

Resilient DC Microgrids with Cyber-Physical Security Monitoring

Summary

Ph.D. student will work on DC microgrids represented as cyber-physical systems and their security and conditions monitoring employing physical sensing and cybersecurity domain methods. This approach is expected to enhance the resiliency of DC microgrids to physical faults and attacks, as well as cyber-attacks. The cyber-physical domain can provide more complete information for distinguishing faults from attacks and isolating them, ultimately improving the resilience of DC microgrids.

Research field:	Electrical power engineering and mechatronics
Supervisors:	Dr. Andrii Chub Prof. Dr. Hayretdin Bahsi
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

DC microgrids are becoming the preferred solution for more efficient generation, storage, and use of renewable energy. On the other hand, this technology is strongly dependent on the cyber domain, making it more vulnerable to cyber-attacks. The ability to detect and distinguish physical attacks, faults, and cyberattacks is paramount to advance the future DC microgrids.

This research project will consider DC microgrids as cyber-physical systems, where power electronic converters will perform physical condition monitoring. More particularly, this research will target DC microgrids based on partial power processing that enables very high conversion efficiency. Combining information obtained from measurements with cyber-domain information can allow for distinguishing between different faults and attacks. As a result, DC microgrids can achieve much higher resiliency.

This work will contribute to DC distribution technologies and help them achieve more resilient operation.

Responsibilities and (foreseen) tasks

- Synthesis and implementation of control systems for partial power DC-DC converters, embedding conditions monitoring algorithms
- Characterization and modeling of DC microgrids as cyber-physical systems
- Synthesis and verification of cyber-physical security monitoring algorithms for DC microgrids
- Development of cyber-physical security verification test bench of droop-controlled DC microgrid
- Development of cyber-physical resiliency metrics for DC microgrids
- Integration of the developed algorithms with energy management system
- 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 smart grids or related areas with cyber-components;
- 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 control algorithms;
- experience in modeling microgrids in specialized 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 electronic systems for DC microgrids;
- 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



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