

Detection and monitoring methods by electromagnetic emission measurements

Summary

The overall goal of the project is to establish ground to investigate the electromagnetic (EM) emissions for the power electronic supplies and related electric installations. This will complement to the present regulations of electromagnetic compatibility, in particular, to oversee the bandwidth areas for monitoring and measurement to be used for diagnostics and overall reliability of the power supply. Practical EM near-field measurement methods can be expected to provide additional capabilities for enhanced diagnostic capabilities of systems and installations.

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, 2022 00:00 and June 30, 2022 23:59 (Europe/Zurich)

Description

A growing share of consumer and industrial appliances and installations are using electronic controlled power supplies for their main functionality. One of the consequences of the more sophisticated control and operation brings along, on one hand higher efficiency ratings, on the other hand, new challenges to maintain the acceptable quality of EM-environment. Experimentally it has been evident that for example device failures and aging can lead to increase in the units' EM-emission levels. The research within this thesis project will be seeing through the origins and propagation mechanisms of the spurious EM-emissions related to the operation of the power electronic units.

Research will be carried out relying on measurements of model devices in the laboratory facilities at TalTech. Measurement methods will be reviewed to provide coverage to monitor both radiated and conducted EM emissions in 'wider than regulation practices' frequency bandwidth. The investigation would provide input for the characteristics related to the measurement duration, data intensity and data amounts needed to carry out analysis for the performance diagnostics. The on-line methods of measurement are to be especially targeted.

The thesis is heavily experimental and should address the following questions: 1) Which circuits form the main sources of the EM-emissions for the power electronic units, related to varying emissions due to component aging? 2) How is the aging and malfunction of the power electronic units characterized in the measurement outcome of the EM-emissions? 3) How do the emissions in frequency bandwidth ranges not covered by requirements in the regulative documents benefit to the diagnostic capabilities of devices and systems? 4) Which methods for measurement are most beneficial for carrying out fastest and more successful diagnostics of the devices and practical installations?

Responsibilities and (foreseen) tasks

- Reviewing the industry practice stated in the regulations and standards related to the EM-emission measurements and respective methods required.
- Carrying out tests for EM-emissions of model devices defined for the test targets.
- Collect data and conduct case studies on the selected field applications, including the real working systems and installations, power electronic units under various loading conditions.
- Define and elaborate algorithms efficient for the fault detection, using short- and long-term processing of the measured data.
- 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 electromagnetics, electric power converters, electric power supply, embedded electronics)
- good grades in calculus and physics subjects
- good comprehension of Matlab and practical programming skills
- 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:

- Microcontroller architectures and embedded systems
- Instrumentation and measurement, measurement system programming
- Programming in C, Python, LabView
- Working knowledge of SQL
- Working knowledge of statistics
- Working with cells

The candidate should submit a research plan for the topic, including the overall research and data collection strategy. 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 research group of fundamentals of electrical engineering, closely related to accredited EM-field measurement laboratory body in Estonia with a large portfolio of dedicated research, industrial and study-oriented projects
- The chance to do high-level research in one of the most dynamic Universities and research groups in the region
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers in the fields of EM-engineering and electromagnetic compatibility.

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 energy 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 contact Dr. Lauri Kütt lauri.kutt@taltech.ee or visit <https://taltech.ee/en>



To get more information or to apply online, visit <https://taltech.glowbase.com/positions/538> or scan the the code on the left with your smartphone.