Habilitation thesis summary

RESEARCH ON ELETRICAL MACHINES BEHAVIOUR IN VARIOUS CONTEMPORARY APPLICATION DOMAINS

The habilitation thesis with the title ***"Research on Electrical Machines Behaviour in Various Contemporary Application Domains"*** presents the main scientific, research, and professional activities that I have conducted since the completion of my doctorate thesis, in 1996 (diploma series M, Ministry number 000122, UPT number 841 on 04.12.1996). I underline the activities I have pursued since the achievement of the University Professor title (5429/03.12.2004) up to the present day.

In this period of time the activities that I have pursued took place within the Institute for Sub-engineers, Reşiţa (1978 – 1990), Engineering Faculty Reşiţa (1990 – 1992), both subordinate to the Polytechnic University in Timişoara, and within the "Eftimie Murgu" University, Reşiţa, Faculty of Engineering (1992 – 2012), Faculty of Electrical Engineering and Informatics (2012 – 2015), and the Faculty of Engineering and Management (2015 – present) at the Electrical Engineering and Informatics Department.

This thesis is organized in seven chapters and a bibliography that presents my scientific achievements.

The *first chapter* gives a summary of the habilitation thesis, in Romanian and English.

The *second chapter* of the thesis succinctly presents the research results in the domains of interest. These results are based on my 41 years and 6 months activity in the Reşiţa Steel Factory (currently TMK – three years and six months), at the Institute for Sub-engineers (14 years), and at "Eftimie Murgu" University, Reşiţa, (24 years). In the 38 year of activity in the higher education I have elaborated several textbooks as single author and multi-author textbooks as follows:

- 12 textbooks with ISBN numbers, 7 of which I am the sole author. The "Electrical Machines" textbook I am a sole author of has been published at "Editura Didactică şi Pedagogică" in 2004;
- One lecture notes volume, without an ISBN, where I am the sole author;
- One laboratory reference book, with ISBN, where I am the sole author;

- 5 laboratory reference books, without ISBN, out of which one has me as a sole author.

An important component of my scientific research activity was concretized by the design, implementation, rendering operative and testing two micro hydroelectric power plant prototypes with an autonomous synchronous, self-excited generator (abbreviated in the following with MCH). The first MHC has a 12 kVA nominal power and is located in Dognecea, Caraş-Severin County The second MHC, with a 7.5 kVA is located at Ochiu Bei, Caraş-Severin County.

In order to reduce the electricity consumption of large economic agents in the Caraş-Severin County, I have lead and participated to projects and contracts that focused on energy balance elaborations. In the domain of exterior lighting energy consumption optimisation I have led and participated to research and design projects for exterior lighting systems for Caransebeş, Reşiţa and Băile Herculane cities.

In the *third chapter* of the thesis I have presented several area of interest activities:

- Optimal operation of asynchronous machines, aiming to power factors higher than the neutral value;
- Optimal design, implementation and testing of the self-excited, asynchronous machine functioning as a generator. The optimal design has been realised depending on principal selected parameters that aim to decrease the generator's costs on its entire operation life;
- The operation of the continuous current (electrical) machine in the control loop of the asynchronous generator rotation (frequency). In this domain, I have designed several versions of power up schemes for a continuous current engine, such that it can operate with various rotations, depending on the frequency range of the instantaneous frequency, with reversible drive;
- The optimal operation of an electric transformer in a control chain. Because in the idle connection of the transformer the protection outfit can disconnect, I have studied and checked, in practice, the impact the connection moment has on the zero pass of the power voltage for the phase in observation.

The *fourth chapter* presents achievements in the domain of equipping micro hydroelectric power plants with self-excited, autonomous, synchronous generators. In this direction, the two MHC prototypes mentioned above were tested to observe the equipment reliability and their automatic operation. The micro hydroelectric power plant, located on the Dognecea lake, operated in autonomous regime, powering one consumer with an approximately 1 kW installed capacity. The start and operation of this MHC has been automatically realised, only necessitating an opening of the intake sluice. The MHC located at Ochiu Bei was an updated version of the one located at Dognecea lake. It also operated in an autonomous regime, delivering energies at 0.9 $U_n \div 1.1 \cdot U_n$ voltages and frequencies of 48÷52 Hz.

Chapter five presents research results in the electric tractions area, an area where electrical machine are very much present. For the diagnosis for traffic safety installations in the railway tractions, diagnosis charts were elaborated. The charts were the used by specialised software packages that can be used on modern mobile devices (smart phones, tablet) or personal computers. The software packages are used to detect faults in the operation of train traffic security installations, and thus assists in achieving a fluid train traffic. The diagnosis software packages that have been developed together with the ones to be developed in the near future (25 packages in total) will be collected on CDs that can be used by the maintenance staff or the Romanian Railroad Company. Currently, the available software packages are used to diagnose failures of Automatic Block Signal installations on the Caransebeş-Orşova railroad section.

The *sixth chapter* of the habilitation thesis presents research results in a connected domain: the up-to-date electrical energy usage (e.g. led based street lighting, convertors to power up electrical traction engines) and its optimisation. To optimise outdoor lighting I have focused on the use of efficient energetic light sources and the optimal design of the lighting systems.

Chapter seven presents a synthesis of my professional, scientific and academic development plan. Thus, the main teaching and research lines I intend to follow are to train future doctorand candidates and further build a multi-disciplinary research unit that is based on cooperations between different university and research centres. The experience I have accumulated with advising doctorand students in electrical engineering at the “Eftimie Murgu” University in Reşiţa gives me motivation and reason to continue such trainings in research projects with economic partners, and not only.

The *last part* of the thesis lists bibliography that supports the statements about the pursued research and scientific activities that I have mentioned, on the specific domains analysed.

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