the arguments that the candidate brings to pave the way for the formation of a team of young doctoral students, thus broadening his research horizons and transforming him into an established researcher. The arguments that underlie the title of Doctorate Supervisor are the skills accumulated over the years in research projects, among which, perhaps the most important is the ability to lead groups of researchers.

On a personal level, the research activities were developed in two directions: as a researcher in the Department of Electric Machinery and Actuators, UTCN and in a micro-enterprise SC BMEnergy SRL, in which I am the Administrator, and which I established in 2010 with a former colleague, Victor Meșter. We took this path because, 15 years ago, when I obtained my PhD degree, I strongly believed, as I still believe, that we must support the development of the industry in the area in the domain of our expertise. I think that, as teachers and researchers, we can work on two aspects to achieve this goal: to thoroughly prepare students so that, when they become graduates, they will honour the name of Engineer and to participate in research projects that have a significant impact on the economy. The opportunities are high in Romania considering the two objectives, because we still have a lot to do in this regard to increase the quality of the educational act, on the one hand, and to strengthen the collaboration with the companies in our field of activity, on the other hand. Close collaboration with the economic sector is very important because we can transfer to students the skills needed by employers, but also from the point of view of partnerships on research projects, which must target themes with a positive impact on companies, making them more economically and technologically competitive.

During my 15 years of post-doctoral activity, I trained as a researcher aiming at two main themes: the development of micro-wind turbines and electric propulsion systems for vehicles, and a secondary theme: energy management in on-board electrical systems. Thus, the first three chapters treat each, synthetically, the most important results obtained in the research activity in the directions stated above.

Chapter 1 begins with a presentation of the development context of renewable energy production systems, with an emphasis on the development of micro-wind turbines. Then, the mathematical apparatus that can be used for the pre-dimensioning of electric machines with permanent magnets is detailed, both in the axial and radial flux topologies. Next, the results of the research activities on axial flux generator and ferrite permanent magnets are presented, comparing the experimental and simulation results. In the second part of chapter 1, two types of radial flux generators are presented, one with counter-rotating rotors, and the other with external rotor. For both variants the performance is validated at the simulation level. In the last part of this chapter, the research activities undertaken are targeting the development of an electromechanical actuator for the furling mechanism of a micro-wind turbine.

In Chapter 2, the development steps for two technical solutions used fo electric propulsion are presented. The first of them is an axial flux machine having one stator and one rotor, which directly drives the steel wheel of an electric railway vehicle, and the second is a

radial flux electric machine without stator slots, for the propulsion of light electric vehicles, such as the solar vehicle.

Chapter 3 details the energy management algorithm using fuzzy logic for a hybrid energy storage system applied to electric vehicles. The storage elements considered are the electrochemical battery and a supercapacitor pack.

In the last part of the paper, the achievements at the level of research and extra-curricular activities, contributions and career development prospects are detailed.