Digital twin design and development for power system real time applications

Summary

This PhD project focuses on developing a digital twin of a converter based generation dominated power system. The work involves conceptual design of the digital twin, critical analysis of alternative solutions, implementing and testing the chosen technical solution. The purpose of the developed system is to act as a data source and test platform for real time applications.

Research field:	Electrical power engineering and mechatronics
Supervisors:	Prof. Dr. Jako Kilter
	Madis Leinakse
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 research

The objective of this PhD project is to design and develop a digital twin of a power system that could be used for testing and implementing real time applications. The addressed power system includes converter based generation (wind and PV) and storage. The designed digital twin may be linked to or involve Phasor Measurement Units (PMUs), Wide Area Monitoring System (WAMS), Real-Time Digital Simulator (RTDS), Programmable Logic Controllers (PLCs). Implementation of the solution may involve developing software in Python, Matlab or other programming language. The ultimate objective of the work is to create a platform that would enable development and testing of real time applications for increasing operational awareness of the power system. Thereby, increasing system security.

Responsibilities and (foreseen) tasks

- **Research and Development:** Conduct research in the field of digital twins of power systems and develop one for a specific application.
- **Teamwork:** Co-operation with colleagues to map needs, opportunities, determine optimal design and implement solution.
- **Lab Work:** Work at a power system laboratory. Including work with different devices and software tools to implement designed digital twin.
- **Validation and Evaluation:** Conduct rigorous validation and evaluation of the designed digital twin to ensure accuracy and reliability.
- **Documentation and Dissemination:** Document research findings, methodologies, and outcomes, and disseminate results through academic publications and presentations.
- **Teaching and supervision:** Supervising BSc and MSc theses related to research subject, teaching in supporting role and limited capacity.

Applicants should fulfill the following requirements:

- a master's degree in Electrical engineering from last 3-5 years
- a clear interest in the topic of the position
- profound knowledge of electric power systems
- 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 aid in relevant organizational tasks

The following experience is beneficial:

- (co-)authored scientific papers published in Q1 or Q2 journals
- programming using high-level programming languages (e.g. Matlab, Python, C++, C#, Java or similar)
- hands on experience with lab equipment (RTDS, PMUs, PLCs) and systems (WAMS)
- renewable power plants and batteries

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 the leading power system research group in Estonia with a large portfolio of pan-European and national research and development, and study projects, mainly concerned with renewable energy integration and wide-area based applications in electric power systems.
- The chance to do high-level research in the domain of power systems and renewables integration in an international and enabling environment with state-of-the-art research infrastructure.
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers in the fields of power systems monitoring and control

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 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 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 Madis Leinakse madis.leinakse@taltech.ee and Prof. Jako Kilter jako.kilter@taltech.ee

To get more information or to apply online, visit https://taltech.glowbase.com/positions/874 or scan the the code on the left with your smartphone.