

Distributed Control in Microgrids

Environmental concerns, fossil depletion, and increasing penetration of renewable energy sources are pushing the incumbent power generation paradigm toward a more distributed future. The microgrid (MG), which indicates a localized cluster of distributed generations (DG), loads and storages continues to gain popularity, where the cooperation control scheme is indispensable to ensure voltage/frequency regulation, load sharing, power balance due to the heterogeneous properties of energy generations. The conventional centralized control assumes a centralized controller for the global decision-making but is sensitive to a single point-of-failure, while the decentralized control with high reliability threatens system stability due to the lack of effective global information, both of which restrict the MG operation.

To deal with these challenges, the distributed control structure in MG will be presented, where each DG exchanges information with its immediate neighbors via the spare network. First, the distributed dynamic cooperative control based on average consensus and feedback control is elaborated, adaptive to real-time perturbations in a precise format. Then, the pinning cooperative control aims to simplify the control complexity and enhance control performance with the increasing scale of DGs. Considering that the conventional decision based on the current local-neighboring DG may lead to false/over/under control, the distributed model predictive cooperative (DMPC) control takes the advantage of predicted trend and rolling optimization to improve dynamic performance and robustness. Therefore, both the high reliability and global optimization of MG cooperative operation are guaranteed.