Globally Optimal State Estimation of AC Power Systems Using Semidefinite Programming (20110169, Dr. Georgios Giannakis)

IP Status: Issued US Patent; Application #: 13/862,139

State Estimation for Power Distribution and to Manage Power Grids

An algorithm uses semidefinite programming (SDP) formulation for state estimation (SE) to find the optimum solution for power distribution and could be used to manage power grids. The improved SE algorithms, which provide greater reliability (e.g., decreased power interruption, greater resilience to malicious attacks) for a regional transmission organization (RTO) or smaller distribution network, could also provide more efficient power generation from a cost perspective and conceivably better integration of renewables. The robust SDP-based SE techniques are resilient to outlying measurements and/or adversarial cyber-attacks, and allow local control areas to solve centralized SDP-based SE problems in a distributed fashion.

Achieves Global Optimality

Within energy management systems used with the electrical power grid, SE is a key step in building real-time network models based on distributed measurements throughout the grid. Current SE implemented in Supervisory Control and Data Acquisition (SCADA) solutions, based on iterative schemes, only attain a local optimum. They face initialization challenges, are computationally intensive and cannot guarantee convergence to the correct state. As a result, power grids are subject to increased risk of power interruption and inefficient power generation. This new technology uses SPR to efficiently estimate the states and potentially achieve a global optimum. The new algorithm enables an energy management system that quickly determines the current optimal state of power needed in the grid and contributes towards real-time distribution of energy. The technology provides a faster, more accurate estimation of the grid, critical in optimizing power flow and determining available transfer capability, thus improving security to counter cyber-attacks and improving load balancing.

BENEFITS AND FEATURES:

- Provide greater reliability (e.g., decreased power interruption, greater resilience to malicious attacks)
- More efficient power generation from a cost perspective
- Better integration of renewables
- Global optimality
- Computational efficiency
- Distributed implementation
- Resilience to malicious attack
- Fast: polynomial time vs. iterative

APPLICATIONS:

Technology ID 20110169

Category

Software & IT/Algorithms Software & IT/Communications & Networking

Learn more



- Efficient monitoring of power grid states for system control and economic dispatch with cybersecurity constraints and concerns
- Electrical power grids
- SCADA systems
- SCADA system manufacturers
- Grid optimization software companies
- AC power networks; smart grids
- RTOs or smaller distribution networks

Phase of Development - Proof of concept: algorithm developed, simulated with IEEE data sets

Researchers

Georgios B. Giannakis, PhD Professor, Department of Electrical and Computer Engineering External Link (ece.umn.edu)

Publications

PSSE Redux: Convex Relaxation, Decentralized, Robust, and Dynamic Approaches arXiv, Aug 2017 Power System Nonlinear State Estimation using Distributed Semidefinite Programming IEEEJournal of Selected Topics in Signal Processing, Vol. 8, no. 6, pp. 1039-1050, December 2014 Monitoring and Optimization for Power Grids: A Signal Processing Perspective IEEE Signal Processing Magazine, Vol. 30, no. 5, pp. 107-128, September 2013 Distributed Robust Power System State Estimation IEEE Transactions on Power Systems, Vol. 28, no. 2, pp. 1617-1626, May 2013 Multi-area State Estimation using Distributed Semidefinite Programming for Nonlinear Power **Systems** Proc. of 3rd Intl. Conf. on Smart Grid Communications, Tainan, Taiwan, November 5-8, 2012 Robust Power System State Estimation for the Nonlinear AC Flow Model Proc. of 44th North American Power Systems Symposium, Univ. of Illinois at Urbana-Champaign, September 9-11, 2012

Estimating the State of AC Power Systems using Semidefinite Programming

Proc. of 43rd North American Power Systems Symposium, Northeastern Univ., Boston, MA, August 4-6, 2011

Interested in Licensing?

The University relies on industry partners to scale up technologies to large enough production capacity for commercial purposes. The license is available for this technology and would be for the sale, manufacture or use of products claimed by the issued patents. Please contact us to share your business needs and technical interest in this technology and if you are interested in licensing the technology for further research and development.