

Research, Design, and Implementation of Partial Power DC-DC Converters

Summary

PhD Research Project in the Field of Applied Power Electronics

Research field:	Electrical power engineering and mechatronics
Supervisors:	Dr. Andrii Chub 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 November 16, 2020 00:00 and December 16, 2020 23:59 (Europe/Zurich)

Description

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The future of the energy sector is associated with wide electrification of energy production, transportation together with wide use of renewable energy sources. Consequently, it will require extensive use of power electronic converters along with DC distribution for energy transmission and distribution. Conventional power converters that are processing the entire power flow provide high performance in terms of regulation range, controllability and protection are commonly used in such applications. However, their reliability and capital costs can limit their wider adoption in the energy sector. On the other hand, partial power DC-DC converters (PPC) have shown excellent cost-performance ratio in their early applications, like wind turbines with doubly-fed induction generators.

This project is focused on the development of cost-efficient power electronic systems for DC distribution in renewable energy generation and storage applications. The primary outcome of this PhD work will be in the development of bidirectional PPCs based on current-source topologies that are capable of operating in buck and boost modes, while providing soft-switching for semiconductors in a desired load and voltage range. In addition, special attention will be paid to protection methods that enable optimal design of PPCs.

Ph.D. student will develop new topologies of soft-switching buck-boost PPCs as well as optimal design methods for DC distribution systems and associated protection techniques.

Project tasks:

- Analysis and synthesis of PPCs based on current-source isolated dc-dc converter topologies
- Buck-boost implementation of the PPC for reduced partiality ratio
- Development of multimode control with smooth transition between modes for analysed topologies
- Optimising the voltage and current stresses in components at different PPC operating modes
- Development of effective and low-cost protection methods for the DC power distribution systems
- Experimental verification of developed converters and control methods for selected applications

Duration:

The duration of the project is planned for four years starting in the Spring semester 2021.

Preferred qualifications (in order of importance):

- Practical experience in the design of power electronic converters
- Experience in the modeling of electronic circuits in PSIM or PLECS 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 applicants should fulfill the following requirements:



- The successful candidate should hold an M.Sc. degree in Electrical Engineering.
- A strong background and interest in Power Electronics are expected.
- Prior practical experience with galvanically isolated dc-dc converters is preferred.
- The candidate will work in the international team and collaboration with partner universities and companies. Hence, we expect fluency in spoken and written English.

Questions about the position can be directed to Dr. Andrei Blinov (andrei.blinov@taltech.ee) or to Dr. Andrii Chub (andrii.chub@taltech.ee).



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