EMC Methods at Partial Power DC/DC Converters

Summary

PhD position goal is to elaborate principles and strategies related to protection of electromagnetic spectrum from wideband interference, related to the perspective technologies to be deployed in partial power DC/DC high-efficiency power electronic converters technologies and systems composed on these units. Research questions targeted are related to 1) appropriate measurement methods and procedures to assess the electromagnetic spurious emissions levels from operating converters 2) basic phenomena responsible for the potential electromagnetic emissions in partial power DC/DC converter designs 3) potential strategies of the long-term monitoring of electromagnetic disturbance levels and propagation in view of extended wearout and aging of the components on the power electronic energy conversion units.

Research field:	Electrical power engineering and mechatronics
Supervisor:	Dr. Lauri Kütt
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

Electromagnetic compatibility (EMC) as a field in engineering has long history with numerous standards and regulations in place around the world. Meeting the EMC requirements is a well-established design criteria for mature technology concepts. The challenges in the EMC on one hand arise from the elaboration of novel strategies for power conversion, where for example multiple power electronic converters are packed in a high-density arrangements. Spurious emissons are often damped by efficiency-decreasing circuits, where the added components require more space and add mass as well as cost of units.

The partial power DC/DC converter architectures are a promising development, where the efficiency increase is provided through a partial proportion of energy conversion through switching converter. This presents a new topology for the electromagnetic interference propagation, where the filters and damping of the EMI requires a careful consideration to be most fruitfully implemented. On another direction, the spurious emissions are observed as the condition monitoring inputs, whereby failures in components are are investigated to be predetected through variations in the interference emissions patterns.

The goal of this PhD project is to define and experimentally validate the methods for the EMC measurements and evaluation related to partial power converter topologies specifics. A dedicated approach will be provided provided towards the EMI emission analysis of practical built power converter units and supply systems based on partial power converters.

The thesis should address the following questions: 1) Which aspects of measurement and quantification of the EMI is appropriate for measurement and setup for partial power converters? 2) Which limitations arise from the known methods of suppression of EMI for the partial power converters? 3) How to implement the long-term EMI monitoring for the benefit of reliability estimation and condition monitoring of the partial power converters?

Responsibilities and (foreseen) tasks

- Compile a critical practical case based listing of usable methods for EMI measurements, addressing the opportunities, challenges and shortcomings related to partial power DC/DC converters;
- Extract practical data from the measurements done applying different signal processing and statistical processing methods; conducting measurements on operating units and test configurations;
- Configure the measurement setups, measurement devices and required auxiliary equipment for qualified measurements of partial power converters;
- Formulate the proposals of methods in form of scientific publications, report on the applicability of the methods using the scientific expression;
- Contribute to the organization of research and practitioner workshops where project findings are presented

Applicants should fulfil the following requirements:

- a master's degree in electrical engineering sciences (preferably in areas related to electrical power conversion, power electronics, applied electromagnetics)
- a clear interest in the topic of the position
- excellent command of English
- 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:)

- Experimental and/or theoretical electromagnetic analysis, electromagnetic compatibility
- Programming in C / C++ / Python
- Working knowledge of statistics and signal processing;
- Working knowledge of mathematical data analysis software, such as Matlab, NI Labview

The candidate should submit a research statement and motivation for the topic, including the expression of interest in the particular aspects of measurement, data processing of physical phenomenon research. The candidate can expand on the listed research questions and tasks, and propose theoretical lenses to be used.

We offer:

- 4-year PhD position in one of the largest, most internationalized and leading engineering science research centers in Estonia with a large portfolio of ongoing pan-European and national R&D projects in the field of electric engineering;
- The chance to do high-level research in one of the fast developing laboratories in the field of applied electromagnetics with direct hands-on approach;
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers in the fields of electrical engineering.

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 educates future electrical and power engineering leaders and engineers at the bachelor's, master's and doctoral level. Through training courses, the department ensures lifelong learning and continuous development.

The department carries out large-scale interdisciplinary scientific research, development and professional projects, thanks to which the competence in the field of electrical energy and mechatronics continues to grow. With research, application and development services, the department increases the competitiveness of companies in both the domestic and international markets, keeping knowledge in Estonia. The department has coordinated or been a partner in numerous international projects, such as Horizon 2020, INTERREG, 7FP, Nordic Energy Research, etc.

The Department of Electrical Power Engineering and Mechatronics conducts research within seven 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 departments' focus areas are related to both domestic and global developments, such as increasing digitalization and decarbonization, decentralization and decentralization of electricity generation, and the increasing use of renewable energy sources. The department conducts research in the following relevant areas tackling the energy transition:

- optimization of electrical 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.

(Additional information)

For further information, please feel free to contact Dr. Lauri Kütt at lauri.kutt@taltech.ee for further details on the subjects associated with this position offer.

To get more information or to apply online, visit https://taltech.glowbase.com/positions/779 or scan the the code on the left with your smartphone.