Objective

To reduce the negative impacts of renewables on the system, we need to develop proper control strategies.

- **Objective 1**: Developing methods to coordinate flexible loads to improve electric power transmission system stability
- **Objective 2**: Developing decentralized strategies to control reactive power of solar PVs to mitigate voltage unbalance in the distribution system

Project I

Past demand response program: 1) benefit the market 2) improve frequency stability by time shifting the energy consumption of flexible loads.

Our purpose and demand response strategy: Demand response based on spatially shifting load, without load shedding, in order to improve voltage/small-signal stability after a disturbance.

Results

Voltage Stability

\[
\min_{\alpha(t)} \alpha \sigma_0(1) + C(P_k(2))
\]

Stability margin: loading margin, SSV, distance to closest SNB

Project II

Steinmetz circuit design:\[1,2]\: it aims to achieve voltage balance by controlling the reactances of three-phase delta-connected constant-impedance loads. The method is simple, open-loop, and decentralized, and so inexpensive to implement.

Future Work

Project I:
- Gain a better understanding of why the loading patterns change in the way they do.
- Develop a formulation that incorporates both the voltage stability metrics and the small signal stability metrics and determines how different metrics impact the control of resources.

Project II:
- Test these approaches on realistic distribution feeders with high penetrations of distributed PV systems.
- Prove the convergence of the feedback controller.
- Benchmark the performance of these decentralized strategies against a centralized optimal control strategy.

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