



# RESEARCH

## Dynamic State Estimation and Cyber Security Issues

### Overview

Wide-spread deployment of phasor measurement units in power systems is expected to facilitate their utilization for monitoring of both the steady-state and dynamic state of the system. In anticipation of this development, CURENT is investigating robust static and dynamic estimation methods and their implementation for large scale systems. An important consideration in using these devices for monitoring and subsequent control decisions is the security of data and information received in real-time. CURENT is developing customized solutions to address these security issues.

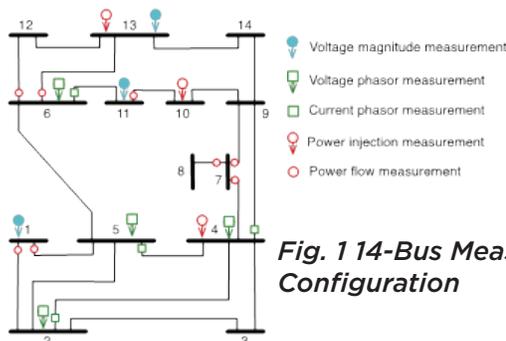
### Technology Pathway

Robust state estimation will offer improved accommodation of modeling and parameter inaccuracies. Accurate characterization of communication layer perturbations in decentralized (hierarchical) dynamic state estimation will provide design guidelines for optimized sensor deployment. For steady state monitoring, the center is developing computationally efficient and robust phasor only state estimator.

This estimator is expected to have the following properties:

- Detect, identify and remove bad measurements and parameter errors
- Direct solution due to linearity of the measurement equations
- Remain robust against intentional/targeted or random measurement errors using strategic measurement placement

The center will also be addressing the issue of data security working closely with the Grid Security group in Chattanooga on security of phasor measurements. What differentiates the work from other data security work is the very large amount of data which need to be delivered and checked for security in a computationally efficient manner in real-time. The security mechanism is therefore quite complex. There are three issues we address: confidentiality, integrity and availability of data.



**Fig. 1 14-Bus Measurement Configuration**

### Impact

- Dynamic estimator will facilitate dynamic security assessment by tracking the dynamic state of the system and make short term predictions of its trajectory.
- Phasor only state estimator will provide fast and robust estimates which can be used for assessing static security issues such as contingencies and voltage stability.
- Establishing a security mechanism for real-time data, subsequent monitoring and control decisions will become more reliable and effective.

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