

ICT PHD

Research project for a PhD curriculum in ICT –Industrial Applications of ICT

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Proposed Title of the research: Power converters for improved efficiency and reliability of electric vehicles

Keywords: (5) Power converters, power density, Sustainability, Torque density, Green transportation

Research objectives: --(max 10 rows)

The next generation of electric vehicle (EV) propulsion architectures will be modular and efficient and will benefit from the performance of wide-bandgap devices (WBG). However, to take full advantage of improved efficiency and advanced integration, promised by these devices, there is an urgent need to develop advanced modulation and control techniques for the EV power converters, aiming to improve the EV powertrain performance without compromising the reliability, allowing for improved integration, lifetime extension, fault tolerance, predictive maintenance, reduced EMIs, and increased powertrain efficiency.

In particular, the specific objectives of the project are the following:

- Definition of the requirements of the converters used in transport systems and their sizing (DC / DC and DC / AC converters and related controls);
- Design of a high-power density converter prototype to be used for vehicle electrification applications
- Definition of control algorithms that allow maximization of performance
- Validation and test of converter prototype developed during the project.

Proposed research activity -- (max 10 rows)

With the progressive increase in installed electrical power in transport applications, DC/DC and DC/AC converters are assuming a central role thanks to their ability to connect equipment at different voltage levels and permit variable frequency control of electric motors.

Modern electrical distribution systems in transportation use intelligent DC/DC converters to manage and distribute electrical energy. Multi-port DC/DC converters are also seen as an enabling solution to effectively govern hybrid power sources, which involve the use of different energy storage technologies, such as fuel cells, batteries, and super-capacitors. However, the real challenge is to increase the power density of such components, maximize efficiency and facilitate the integration of power electronics into energy storage systems, with the need for new solutions for converter architectures, modulation strategies and control algorithms.

Supporting research projects (and Department)

The successful candidates will become part of the MeltingLab research team, working of electrical machines and converters of the University of Modena and Reggio Emilia. The candidate will be involved in the activities of the project TRANSFORM, an EU funded project which aims at the development of an industrial chain in Europe for the application of wide-bandgap devices in power electronics and control of electrical machines.

Possible connections with research groups, companies, universities.

The activity will be carried out in close collaboration with the HPE COXA company, which will make its laboratories available. With the support of HPE it will be possible to test the prototypes and design solutions that will be developed as part of the project.

Within the project, a period of work abroad is foreseen for a minimum of 6 months. To this is added a period of at least 12 months at the HPE headquarters in Modena.