Multimodal AI and ML Applications for Electric Power Systems

Summary

The Department of Electrical Power Engineering and Mechatronics at TalTech invites applications for a fully-funded PhD position in the field of AI applications in electric power systems, with a special emphasis on multimodal AI models and their applications in electric power systems. This interdisciplinary PhD position combines artificial intelligence (AI) and modern electric power systems. The primary objective of the research is to investigate and develop multimodal machine learning models capable of processing heterogeneous data sources—specifically time-series sensor readings, visual data (e.g., images and video streams), and unstructured textual documents. As electric power systems undergo digital transformation, the integration and intelligent analysis of such diverse data modalities are increasingly critical for operational reliability, predictive maintenance, system diagnostics, and grid optimisation. The PhD candidate will contribute to developing robust, interpretable, and scalable AI methodologies tailored to the requirements and constraints of power system applications.

Research field:	Electrical power engineering and mechatronics
Supervisor:	Dr. Tarmo Korõtko
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, 2025 00:00 and June 30, 2025 23:59 (Europe/Zurich)

Description

This PhD position offers an exciting opportunity to conduct cutting-edge research in the field of AI applications in electric power systems, with a special focus on applying GPT and DL technologies. The research will aim to develop innovative solutions that leverage the power of AI and machine learning (ML) to enhance the efficiency, reliability, and sustainability of electric power systems.

Digital sensors, monitoring systems, and automated control have resulted in electric power systems generating increasingly diverse and voluminous datasets. These include numerical time-series data from sensors and meters, visual input from drones and surveillance systems, and technical documentation in textual form. The ability to jointly analyse these distinct modalities using multimodal AI and ML models opens new avenues for system resilience, adaptive management, and enhanced situational awareness.

This doctoral research seeks to develop and assess advanced AI architectures capable of fusing multimodal data streams for power system monitoring, diagnostics, and control applications. The focus will be on the design, implementation, and evaluation of deep learning techniques—including, but not limited to, multimodal transformers, graph neural networks, and contrastive learning frameworks—that are attuned to the operational context of electrical infrastructure.

The project will include empirical testing on real and simulated datasets, drawn from smart grid components, substation monitoring systems, and operational reports. Emphasis will be placed on the explainability and robustness of the models, especially in mission-critical decision-support contexts.

Responsibilities and (foreseen) tasks

- Conduct a comprehensive review of multimodal learning techniques applicable to power systems
- Design and implement AI architectures for integrating time-series, visual, and textual data
- Evaluate the proposed models on benchmark datasets and real-world case studies
- Develop and test models in lab-based and/or field-simulated power system environments
- Investigate model robustness, interpretability, and computational efficiency
- Publish findings in peer-reviewed scientific venues and present at relevant academic conferences
- Support the organization of project workshops and dissemination activities.

Applicants should fulfil the following requirements:

- master’s degree in electrical engineering, computer science or applied informatics from last 5 years

- a clear interest in the topic of the position
- principal understanding of electric power systems and a strong background in AI technology
- Strong programming skills (e.g., Python, TensorFlow, PyTorch)
- excellent command of the English language
- ptofound 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 published scientific papers
- practical experience in working with large datasets, databases and data science
- operations systems engineering

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 microgrids research group in the region with a large portfolio of pan-European and national research and development, and study projects, mainly concerned with renewable energy integration and digital and AI applications in electric power systems.
- The opportunity to carry out high-level research in the domain of AI applications in energy systems.
- Access to state-of-the-art research facilities for microgrids, renewables integration and power system digitalization.
- Opportunities for student exchange through EuroTeQ and Erasmus+ programmes, visits to research conferences and laboratory facilities and networking with leading universities and research centers.

About the department

The Department of Electrical Power Engineering and Mechatronics of Tallinn University of Technology is an interdisciplinary research centre focusing 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 national and international cooperation networks and organizations. The department has coordinated and partnered in 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. It operates state-of-the-art laboratories with high-end equipment, offering accredited services in lighting and different electrical measurements. The department's focus areas are domestic and global challenges related to increasing digitalisation, decarbonisation and decentralisation of electric power systems and increasing use of renewable energy sources. The department carries out research in the following relevant areas:

- Optimisation of electric power systems and system analysis for electrification and decarbonisation
- 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, and IoT applications in energy
- Implementation of energy and resource efficiency, including digitization of supply chains, mapping of opportunities to optimise systems and reduce energy consumption
- developing smart city solutions, including environmentally friendly and self-driving vehicles/drones, and digital twin applications.

Additional information

For further information, please contact Dr. Tarmo Korõtko tarmo.korotko@taltech.ee

To get more information or to apply online, visit https://taltech.glowbase.com/positions/1002 or scan the the code on the left with your smartphone.