**Possible title: Photovoltaic systems power production prediction by using machine learning with limited time-series data.**

**Thesis description**

Swedish authorities in order to prevent climate change and environmental pollution have set as national goals to achieve 100% power produced by renewable energy resources by 2040 and 0% CO2 emissions by 2045 in the Swedish power system value chain. To this end, several technologies are deployed. Renewable energy resources, storage systems, smart monitoring, big-data handling, artificial intelligence and internet of things (IoT) are some important enabling technologies aiming to optimize and secure the performance of the electricity system by balancing demand and supply. Optimal and secure performance of energy system entails extended measurements for time-series collections about power production, load demand and the parameters that affect both as for example weather conditions. Such extended measurements are preformed by using advanced metering infrastructure such as sensors and smart meters. Despite the recent vast deployment of smart meters (SMs), the collection of time-series data of energy system is still underdetermined. In addition, privacy issues, possible metering or communication problems causing missing and/or delayed data as well as newly built PV power plants do not have enough historical data to train an accurate prediction models. This lack of knowledge of behind the meter real-time photovoltaics power production prediction inhibits effective monitoring and management of energy systems. One approach for solving this problem is to widely install metering and sensors infrastructure, which is cost prohibitive while privacy technical issues are still real barriers. However, the lack of knowledge of historical data remain the basic barrier of such knowledge. Alternatively, data-driven real-time power production prediction based on machine learning transfer knowledge is a feasible alternative solution for electric utilities and companies active in the smart solutions software applications.

This project aims to transfer knowledge from pre-trained machine learning prediction models to photovoltaic systems for which limited time-series data are available. In particular, prediction models are going to be used that are based on time-series data from systems at which all related model prediction parameters are available. Then, transfer knowledge machine learning models are going to be developed to predict the power production from photovoltaic systems for which limited time-series data for the prediction parameters are available. The expected results contribute to improved energy systems observability and operations such as, energy management optimization for efficient deployment and coordination of energy resources as well as electricity grid security to balance supply and demand segments.

This project is supported by DAMI4.0 research center at Karlstad University via AI-4ENERGY project in terms of data sharing, co-participation in working groups and advisory issues. The project follows the next preliminary workflow. At first, machine learning pre-trained models for power prediction are used and the parameters that mostly affect the predicted data-set are highlighted by using real measured time-series data. Then, transfer knowledge machine learning models will be used to optimize the performance of the pre-trained models to successfully predict the output of photovoltaic systems with limited-time series data.

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