Partial Power Converters for Ultra-Efficient DC Microgrids

Summary

Ph.D. student will work on innovative solutions to further advance high energy conversion efficiency intrinsic to DC microgrids. This Ph.D. work includes but is not limited to developing novel topologies and control approaches based on the partial power conversion principle and their real-world application in DC microgrids for renewable energy integration, storage, power flow control, etc.

Research field:	Electrical power engineering and mechatronics
Supervisor:	Dr. Andrii Chub
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, 2024 00:00 and June 30, 2024 23:59 (Europe/Zurich)

Description

Power electronics is an enabling technology for the ongoing electrification of the economy. The existing power electronic converters are predominantly based on processing entire power via power electronic converters, causing maximum stress on semiconductor components. These technologies are mature and widely accepted in the industry, but available semiconductor and magnetic components technologies stall their advance. As a result, new energy conversion approaches are being considered to overcome these technological barriers.

Partial power processing is a novel and promising approach that enables electric energy conversion efficiency of well over 99% in applications where the gain of a DC-DC converter is close to one. This emerging technology is perfectly suited to develop the next generation of DC microgrids with ultimate efficiency. However, it requires application studies of how topologies and control approaches can be matched with each application to attain all possible benefits of partial power processing.

This work will contribute to the field of applied power electronics and control with high practical value for the development of DC distribution technology.

Responsibilities and (foreseen) tasks

- Synthesis and implementation of new dc-dc converter topologies based on partial/differential power processing principles
- Design and implementation of magnetic components with optimized volumetric parameters
- Synthesis and verification of novel control methods resulting in efficiency optimization
- Feasibility study and benchmarking of different semiconductor devices against application requirements
- Design of control systems based on small and large signal models
- Publishing research findings in top-tier journals and dissemination at the flagship conferences of the IEEE IES/PELS - 3 Journal and 4 Conference papers is the minimum expected level to qualify for defense.

Applicants should fulfill the following requirements:

- master's degree in power electronics;
- B2 English level certificate if English is not the native language and the language of instruction in MSc study was not English;
- practical experience in the design of power electronic converters;
- experience in the modeling of electronic circuits in PSIM or PLECS software;
- experience with PCB design (preferably using Altium Designer);
- experience with closed-loop control system design with analog/digital sensors and DSPs;
- good understanding of power semiconductor components, basics of their driving and packaging;
- excellent command of English and strong and demonstrable writing and analytical skills;
- capacity to work both as an independent researcher and as part of an international team;

- capacity and willingness to provide assistance in organizational tasks relevant to the project.

(The following experience is beneficial:)

- international publications will be valued;
- internship experience abroad will be considered a plus;
- industrial experience is preferable.

We offer:

- Early Stage Researcher position in one of the leading applied power electronics research centers in EU with a large portfolio of ongoing pan-European and national research and innovation projects
- Opportunities for conference visits, research stays, and networking with leading universities and research centers in the fields of power electronics and microgrids.

About the group

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 the 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 Smart-Grids).

Highlights:

- Well experienced and dynamic team of young researchers and engineers (1 Professor, 4 Senior Researchers, 1 Senior Lecturer, 4-6 PostDocs, and 8-12 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 the European Centre for Power Electronics (ECPE)
- Strong record of scientific publications (over 60 annually published research papers)
- Project-based PhD studies 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 national and EU funding programs and joint research projects

(Additional information)

For further information, please contact Dr. Andrii Chub andrii.chub@taltech.ee

To get more information or to apply online, visit https://taltech.glowbase.com/positions/787 or scan the the code on the left with your smartphone.