Aggregation of Energy Flexibility in nZED from different flexibility vectors

Summary

Flexibility is of prime importance for current and future Power Systems (PS) with increasing grid integration of renewable Energy sources (RES). In this regard, the main challenge is the management of the increased variability and uncertainty imposed by RES in the power balance. Contribution from the aggregated flexibility of nearly Zero Energy Buildings (nZEB) can significantly increase the flexibility of nearly Zero Energy Districts (nZED). This project aims to increase the ENERGY FLEXIBILITY of nZED as a key enabler of the transformation towards the high integration level of renewable energy resources in the grid. Most attention will be paid to developing a novel machine learning-based method, which accurately characterizes and exploits the aggregated flexibility from the demand-side to avoid excessive investments in conventional power plants and costs for balancing power.

Research field:	Electrical power engineering and mechatronics
Supervisors:	Dr. Roya Ahmadiahangar Prof. Dr. Argo Rosin
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

Forecasting the flexibility, especially in nZEB (nearly zero energy building) and aggregated in nZED(nearly zero energy districy) , depends on several parameters, including weather, electricity generation, and demand, grid constraints and market prices aswell as the characteristics of the building, ventilation and heating system, control system, smart appliances, the available capacity of ESS, behaviour of occupants and their willingness to change their usage pattern and share of flexible loads. Conventional approaches like computing the average of the data are not efficient in analyzing this volume of data. Therefore, machine learning (ML) approaches are considered a powerful tool to deal with huge datasets. The power consumption of flexible appliances and the usage behavior of consumers is required in defining the EF of each nZEB . Another issue toward the utilization of the flexibility in nZED, is the lack of standard metrics for characterisation of flexibility.

While most efforts so far targeting characterisation and forecasting of the nZEB flexibility, scaling up to nZED level, and the use of deep learning-based methods increase the characterization accuracy of the available flexibility. The main reason is enabling of accurate aggregation of consumption profiles with different user behaiviour and several flexibility vectors. The main novelty is the aggregation of flexibility vectors and distinguishing the impact of AC and DC grids.

Project tasks:

- Investigation and development of aggregation methods for energy flexibility in nZED, capable of distinguishing flexibility of AC and DC buses within nZEBs and nZED.
- Comparison analysis of AC and DC flexibility
- Development of a novel deep learning-based multi-task learning model capable of forecasting the aggregated flexibility of nZED from different flexibility vectors, considering practical constraints and hybrid vectors.

Duration:

The duration of the project is planned for **four** years starting in the **September 2022**.

Preferred qualifications (in order of importance):

- Experience in the modeling in MATLAB and Python software
- Experience in design of control systems
- Understanding of Machine learning and dep learning

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 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 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.

The applicants should fulfill the following requirements:

The successful candidate should hold an M.Sc. degree in Electrical Engineering. A strong background and interest in Power Systems are expected. Basic knowledge of Machine learning is a benefit. The candidate will work in the international team and collaboration with partner universities and companies. Hence, we expect fluency in spoken and written English.

Questions about the position can be directed to Dr. Roya Ahmadiahangar (roya.ahmadi@taltech.ee) or Prof. Argo Rosin (argo.rosin@taltech.ee).

To get more information or to apply online, visit https://taltech.glowbase.com/positions/534 or scan the the code on the left with your smartphone.