ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

Mavel Edt S.p.A. - Innovative and reliable power electronics for transportation electrification

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Context of the research activity	The objective of the doctoral thesis is the study, design and implementation of innovative power electronic converters for new generations of electrified vehicles, such as battery electric vehicles - BEV, hybrid vehicles - HEV and hydrogen electric vehicles (fuel cell) - FCEV.
Objectives	The electrification of 3D mobility (land, air, water) today represents a key strategic action in reducing pollution in a sustainable society. Power electronics is an enabling technology with a key role in the electrification of various vehicle solutions, such as battery electric vehicles - BEV, hybrid vehicles - HEV and hydrogen electric vehicles (fuel cell) - FCEV. Currently, electric powertrains use power electronic converters designed with traditional silicon-based power electronics. Silicon-based power devices have reached their technological limit, limiting the efficiency (especially at low loads) and the power density of converters (< 30 kW/liter). The development of new power devices based on new wide bandgap (WBG) semiconductor technologies, such as silicon carbide (SiC) and gallium nitride (GaN), allows the development of high-performance power electronic converters. high efficiency and power density, thus reducing the consumption of electric vehicles and optimal use of the batteries. The objective of the doctoral thesis is the study, design and implementation of innovative WBG power electronic converters for new generations of electrified vehicles (BEV, HEV, FCEV). Research activities include the following tasks: • Study of new topologies of power electronic converters for electric mobility, aimed at production. • Analysis and design of innovative converter solutions with high reliability, high efficiency (>98%), high power density (>70 kVA/liter) and low impact from the point of view of electromagnetic compatibility, in compliance with automotive standards. • Study and implementation of aging models and predictive maintenance/ diagnostic techniques for power electronic converters and electric motors, improving vehicle safety by avoiding unexpected failures during vehicle operation.

	• Artificial Intelligence-based design optimization techniques of power electronic converters for electrified powertrains. • Prototyping and testing of the identified solutions. The doctoral thesis will be carried out at the Power Electronics Innovation Center of the Polytechnic of Turin in close collaboration with Mavel edt Spa.

Skills and competencies for the development of the activity	• Excellent knowledge of power electronics and control solutions for power conversion • Excellent knowledge of simulation/design environments for power electronics (Plecs, Spice, Altium Designer) • Very good knowledge of real time control and programming skills (Ansi C, Matlab/Simulink) • Very good practical skills in prototyping and testing of power and signal electronic boards. The candidate must demonstrate very good capability in facing new challenges and must be very motivated in reaching the research objectives.