

Electric Power and Power Electronics Institute

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DISTRIBUTED REAL-TIME CONTROL AND CONVEX OPTIMIZATION IN POWER SYSTEMS

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Abstract

The existing resources for power system control, such as spinning reserves from bulk generators, may not be adequate to achieve the required reliability and efficiency, as larger variations in power injections arise from the deepening penetration of intermittent renewable generation. While increasing the existing controllable resources may incur high operating cost and emissions, a promising option is to exploit control capabilities of distributed energy resources (DERs) such as PV inverters, energy storage devices, and controllable loads. Realizing the full potential of the latter option calls for scalable, flexible, and real-time control and optimization paradigms to support plug-and-play operations of DERs, and further the transformation of power systems from a centralized, hierarchical architecture to a distributed, open-access architecture that incorporates optimality and stability objectives. This talk introduces two sample endeavors towards this transformation. The first is a distributed frequency control algorithm for transmission networks, which can restore the nominal frequency and the reference inter-area power flows, in a way that minimizes the total cost of control for participating generators and DER aggregates, while relying purely on local measurement and computation and communication between neighboring buses. The second is a convex relaxation technique for optimal power flow (OPF) problems in multiphase distribution networks with both wye- and delta-connected loads and DERs, which lays the foundation for further development of distributed and fast optimization solvers with optimality guarantees.

Biography

Changhong Zhao received the B. Eng. degree in Automation from Tsinghua University in 2010, and the PhD degree in Electrical Engineering from California Institute of Technology in 2016. His PhD thesis won the Caltech Demetriades-TsafkaKokkalis Prize and the Caltech Charles Wilts Prize. He is currently a Research Engineer with National Renewable Energy Laboratory, Golden, CO, USA, with research interests in power system dynamics and stability, optimal power flow, distributed control of smart grid, and multi-energy systems.