Resilient Networks Minitrack

This minitrack focuses on enhancing the reliability, security, and resilience of electric power infrastructure. Advanced technologies will require sophisticated methods for understanding how they can be incorporated into increasingly complex infrastructure.

The combined cascading failure of electricity and other infrastructure networks greatly increases the discomfort, hazard, and economic loss to society. There are considerable challenges in modeling and coordinating the important interactions (including human, market, or economic factors) and quantifying the adverse interactions so that their risk can be estimated, mitigated, and controlled. It is also important to verify and quantify these interactions in large-scale testbeds. An essential part of the testbed design is creation of synthetic networks of various infrastructures that allow the scale and complexity to be faithfully represented allowing evaluation of novel robust solutions. Methods for reinforcing networks through hardening the physical components or offering distributed energy resources (DER) as network support are of interest as well.

The electric power system is a safety-critical infrastructure system. Operators now have an unprecedented wealth of data from a variety of sources such as demand response participants, synchrophasors, and other enhanced measurement systems. If managed properly, this data can provide opportunities to increase the efficiency, reliability, and overall performance of the power system. With the increased adoption of grid modernization, demand response programs, and distributed generation that is often renewable, intermittent, and stochastic, system operators need to manage vast amounts of data in the presence of data inaccuracy and system uncertainties. This introduces new opportunities for various artificial intelligence (AI) and machine learning (ML) technologies including probabilistic AI/ML.

The following four papers were selected for inclusion in the HICSS 56 conference from the 11 manuscripts that were submitted for consideration. The minitrack chair thanks the 17 reviewers who participated in the process, many reviewing multiple papers.

- **Distributed Power System State Estimation Using Graph Convolutional Neural Networks:** Using graph convolutional neural networks for distributed state estimators that are computationally efficient and robust to cyberattacks.

- **Comparing Machine Learning and Optimization Approaches for the N-k Interdiction Problem Considering Load Variability:** Bilevel optimization to identify problematic combinations of failures representing line failure attacks and defender's generator dispatch using network-flow relaxation of the power flow equations and two newly developed machine learning algorithms.

- **PPGN: Physics-Preserved Graph Networks for Real-Time Fault Location in Distribution Systems with Limited Observation and Labels:** A two-stage graph neural network that learns the graph embedding representing the network and finding relations between labeled and unlabeled data to improve location accuracy.

- **A Generalized Approach to Contingency Screening with System Islanding:** Identifying critical pairs of contingencies that result in severe reliability violations or large numbers of islanded system components.

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