POLITECNICO DI MILANO

PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 37th cycle

THEMATIC Research Field: DESIGN AND DEVELOPMENT OF THE POWER ELECTRONICS AND ELECTRIC DRIVES FOR ELECTRIC AND HYBRID SUPERCARS.

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Nowadays, there is a growing interest both from the industries and from the public opinion for electric vehicles. Compared to some years ago, this interest is not related to a kind of fashion any more, since people are becoming more and more aware about climate change and sustainable lifestyles. Hybrid and electric vehicles are facts and they represent a first attempt to reduce CO2 emissions in cities. In addition, supercar manufacturers are attracted by the electric propulsion and their high performances. To the aim of increasing the efficiency and reducing the weight of the electric vehicles further, the power electronics and its control should be revised and improved. One of the main goals of this research is to study a possible way to integrate the switching elements with the electric motor to have a single and simple cooling system for both of them and to reduce the length of the supplying cable (so as to reduce the EMI effect). Moreover, another objective of this study is the comparison and the identification of the best motor control strategy to minimize input and output current ripples (so as to reduce the machine losses) as well as the improvement of battery management systems (BMS) Finally, the best topology for this kind of application (twoor multi-level) should be investigated.
Methods and techniques that will be developed and used to carry out the research	The PhD candidate will perform both simulation and testing activities. The student will develop the knowledge

	for modelling the electrical and the thermal part of the system using both electrical circuit representation and numerical 3D simulations. Moreover, the candidate should develop prototypes to check whether the predictions are sufficient accurate or not. Therefore, he/she will become more and more familiar with the equipment available in the electric drives laboratory to be able to use it autonomously. Then, the candidate should develop in simulation first and then check on hardware a suitable and innovative control logic for the selected power electronics. The final goal of this research will be to define a reference design for the electric drive. The candidate will work in a research group with years of experience in the field of the power electronics and electrical drives. He/She will have to work in close contact with the designers of the electric machine.
Educational objectives	The field of electric vehicles is one of the most dynamic environment in these years, since the involved technology is developing quickly. Thus, the PhD candidate will work in this challenging and stimulating sector. In particular, he/she will take care of the ¿brain¿ of the vehicle, since the electric drive manages the performance and the efficiency of the motor and the power electronics as well. In this framework, the candidate will become an expert in control strategies specific for automotive applications as well as modelling techniques for the evaluation of the thermal management and the design of the semiconductors in an integrated environment. During the PhD career, the candidate will have the opportunity to meet the best national and international experts in this field and to share ideas among them.
Job opportunities	Future job opportunities are mainly in the electrical engineering field, particularly the automotive applications. The milestones achieved during this research as well as the gained competences are of great interest for R&D departments in all automotive companies. In additions, job opportunities will be in both academic and non-academic institutions and organizations engaged in innovation, research and technical development.

Composition of the research group	1 Full Professors 3 Associated Professors 4 Assistant Professors 2 PhD Students
Name of the research directors	Francesco Castelli Dezza, Davide Tarsitano

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	564.01 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities:
Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. The amount is about Euro 3.000,00.

Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: individual use.
Desk availability: individual use.