Design and Development of AC Grid Interface Converter for Residential DC Microgrids

Summary

The Ph.D. project is focused on the study of power electronic solutions for Grid Interface Converter that would meet the requirements of the DC microgrid and provide effective coupling with the AC distribution grid. The study will cover both well-known topological configurations as well as emerging single-stage solutions.

Research field:	Electrical power engineering and mechatronics
Supervisors:	Dr. Andrei Blinov Indrek Roasto
Availability:	This position is available.
Offered by:	School of Engineering Department of Electrical Power Engineering and Mechatronics
Application deadline:	Applications are accepted between September 01, 2021 00:00 and September 30, 2021 23:59 (Europe/Zurich)

Description

Advancing electrification with its broad use of electronic devices and renewable energy sources has increased the role of power electronic converters in the power distribution system. Particularly, in the residential sector a significant part of loads now use built-in power electronic interface with DC voltage for the power supply. Since renewable sources (e.g. photovoltaic solar) and storage systems (batteries, supercapacitors) are also DC in nature, this has triggered a growing interest towards the concept of residential DC microgird. The DC distribution avoids any frequency stability and reactive power issues and can potentially provide reduced system cost.

One of the key components of the DC microgrid is an AC grid interface converter (GIC), which should ensure its flexibility and resilience. The GIC provides an interface between the DC and AC grids and its primary role is in control of the devices within the DC microgrid (e.g. using droop control) and management the energy exchange with the AC grid. The requirement of galvanic isolation typically leads to two-stage GIC design with an intermediate dc-link. Alternatively, a range of emerging single-stage solutions can meet the isolation requirement, while offering potential advantages in terms of power density and cost.

Project tasks:

- Analysis and synthesis of GIC 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
- Optimising the voltage and current stresses in components at different operating modes
- Development of effective supervisory, management and control functions for the GIC
- Experimental verification of developed concepts and control methods for DC microgrid application

Duration:

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

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
Experience with mixed-signal PCB design (pref. Altium Designer)
Experience with closed-loop control systems, sensors, analog and digital interfaces

The successful applicant should hold an M.Sc. degree in Electrical Engineering with strong background in Power Electronics. Prior practical experience with galvanically isolated DC-DC converters and/or three-phase inverters is preferred. Fluency in spoken and written English is expected.

To get more information or to apply online, visit https://taltech.glowbase.com/positions/369 or scan the the code on the left with your smartphone.

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