

EMC Methods at GreenTech and Efficient Electric Installation Sites

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 practical electric installations related to 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 practical installations 2) basic phenomena responsible for the potential electromagnetic emissions in practical electric installations 3) potential mitigation strategies of the electromagnetic disturbances in view of long-term operation and aging of the components on the high-efficiency 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, 2023 00:00 and June 30, 2023 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. A closer look though reveals that many of the normative terms could fall short, given the range of power electronic devices' deployment in the practical electric systems. Switching energy conversion units are basically mandatory for every commercial electric installation, for example, to meet the high efficiency goals. Similarly the renewable systems integrating battery storage are using power electronic converters as main energy conversion units. Each of such converters in the system could be prone to emit a portion of electromagnetic radiation or conductively transmitted, potentially disturbing to the other devices in proximity.

The electrical installations altogether present high challenges for the EMC criteria evaluation and measurement. Given the large dimensions and on-site electromagnetic field quantities measurements' challenges it needs consideration to find the most appropriate path for measurements and site survey to be completed in acceptable time-frame. The methods proposed by the normatives in effect, but also upcoming (such as CISPR 37), would require extensive time, making additional challenges and expensive.

The goal of this PhD project is to define and experimentally validate the methods for the EMC criteria related EM-field investigation and measurement. A dedicated approach will be provided towards the EM emission analysis of practical built electric installations and facilities.

The thesis should address the following questions: 1) Which aspects of measurement and quantification of the EM-fields from present normative is appropriate to be used for electrical installations? 2) Which limitations arise from the known proposed methods of measurement of electric installations? 3) How to minimize the inaccuracy and uncertainty related to measurements of EM-fields from few points?

Responsibilities and (foreseen) tasks:

- Compile a critical practical case based listing of usable methods for on-site EM-field measurements, addressing the opportunities, challenges and shortcomings;
- Extract practical data from the measurements done applying different signal processing and statistical processing methods;
- Configure the measurement setups, measurement devices and required auxiliary equipment;
- 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, electrical installations and/or power delivery)
- 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/677> or scan the the code on the left with your smartphone.