THESIS SUMMARY

The habilitation thesis presents the scientific activity and research results obtained since the defense of the Ph.D. thesis in April 1999 to 2014, when the habilitation was printed. It is a short overview of the scientific contributions and achievements during this period, outlining the most significant activities and research efforts performed over the last fifteen years in the Electrical Engineering Faculty, from Technical University of Cluj.

In the first paragraph of the thesis the habilitation request motivation is shortly unfolded. The paragraph presents the professional experience gained during over these years, covering important theoretical knowledge and experimental skills in the mentioned scientific domain. A high number of publications including papers at international conferences, books, a patent, ISI quoted papers or research grants confirms the quality of the research and scientific activity being undertaken. The habilitation request is also motivated by the important research experience gained in international universities as invited researcher.

The second paragraph offers a brief presentation of the research areas chosen and competences gained. These research areas and competences are in Electrical Engineering, focusing mainly on the scientific domain of the Electrical Drives Digital Control Systems development and implementation. This is a multi-disciplinary research field where important theoretical and experimental competences have been gained in topics such as: pulse width modulated converters design and implementation for low-power electric motors, servomotor-based electrical drive systems development and implementation, microprocessor architectures-based digital control systems design and implementation (Intel processors, microcontrollers, FPGA processors, PLCs, etc.), fault-tolerant low-power electrical drives experimentation, or building mechatronics and automation systems implementation.

The third paragraph is dedicated to areas of competence complementary to electrical engineering. It is mentions the important theoretical and experimental knowledge gained in this period in the area of biologically-inspired digital control systems development and implementation (embedding high performance real-time parallel and distributed computing hardware architectures) for fault-tolerant electrical derives experimentation. Additionally it is outlined the experience in digital control systems programming (LabView graphical software toolkit, assembly language, VHDL, PLC ladder-logic, micropascal, etc.).

The memoir of the technical-scientific activity and research results is presented in the fourth paragraph of the thesis. It highlights the area of electrical drives digital control systems development and implementation, with a special attention on servomotors-based systems modeling, simulation, and experimentation. A high number of scientific works are dedicated to dynamic performances evaluation of servomotors-based electrical drive systems, respectively to the modeling and simulation of these systems. Modern control strategies implementation is also widely analyzed and experimented. Among these outstands the vector control strategy, the H_2 robust control strategy implementation for servo drive systems, the sliding-mode robust control or fuzzy control strategies for electrical drive systems, respectively variable structure controllers implementation for closed-loop servomotor-based systems, which are presented and explained in detail in several papers. Important research efforts have been dedicated to the low-power current-source PWM inverter design methodology and experimentation for two-phase bipolar stepping motors widely used in servo drive automation systems. The research was targeted on detailed electronic circuits presentation, simulation results, respectively laboratory measurements of a versatile power electronic module specially conceived for stepping and d.c. motors closed-loop

drive. Furthermore, during the postdoctoral research stage a special attention was focused on the linear synchronous motors power converters design, development and implementation. There have been studied special type linear synchronous motors with application in health service tray systems, specially designed and experimented for elderly persons. At the same time, digital control systems development and implementation plays a main role in the scientific and research activities of the above mentioned period. Among the designed and experimented control architectures are mentioned the hardware-in-the-loop configurations built up upon microcontroller-based configurations, implementing real-time PID control strategy, or fractional control algorithms prototyping. Programmable logic controllers-based architectures also are widely used systems in modern industrial control applications. An example of such a development system is described in the thesis. Another important research topic refers to the fault-tolerant electrical drive systems development and implementation. There the main efforts are focused on fault-tolerant power converters and fault-tolerant digital control systems design and experimentation. The basic idea of this topic is to imitate biological organism's self-healing and fault-tolerance behaviors and to implement it in digital silicon structures in order to achieve high reliability control architectures. The research efforts presented in this paragraph have also been financially supported by projects won by the author in national grants competition. Last but not least, the human-computer interaction technologies implementation in electrical drive systems is an important research task of the mentioned period. There multimodal communication abilities (such as voice recognition and image processing) have been implemented in a specially developed mobile robot. This research proves that if the robot is endowed with multimodal communication abilities it becomes suitable to exhibit more intelligence and additional cooperativeness in its behavior.

Paragraph five indicates the main directions for career development which require the habilitation. There it is mentioned that in the future career development will be followed the same area of the Electrical Drives Digital Control Systems development and implementation in Electrical Engineering. This scientific domain includes main topics such as PWM smart converters design and implementation for low-power electric motors, servomotor-based electrical drive systems development and experimentation, microprocessor architectures-based digital control systems design and implementation. At the same time it is expected that in the future career development higher attention and research efforts will be focused on the fault-tolerant electrical drive systems design and experimentation. This line of research also considers the fault-tolerant low-power electrical drives experimentation and bio-inspired digital control systems development and implementation for critical electrical drive applications.

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