Enhancing Renewable Energy Penetration Through Improved Hosting Capacity and Flexibility of Electric Energy Production, Storage and Management Applications

Summary

We invite applications for a PhD position focused on enhancing the integration of renewable resources, especially solar photovoltaic (PV) systems into power grids. Research conducted is aimed at maximizing the overall renewable-based energy utilization, relying on the efficient utilization of energy storage, flexible load management and optimized implementation of external energy resources from power grid. Key research areas include theoretical and practical model development, simulation, case studies, and collaboration with industry partners. Applicants should have a master's degree in electrical engineering or a related field, strong analytical skills, and proficiency in modeling tools. The PhD student is expected to publish research results in high-impact peer-reviewed journals and present at international conferences while contributing to the development of policy recommendations and technical guidelines for renewable energy systems' integration.

Research field:	Electrical power engineering and mechatronics
Supervisors:	Dr. Lauri Kütt
	Noman Shabbir
Availability:	This position is available.
Offered by:	School of Engineering
	Department of Electrical Power Engineering and Mechatronics
Application deadline:	Applications are accepted between October 01, 2024 00:00 and October 25, 2024 23:59 (Europe/Zurich)

Description

The focus will be on advancing the integration of renewable energy resources, especially solar photovoltaic (PV) systems into the electric power grid, storage principles for the on-site produced energy and management of the electric energy resource at any time throughout the year. The successful candidate will engage in cutting-edge research aimed at improving solar PV hosting capacity, energy storage dimensioning, enhancing energy management strategies, and developing flexibility applications to ensure a reliable and sustainable local and wide-area energy system. Here are the key research questions:

- How can the existing capacity of power grids be maximized to accommodate higher penetration of solar PV systems?
- What are the critical factors influencing the hosting, storage and flexibility capacity of various grid configurations?
- What innovative energy management strategies can be implemented to optimize the integration of different renewable production and loading units?
- How can electric energy storage and load dynamic response be effectively utilized to support high levels of renewable integration?
- What role can flexibility applications play in mitigating the variability and intermittency of renewable generation?
- How can flexibility services be economically and technically integrated into existing grid operations?

Responsibilities and (foreseen) tasks

- Develop advanced models to simulate the impact of increased solar PV penetration on power grids.
- Design and implement algorithms for optimizing energy management strategies.
- Perform case studies using real-world data to validate and refine models and strategies and analyze the effectiveness of proposed solutions in various scenarios.
- Develop and test flexibility applications, including energy storage and demand response mechanisms.
- Evaluate the performance and economic viability of these applications in supporting renewable integration.

Applicants should fulfill the following requirements:

- • Master's degree in electrical engineering or computer science
  - • Deep understanding of electric power systems and electric power distribution
  - • Proficient programming & data analytics skills (e.g., Python, MATLAB, R)
  - • Proficient English language user (at least CEFR level of C1)
  - • Excellent problem solving and analytical skills
  - • Capacity to work both as an independent researcher and part of an international team
  - • Willingness to aid in relevant organizational tasks

The following experience is beneficial:

- • Published scientific papers
  - • Practical experience in working with MATLAB/Python/R
  - • Experience with grid simulation tools (Power Factory DigSilent)
  - • Basic knowledge of machine learning techniques

The candidate should submit a motivational essay on the topic, including the most intriguing research and future elaboration aspects for the candidate, in relevant technical matters. The candidate can propose on the expansion of listed research questions that candidate would see most motivating challenges to solve.

We offer:

- 4-year PhD position in one of the largest, most internationalized and leading social science research centers in Estonia with a large portfolio of ongoing pan-European and national public administration, digital governance and innovation studies projects
- The chance to do high-level research in one of the most dynamic digital government contexts globally
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers in the fields of public administration, innovation studies and digital government

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 has coordinated and partnered with several international projects, including Horizon 2020, INTERREG, 7FP, Nordic Energy Research etc. The Department of Electrical Power Engineering and Mechatronics conducts research within 7 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 focus areas of the department are related to domestic and global challenges related to increasing digitalization, decarbonization and decentralization of electric power systems and increasing use of renewable energy sources. The department carries out research in the following relevant areas:

- Optimization of electric power 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 green technology, including energy storage, renewable energy, hydrogen systems
- Supply and demand-side management, IoT applications in energy systems
- Implementation of smart industry, including industrial robotics, automation, 3D printing, computer vision, digital twins

Additional information

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For further information, please contact Dr. Noman Shabbir, noman.shabbir@taltech.ee and Prof. Lauri Kütt, lauri.kutt@taltech.ee

To get more information or to apply online, visit https://taltech.glowbase.com/positions/865 or scan the the code on the left with your smartphone.