TEXAS A&M UNIVERSITY
Department of Electrical & Computer Engineering

Friday, Nov. 12, 2021 | 11:30 – 12:00 p.m. Central

Meeting Location: ETB 1020

Cyber-Physical Defense in Smart Distribution Networks

Abstract

The existing electric grid is transitioning to a smart grid with increased penetration of distributed energy resources (DERs), such as photovoltaic (PV) units, battery storage units, electric vehicles (EV), and EV chargers. DERs facilitate the increase in renewable energy generation, which leads to a more sustainable, efficient, and reliable grid paradigm. However, with the rise of communication exchanges and data flow due to DERs, cybersecurity vulnerabilities arise. Much of the literature has focused strictly on mitigating data attacks resulting in nontechnical losses, false state estimation, and inaccurate load forecasting. However, the grid paradigm's cyber-physical security also needs to be considered to ensure that no grid operations take place that impact the physics of the system. Our project achieved that by developing a Machine Learning (ML) algorithm that will detect anomalies in the commands issued to the distribution network's assets. The algorithm was trained using data from a base case obtained from the simulation of the IEEE 34 distribution network. It was tested and improved by adding modifications to the base case. We successfully developed a local anomaly detection algorithm for a photovoltaic system and two voltage regulators, achieving F1-scores of 0.5141, 0.8173, and 0.8982, respectively. All three algorithms achieved low values of false negatives, which is promising as false negatives have a much higher cost since missing one anomaly can result in disastrous effects on the entire grid.

Leen Al Homoud

M.Sc. Electrical Engineering

Leen Al Homoud received her B.Sc. degree in Electrical Engineering from Texas A&M University, Texas, USA, in 2021. She is currently pursuing an M.Sc. degree in Electrical Engineering at Texas A&M University, Texas, USA. Her research interests include power system modeling and analysis, cyber-physical power systems, distributed energy resources, smart grids, and power electronics.