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Distributed Cluster Control for Low Inertia Power System

Boming Zhang
Dept. of Electrical Engineering, Tsinghua University, Beijing, China

Abstract

In recent years, renewable energy generation exhibits a distributed development trend, and has changed the way power systems are operated. Due to the integration of renewable generation and access of electronic devices, power systems are suffering from low inertia due to the lack of spinning reserve to support frequency and voltage, and therefore require greater control flexibility. Meanwhile, massive renewable generation possesses the ability to provide corresponding support by being coordinated to exert “friendly” effect on power systems.

To effectively organize and control a huge amount of geographically dispersed renewable generation, the concept of “cluster” has been put forward, which operates renewable generation as a separate controllable cluster integrating to the grid. By using appropriate methods, a cluster can act as a single synchronous generator to regulate active/reactive power output, track the instructions of system operator, and even provide ancillary services. For instance, DFIG-based wind farms can provide fast primary frequency support by exploiting the kinetic energy stored in rotors, including imitated inertia and droop characteristics.

Besides, by regulating reactive power injection of inverter, PV cluster can fast respond to voltage mismatch and improve voltage profile. To achieve fast coordination and avoid centralized model maintenance, superlinear distributed schemes are proposed. Based on feedback optimization, cluster control replaces accurate modeling of physical systems by iteration, and can perform well under

inaccurate measurements and communication delay. The research for renewable generation clusters aims to coordinate renewables to provide frequency support and voltage regulation like a synchronous generator, in a more efficient, reliable and flexible way.