

# Power Quality and Disturbances Monitoring and Estimation in the Electric Power Delivery Systems Contributing To Green Deal

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## Summary

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*PhD position goal is to elaborate principles and strategies related to protection of power supply quality in aspects related to present (eg AC power distribution) and proposed (eg mixed AC and DC power distribution) and electric power delivery and distribution systems. Targets for investigation include microgrid scale weak networks up to more stronger, locally supported multi-point supplied networks with high local power production (eg renewable sources) and storage units (eg batteries). Research questions targeted are related to 1) appropriate measurement methods and procedures to assess the quality of electric power delivery available 2) investigation on expanded methods for continuous on-line monitoring and network power quality 3) evaluation of appropriate methods to define the limits of operation, related to extensive power quality indexes monitoring.*

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

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Electric distribution grids are facing some of the most rapid inclusion of domestic and industrial units capable of electric power infeed. As part of renewable energy infeed systems, such converters can introduce several co-effects of their operation, such as increased voltage ripple and waveform distortion, significant increase of high-frequency electromagnetic emissions etc regardless of the advanced control options related to the energy delivery functional targets. However, such power delivery quality decreasing factors can impose some of the strictest limitations, as the network altogether would not be able to operate with excess disturbances.

The aspects of power quality disturbances can and are prone to arise from aging power converter units, devices with degraded capabilities that are constantly operating and connected to the grid. This means that even while verified at the time of commissioning, the grid would need to have some capabilities to detect the problematic units and connections that might arise as potentially harmful to the operation. On-line continuous measurements are required for appropriate survey, but similarly methods to detect the potential maloperation points.

The goal of this PhD project is to define and experimentally validate the methods for the power quality criteria surveillance, related to voltage waveform distortions, increased ripple and high-frequency disturbance infeed.

The thesis should address the following questions: 1) Which aspects of measurement and quantification of the power quality monitoring from present best practices is appropriate to be used for electrical grids on-line monitoring? 2) Which limitations arise from the known proposed methods of measurement of electric power quality monitoring? 3) How to assess the potential failure points and disturbance sources from the grid using the PQ monitoring data gathered?

### Responsibilities and (foreseen) tasks:

- Compile a critical practical case based listing of usable methods for power quality 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 for the on-line measurements of AC and DC power delivery systems;
- 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](mailto: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/679> or scan the the code on the left with your smartphone.