# Tutelea Lucian Nicolae, Habilitation Thesis, Abstract

The habilitation thesis presents personal work and research results between August 1997 after Ph.D. thesis defended and November 2014. The title of my Ph. D thesis is “Polygonal stator flux control of the ac machines” and it was defended in July 1997 at University Politehnica Timişoara.

The habilitation thesis contains the following chapters: motivation, research directions, scientific and professional achievements, professional and academic development plan and the references chapter.

The motivation chapter briefly presents the research activities linked to the energy conversion, the cooperation with the other universities and the desire to continue the research and academic activities at superior level as a PhD supervisor in Electrical Engineering field.

In the second chapter, the main research directions such as: induction machine design, biaxial excited synchronous generator, permanent magnet machine, reluctance PM assisted motor, linear oscillatory motors, two rotors, single stator axial air-gap permanent magnet machine and complementary research directions such power electronics converters, are presented. For the each direction, only the main results are presented.

The “Scientific and professional achievements” are presenting in more details the activities from the main research direction.

The research direction on the induction machine design is reflected in five paragraphs. The induction machine design for flywheel energy storage project was developed during a post doc stay at Allborg University. A design of outer rotor induction machine software was produced and optimal flux control to reduce the losses at low load. A conference paper and a research report were published on this work. The induction machine and surface permanent magnet machine design for “in-wheel mounted drive for electric car” was developed during cooperation with the Allborg University as a guest research. Five conference papers and six research reports were published on this topic. Optimal design of induction machine was an important project for didactic but also for research purpose. One paper and a chapter in a book were published on this subject. Single phase two speeds induction and permanent magnet synchronous machine is a subject coming from home appliance industries. A two pole induction machine and four pole PM line start motors in the same machines was developed in order to have good efficiency at low power and low torque because this regime is most frequent in the compressor drive for house refrigerator. The project was developed in cooperation with Embraco, Brazilia. Two papers, first in ECCE conference and after substantial modification in IEEE transactions were published on this subject. The dual stator winding asynchronous (DSWA) generator is a new subject in cooperation with a team from Automatic Faculty, UPT in a PN-II-PT-PCCA grant. Five papers were already published on this topic.

The research on permanent magnet directions is reflected in the following chapters: optimal design of surface permanent magnet machine, internal permanent magnet machine but also in induction machine and surface permanent magnet machine design for in-wheel mounted drive for electric car. The optimal design software considering analytical models based on magnetic equivalent circuit, validated by finite element was developed for the surface permanent machine in two versions: with factionary tooth wound windings and for distributed winding. The torque pulsation reductions were also considered in this investigation. The brushless dc motor with permanent magnet for residential applications was also investigated in a national grant where I was director. Six papers were published on this topic. The internal permanent magnet machine was investigated from two points of view: cogging torque and torque pulsation reductions by pole tapered and possibility to use flux concentration and replace the rare earth

permanent magnets with ferrites which are low cost permanent magnet (even chipper than copper). Three papers were published on this topic.

The two rotors, one stator axial air-gap permanent magnet machine was another major research project in cooperation with Casino University, Italy. The main idea was to boost the hybrid vehicle development by some original contribution on electrical machines topology by combining the requested two machines in a single dual port machine. Seven papers and an invention patent in Italy were the project issues.

The bi-excited generator for automobiles (BEGA) research project has been focused on the efficiency of the automotive generators improvements by new generators topologies. We cooperate in this project with Aalborg University and Grundfos. I am coauthor at five papers on this subject.

The reluctance PM assisted motor was the subject with the highest research impact with more than 67 ISI citations. The starter/generator for mild hybrid vehicle was investigated at the beginning, with a prototype building. Finite element analyses, prototype test methodology with parameters estimation and two control strategies were developed. By optimal design, a full scale motor for hybrid or electrical vehicle power-train was designed with remarkable performances. We cooperate on the projects with this topic with Alborg University and Sauer Danfoss on the static power converter. Six papers (two in transactions) were published on this subject.

The linear oscillatory motor was the subject with the most published papers: eight papers from which three in the IEEE transactions and two invention brevets one of them in Germany. The flat and tubular oscillatory motor was investigates. The tubular topologies were investigated also in a national grant where I was director. We cooperate on this subject with Hanyang University, South Korea, Hilti from Germany, Casino University from Italy and Embraco, Brazil.

The powers electronics and control of the wind turbine generators are complementary subjects in a tight relation with electrical machines and energy conversion. Seven papers were published on these complementary research directions.

In the chapter “professional and the academic development plan” two future projects already started (with already 4 published papers) are described briefly with a short presentation of the main problems that will be solved. It is also presented the cooperation’s strategy with the futures PhD students and a strategy to attracting them through research results at the highest level.

The references list contains 198 papers or invention brevets where at 67 I am coauthor (at the 25 first author).