

# Habilitation Thesis

## Title: Researches on Increasing the Performances of Renewable Energy Sources

### Area: Electrical Engineering

#### Abstract

This habilitation thesis presents the most important professional and scientific results in the field of renewable energy that I obtained after the public presentation of my PhD thesis, which took place in 1999, to the present. The habilitation thesis contains four sections:

- motivating request of the habilitation certificate in Electrical Engineering;
- directions and research skills of the applicant;
- the statement of the work and the scientific and technical research results;
- the career directions that require the habilitation.

The first section describes the reasons for the habilitation certificate request in Electrical Engineering. The next section presents my main research directions in which I worked during 1999- 2015, after the thesis public presentation, namely:

- Research on increasing the performances of the low-power autonomous wind power stations.
- Research on increasing the performances of the photovoltaic systems for electricity production.

In the area of increasing the performances of low-power autonomous wind power stations I have acquired the following competences:

- Modeling of the three-phase asynchronous generators with double feeding used in the construction of the wind power stations.
- Control of priority and non priority loads connected to the output terminals of a three- phase induction generator with wound rotor.
- Study of three phase synchronous generators with permanent supermagnets used in the construction of wind power stations.
- Intelligent energy management system for the energy produced by wind power stations.

In the area of increasing the performances of the photovoltaic systems for electricity production I have acquired the following competences:

- Modelling autonomous photovoltaic systems
- Developing MPPT control algorithms of the autonomous photovoltaic systems
- Developing control algorithms for photovoltaic systems with data acquisition and control board CompactRIO 9074.
- Case study of a hybrid wind-photovoltaic system using the program HOMER.

The third section presents the results of my research work based on research directions that I have approached. In the performance increase area of autonomous wind power stations I have worked on the modeling three-phase asynchronous generators used in their construction as well as the design and the implementation of the synchronous generators with permanent supermagnets that can be used in their construction. I have also developed control algorithms in real-time for priority and non priority loads connected to the output terminals of asynchronous generators in the compenence of the low-power wind power stations.

I have also developed an intelligent system for real time energy management of the energy produced by wind power stations. Concerning the performance increase in the area of photovoltaic systems for electricity production I worked for the photovoltaic systems modeling and the development of the control algorithms of fophotovoltaic systems with data acquisition and control board CompactRIO 9074. In this area I have developed control algorithms in the programming LabVIEW environment for tracking the maximum power transfer point (MPPT) between photovoltaic panels and batteries used to store electricity.

It should be noted that this research was conducted in three inter-university scientific cooperation contracts financed by the Francophone University Agency in Bucharest and Montreal in collaboration with internationally renowned professors from universities in France, Canada, Lebanon, Syria and Moldova such as: PhD Jean Francois Brudny, PhD Nichita Cristian, PhD Ilinca Adrian, PhD Hanny Yasser, associate professor PhD Pusca Remus, associate professor PhD Mazen Ghandour and associate professor PhD Ilie Nuca. My activity of research and development, as candidate during my scientific and professional development has been consistent and dynamic. The results can be summarized as follows:

- Books published: 9;
- Articles and patents ISI Thomson Reuters: 7;
- Articles published after 1999 BDI index: 20;
- Articles published after 1999 in journals and conference volumes (non indexed): 30;
- Research contracts after 1999 under my responsibility: 5;
- Research contracts after 1999 where I worked as a member: 3;

The last section presents directions for career development that require certification of candidates in electrical engineering. Therefore, I will accord particular importance for future collaborations to be oriented to the field of renewable energy and the research findings to be transferred to firms that produce the equipment needed for new renewable sources of electricity. Possible solutions to the problems identified as being insufficiently treated so far, will provide a strong motivation to continue the research activity in the field of renewable energy.

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