

Energy Management in Positive Energy DC Buildings and Districts

Summary

The Ph.D. project is focused on the study of energy management methods in the context of DC buildings and districts. The primary task is to research and develop control methods that would be able to manage DC grid supply and demand by integrating renewable generation, energy storage and flexible load management, with the aim of achieving energy neutrality or even positivity at the neighborhood level

Research field:	Electrical power engineering and mechatronics
Supervisors:	Dr. Roya Ahmadihangar 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

Advancing electrification with its broad use of electronic devices and renewable energy sources has increased the role of power electronic interfaces in the power distribution system. Particularly, in the residential sector a significant part of loads now uses built-in power electronics 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 microgrids. The DC distribution avoids any frequency stability and reactive power issues and can potentially provide easier and more efficient integration with reduced system costs. In this regard, the transition of a grid that have already realized much of its savings potential to DC power could be one of the largest remaining sources of energy-efficiency increase and one of the key enablers of positive energy district concept.

Project tasks:

- Analysis of centralized and decentralized control methods in DC microgrids
- Study of existing and developing DC microgrid standards, requirements and other specifics
- Characterization of advantages and drawbacks of various power management methods
- Development of efficient control methods (e.g. based on droop, DC bus signaling)

Duration:

The duration of the project is planned for **four** years starting in the **September 2022**.

Supervisors:

Main supervisor: Dr. Andrii Blinov
Co-supervisor: Dr. Roya Ahmadihangar

Preferred qualifications (in order of importance):

- Experience in the modeling in MATLAB and Python software
- Experience in design of control systems
- Understanding of power semiconductor based converters
- 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 Systems are expected. Basic knowledge of power semiconductor converters and DC systems is a benefit. The candidate will work in the international team and collaboration with partner universities and companies. Hence, we expect fluency in spoken and written English.

About the department

The Department of Electrical Power Engineering and Mechatronics of Tallinn University of Technology is an interdisciplinary research center that focuses on socially relevant and future-oriented research and teaching issues related to power engineering and mechatronics. The mission of the Department is to be a leader in electrical engineering and technical studies and development projects in Estonia, known and valued in society, and a respected partner in both national and international cooperation networks and organizations. The department has coordinated and partnered several international projects, including Horizon 2020, INTERREG, 7FP, Nordic Energy Research etc.

The Department of Electrical Power Engineering and Mechatronics conducts research within 7 research groups and operates state of the art laboratories with high end equipment, offering also accredited services in the fields of lighting and different electrical measurements. The focus areas of the department are related to domestic and global challenges related to increasing digitalization, decarbonization and decentralization of electric power systems and increasing use of renewable energy sources. The department carries out research in the following relevant areas:

- optimization of electric power systems and system analysis to find possibilities for electrification and decarbonization
- diagnostics and monitoring of equipment and systems
- cyber security, 5G data communications and artificial intelligence
- energy networks and research on hydrogen technologies, including energy storage, renewable energy, low carbon technologies, consumption management, IoT applications in energy
- implementation of smart industry, including industrial robotics, automation, 3D printing, machine vision
- implementation of energy and resource efficiency, including digitization of supply chains, mapping of opportunities to optimize systems and reduce energy consumption
- development of smart city solutions, including environmentally friendly and self-driving vehicles / drones, digital twin applications.

Questions about the position can be directed to Dr. Andrei Blinov (andrei.blinov@taltech.ee) or to Dr. Roya Ahmadihangar (roya.ahmadi@taltech.ee).



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