CINELDI
Centre for intelligent electricity distribution
- to empower the future Smart Grid

Norwegian Centre for
Environment-friendly
Energy Research

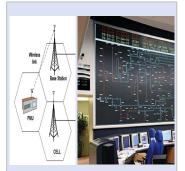**Innovation type:**
System modelling and state estimation method

TRL: 2

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Target group:

Actor/ purpose	X
DSO, TSO	X
Technology provider	X
Member organisation	
Market operator	
Research/ Consultancy	X
Teaching	x

Power system state estimator is extremely critical in modern power grids. By using our proposed concept of "partially known power networks" and the proposed SISE, we can solve the problem of having insufficient information for the state estimation of interconnected power networks. In addition, we can estimate the interconnecting signals such as DSO/TSO interacting signals.

State estimation algorithm for monitoring distribution grids

Available data incl. measurements from different types of sensors, the system structure, the system components and statistical data about loads and generators are exploited to generate an accurate, robust and comprehensible estimate of the operational state of the entire monitored power system such as component's dynamics, voltages, power angles, currents, power flows.

Challenge

The main changes in future power grids can be characterized as increasing complexity, uncertainty and speed of changes, turning power systems into dynamical systems with dynamical characteristics. However, state estimation cannot be easily achieved in smart grids because:

- The phasor measurement units (PMUs) (the most important sensors for implementing dynamic state estimation in modern power networks), are expensive, so they will be introduced gradually in the grids.
- Lack of measurements in the system due to the consumers' privacy consideration, dangerous accessibility, degradation of electrical equipment.
- Dynamical characteristics of some components in the system can be unknown, especially for distributed generation.

Solution

Power system state estimator is extremely critical in modern power grids. A novel modelling approach for power systems with some unknown parts is suggested, considering the whole unknown parts of a power system as system-wide unknown inputs flow into the known part. A simultaneous input and state estimation method (SISE) is developed to estimate the states of a partially known system with system-wide unknown inputs.

Potential

The proposed method can be used to prevent system-wide failures or black-outs, be used to tune power system stabilizers or to improve reliability of system models utilized for dynamic security assessment (DSA) and be exploited to design state estimator-based fault detectors.

Reference in CINELDI

- M Abooshahab, M Hovd, and R Bitmead. Disturbance and state estimation in partially known power networks. IEEE Conference on Control Technology and Applications. (SINTEF Blog)
- R.R. Bitmead, M. Hovd, and M. Abooshahab. A Kalman-filtering derivation of simultaneous input and state estimation. Automatica, 2019