PSERC Power Systems Engineering Research Center

PSERC WEBINAR

Forecast and Model Predictive Control of Distributed Energy Resource Aggregators for Net-Demand Balancing

Lalitha Sankar
Arizona State University

Bulk renewable energy sources are a key part of energy generation in the grid. However, stochasticity of renewables also leads to rapid changes and uncertainty in net demand. Distributed Energy Resource Aggregators (DERAs) have the potential to address this uncertainty via aggregation and control of decentralized distributed energy sources, thereby acting like virtual power plants. We present a new approach that uses forecasting and control to assign DERAs to follow net-demand patterns, while accounting for how the dynamics of the aggregate energy sources and their capacity limits. Each DERA is represented as a flexible "virtual battery" with constraints on state-of-charge and power limits. The dispatch problem is set up as a long-term optimal control task that aims to minimize differences from desired charge levels, output ramping, and net-load tracking errors. To keep operations efficient in real time, we implement a rolling-horizon Model Predictive Control (MPC) method, which updates decisions regularly using the latest net-demand forecasts. For forecasting, we will present two models: linear regression and Long-short Term Memory (LSTM)-based neural network. Using high-resolution CAISO net-demand data and five typical DERA types, our simulations will demonstrate how well our approach tracks net demand; in particular, we will highlight the tradeoffs between forecasting horizon times and MPC update speeds as well as the dependence on the choice of the load forecasting model.

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LINK TO WEBINAR

(10:00-11:00 A.M. PT)

Lalitha Sankar is a Professor in the School of Electrical, Computer and Energy Engineering at Arizona State University. She joined ASU as an assistant professor in fall of 2012 and was an associate professor from 2018-2023. She received her bachelor's degree from the Indian Institute of Technology, Bombay, master's degree from the University of Maryland, and doctorate from Rutgers University. Sankar's research combines techniques from information theory, signal processing, learning theory, as well as control theory to design machine learning (ML) algorithms with security, privacy, and robustness guarantees. Her research applies such methods to complex networks, especially the electric power grid. She has received many awards including the NSF CAREER award, the Electrical Engineering Academic Achievement Award from Rutgers University, and best tutorial and conference paper awards. She led an NSF-funded institute on data intensive research for science and engineering to develop ML methods for the grid from 2019-2023.