UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING
Department of Electrical & Computer Engineering

Spatio-Temporal Graph Neural Network for Power System Oscillation Analysis

Our Team:

- The Renewable Power Grid (RPG) Lab at the University of Houston.
- Website: https://rpglab.github.io/
- Principal Investigator: Xingpeng Li, Assistant Professor, ECE Department.
- Nine current PhD students.
- Seven alumni of the RPG Lab.

Research Focuses:

- Power System Operations and Stability.
- Grid Integration of Renewable Energy.

Mathematical Methods:

- Optimization.
- Graph Theory & Network Science.
- Data Science & Data Analytics.
- Machine Learning & Deep Learning.

Background:

- Today, power systems are in transition to renewable power grids that involve great amounts of inverter-based resources including solar power, wind power and energy storage.
- This transition poses high risks to power system reliability and stability.
  - Real-time power balancing becomes more difficult to maintain.
  - The frequency nadir and rate-of-change-of-frequency would be much worse.
  - Oscillations may be injected by IBR and new oscillation modes may appear.

Research Problem:

- Large amounts of real operational data are available at electric utilities.
- With advancement of deep learning methods, these data are much more valuable.
- However, how to efficiently process the data and automate the power system oscillation analysis is still very challenging today.

Proposed Solution:

- Novel spatio-temporal GNN (STGNN) models will be developed to efficiently automate the data analysis including oscillation detection and mode estimation.
- First, we will identify a subset of salient samples to improve labeling efficiency and increase STGNN model accuracy.
- Then, we will train two STGNN models that are able to take multi-sensor data as inputs: one model is for oscillation detection and the other is for oscillation mode estimation.