**Supporting Security with Advanced Multimodal Grid Data Analytics**

(Final Report)

**Researchers**

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**Summary**

The crux of this activity thread was to utilize grid data analytics for security in both transmission and distribution grids an automated manner. The first main project involved developing techniques for cyber physical intrusion detection in automated distribution systems. We introduced a Grid Security System (GSS) that extends the established cyber security notion of Network Intrusion Detection Systems (NIDSs) to comprise physical reliability metrics and leverage new sensing modalities from Micro- Synchrophasor (µPMU) technology. The security policies are translated into mechanisms using the BRO framework.

We also have developed data analytics mechanisms with a broader perspective of creating feature extraction techniques for machine learning algorithms in power systems. Our efforts lie in utilizing Graph Signal Processing (GSP) to describe signals from the electric grid in the appropriate domain so that one can effectively use them for a variety of purposes. Particularly, we have successfully illustrated the detection of false data injection attacks in the power grid by employing the modeling developed using GSP and addressed the security aspect of grid-data analytics. Furthermore, we have used the same methodology to preserve data integrity and showcased state-of-the-art data compression algorithm.

**Publications Produced (in reverse chronological order):**

1. Raksha Ramakrishna and Anna Scaglione, “Detection of False Data Injection Attack Using Graph Signal Processing For The Power Grid”, IEEE Global Signal and Information Processing (GlobalSIP), 2019
2. Mahdi Jamei, Teklemariam Tesfay, Reinhard Gentz, Ciaran Roberts, Anna Scaglione, Sean Peisert, “On the Performance Limits of Fault Localization using Phasor Measurement Units and their Optimal Placement”, IEEE JSAC SI on Communications and Data Analytics in Smart Grid 2019
3. Raksha Ramakrishna and Anna Scaglione, “On modeling voltage phasor measurements as graph signals”, IEEE Data Science Workshop (DSW), 2019
4. Mahdi Jamei, Anna Scaglione and Sean Peisert, “Low resolution fault localization using phasor measurement units with community detection”, IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (SmartGridComm) 2018
5. Mahdi Jamei, Anna Scaglione, Ciaran Roberts, Emma Stewart, Sean Peisert, Chuck McParland, Alex McEachern, “Anomaly Detection Using Optimally Placed PMU Sensors in Distribution Grids”, IEEE Transactions on Power Systems 2017

**Tools Created**

Available on Github: