Universal Bidirectional Isolated AC/DC Battery Charger for Electromobility

Summary

The Ph.D. project is focused on the study of power electronic solutions for electric vehicle charger (EVC). The primary outcome lies in the development of EVC that would not only meet the today's requirements, but will also be future-proof and applicable to mass installments. The study will cover analysis and improvements for well-known configurations, but will mostly focus on an emerging solutions.

Research field:	Electrical power engineering and mechatronics
Supervisors:	Dr. Dmitri Vinnikov Dr. Andrei Blinov
Availability:	This position is available.
Offered by:	School of Engineering Department of Electrical Power Engineering and Mechatronics
Application deadline:	Applications are accepted between June 01, 2022 00:00 and June 30, 2022 23:59 (Europe/Zurich)

Description

Electric mobility market is expected to grow rapidly in the following decade, endorsed by recent developments of Li-ion battery technology and various governmental initiatives. In order to fulfil the electric vehicle (EV) user expectations and make the ownership experience comparable to conventionally fueled vehicles, the availability of the charging infrastructure has to be improved. In order to reduce investment and maintenance costs of the new installations, new power electronics solutions are necessary, since the standard ones are already very close to the technological limits. In order to accommodate a growing EV fleet in the future, such functionalities as bidirectional operation with vehicle to grid (V2G) mode and grid support features are necessary. Moreover, the wide range of EV battery types requires support of large range of DC voltages. For mass deployment, all of the mentioned features should be realized at low cost and material use.

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Responsibilities and (foreseen) tasks

- Analysis and synthesis of EVC based on bidirectional isolated AC-DC converter topologies
- Implementation of grid-connected operation strategy with necessary soft-start and protection functions
- Implementation of smooth transitions between various operating modes
- Optimizing the voltage and current stresses in components at different operating modes
- Development of smart supervisory, management and control functions for the EVC
- Experimental verification of developed concepts and control methods
- Publishing of research findings in top-tier (Q1) journals and dissemination at the flagship conferences of the IEEE IES and PELS

Applicants should fulfil the following requirements:

- Experience in the design of power electronic DC-AC and/or DC-DC converters
- Experience in the modeling of electronic circuits in PSIM and MATLAB software
- Experience in design of control systems and their implementation in microcontrollers and DSPs
- Good understanding of power semiconductor components and their driving
- Experience with mixed-signal PCB design (preferably using Altium Designer)

- Experience with closed-loop control systems comprising sensors with analog and digital interfaces

The following experience is beneficial:

- Experience in designing minimum viable prototype of power converter
- Working knowledge of electromagnetic compatibility
- Industrial experience
- Working knowledge of battery technologies

The candidate should submit a research plan for the topic, including the overall research and data collection strategy. The candidate can expand on the listed research questions and tasks, and propose theoretical lenses to be used.

We offer:

- 4-year PhD position in one of the leading power electronics groups in EU
- Access to state-of-the-art lab facilities
- Collaboration with the world-leading supplier of power electronics components – Infineon Austria – with possibility of regular visits paid by the company.
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers in the fields of power electronics

About the department and group

Department of Electrical Power Engineering and Mechatronics was established on 1 January 2017 within the framework of the structural reform of Tallinn University of Technology (TalTech) based on the departments of Electrical Power Engineering, Fundamentals of Electrical Engineering and Mechatronics.

We are an academic structural unit that belongs to the TalTech School of Engineering.

The department conducts teaching at the bachelor, master, and PhD levels, as well as research in the field.

Research in the **Power Electronics Group** is focused on the development and experimental validation of new state of the art power electronic converters for such demanding applications as rolling stock, automotive, telecom and renewable energy systems. Key research directions include synthesis of new converter topologies, development of special control and protection algorithms, implementation of new components and elaboration of design guidelines to further improve the efficiency, power density, reliability and flexibility of the on-market power electronic converters. Other research activities are concentrated on the development of power flow control algorithms and new supervision, fault detection, protection and communication methods for the electronic power distribution networks (Micro- and SmartGrids).

Highlights:

- Well experienced and dynamic team of young researchers and engineers (1 Professor, 4 Senior Researchers, 1 Senior Lecturer, 3 PostDocs, and 9 full-time Ph.D. students)
- Long-lasting experience in applied design of power electronic converters for different power ranges and applications
- Since October 2011, the group is the European Competence Centre of Power Electronics and an active member of European Centre for Power Electronics (ECPE)
- Strong record of scientific publications (over 60 annually published research papers)
- Project-based PhD programs with research oriented theses
- Strong relations and cooperation with Estonian and Baltic industrial companies
- Strong relations with European universities and research institutions
- Modern laboratory facilities and infrastructure:
- Active participation in EU funded programs and joint research projects

Additional information

For further information, please contact Prof. Dmitri Vinnikov (dmitri.vinnikov@taltech.ee) or Dr. Andrei Blinov (andrei.blinov@taltech.ee).

To get more information or to apply online, visit https://taltech.glowbase.com/positions/537 or scan the the code on the left with your smartphone.