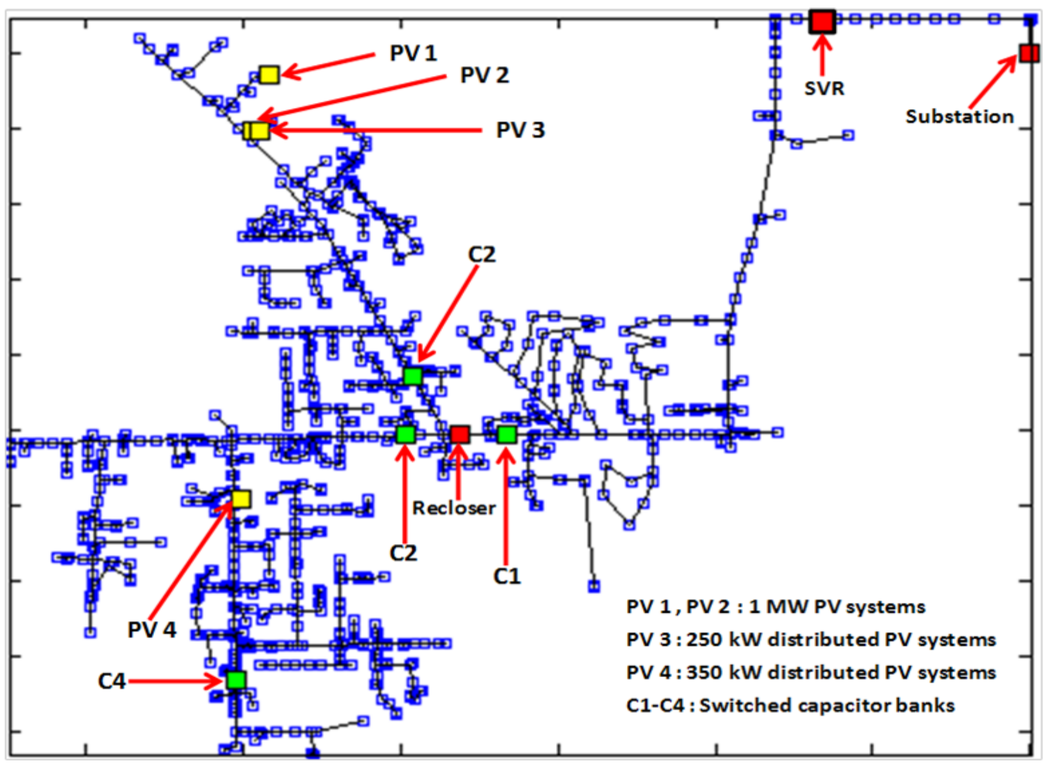
Power Quality Impact Study For the Interconnection of Heterogeneous Distributed Energy Resources

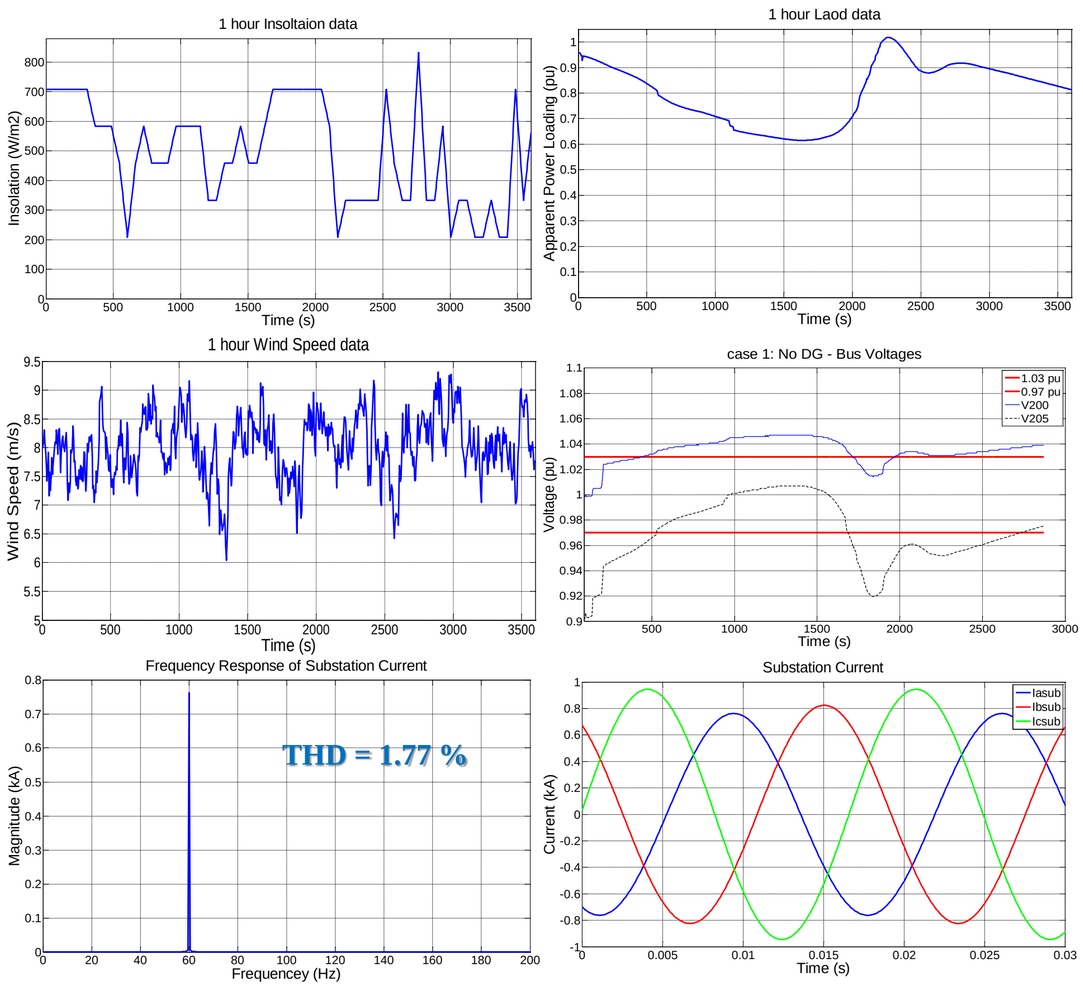
Abstract

This project aims to study the power quality impacts on distribution networks due to the interconnection of multiple distributed generators or DGs. For this, a Florida-based distribution feeder was modeled and studied by integrating different types of distributed generation resources (DG). Different scenarios were implemented in which solar and wind plants were modeled with high variability in load and generation to observe their impacts on system's power quality. All simulations and models were carried out using the high fidelity electromagnetic real-time transient simulation tool, RTDS.

Feeder Model (one line diagram)

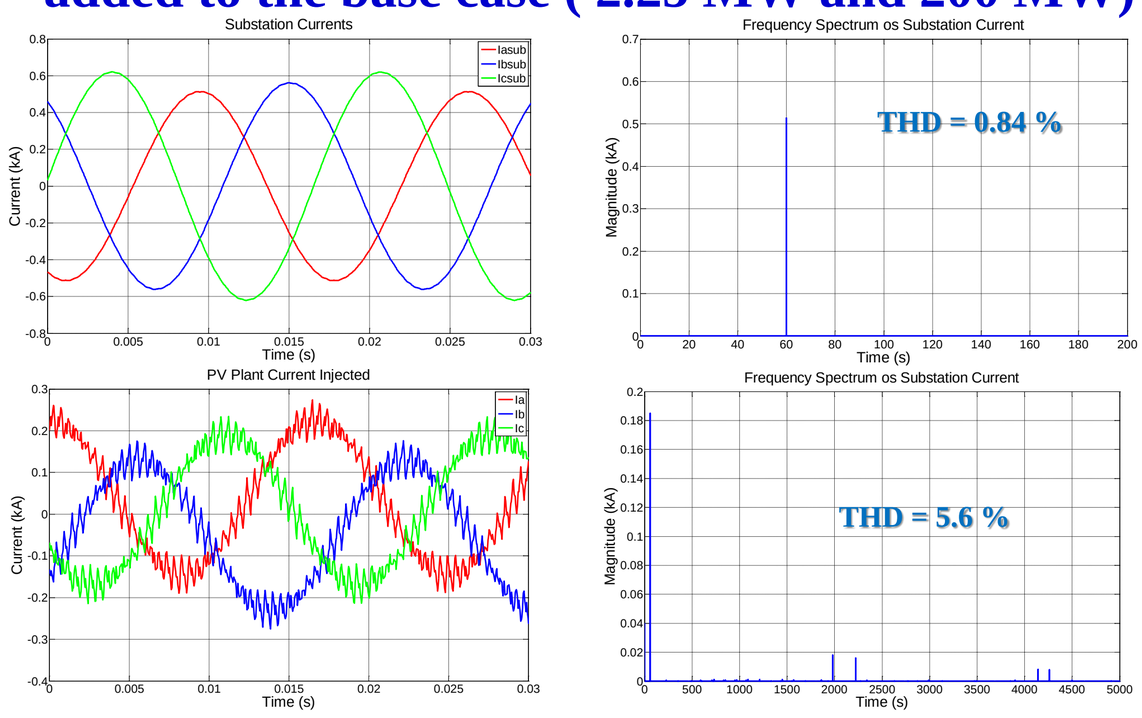


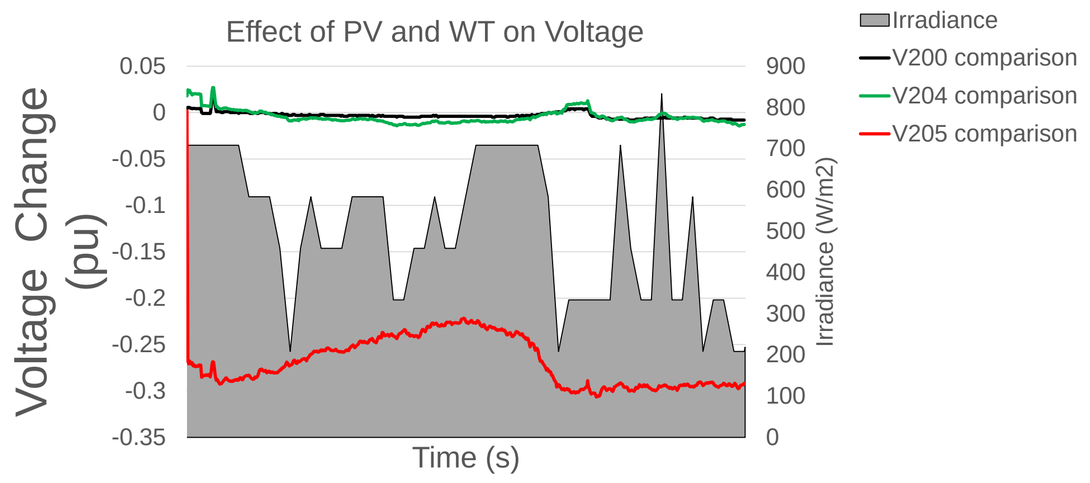
Simulation Results: Case 1- Base case (No DG)

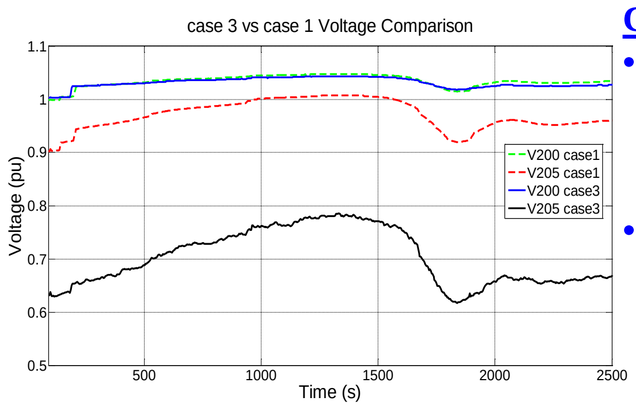


- Shows variation in voltage with the variation load
- At base case, no visible harmonics at the substation current (THD =1.77%)

Case 2: One PV plant and one Wind Turbine are added to the base case (2.25 MW and 200 MW)







Case 3 :

- V200 is close to the substation
  - ✓ V200 at peak load = 12.65 kV
  - ✓ V200 at min load = 13.09 kV
- V205 is farther down the system
  - ✓ V205 at peak load = 7.856 kV
  - ✓ V205 at min load = 9.788 kV

Conclusions

- Unbalanced loads create unbalance currents
- Inverter based DGs do inject harmonics but it is not significant
- Variable generation from DGs create fluctuations in the voltage, however, no flicker has been observed due to that variation
- Power Electronics interfaced DGs produce harmonics, however, those harmonics do not propagate far from the DGs.

Future Work

- More investigation of voltage sag/swell and flicker scenarios.
- Investigate the impacts of low frequency anti-islanding signal injection
- Investigation of impacts of harmonics on nearby transformers
- Investigation of harmonic resonance
- Data collection from the field testing to verify the simulation results

Omar Faruque, email: faruque@caps.fsu.edu, phone : 8506458971