2015 IERE – CRIEPI Tokyo Workshop
"Advanced Electric Power Management
- Thermal Power Generation against Huge Impact
by Renewable Energy Penetration -"

Adjustable Robust Optimization for Generation Scheduling with Large-Scale Wind Power Integration

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Keywords: *Power system; wind power; generation scheduling; robust optimization; unit commitment; uncertainty*

Abstract

Wind power is one of renewable energy resources with low generation cost and zero emission. It is rapidly developed in China in recent years. In some provincial power systems, the wind power capacity is more than 20% of the total generation capacity. System operators have the obligation to balance the system to take the most advantage of wind power. However, due to the inherent uncertainty and variability in wind, the fluctuation in wind power has a great impact on system operations. The integration of large-scale wind power significantly increases the difficulty of generation scheduling.

Robust optimization has recently gained substantial popularity as a modeling framework for optimization under parameter uncertainty. An adjustable robust optimization formulation to solve generation scheduling problems under uncertainty is proposed. Unlike the stochastic programming or chance-constrained approaches, the robust formulation does not require information on the exact probability distributions. This method protects power systems against all possible scenarios within a deterministic uncertainty set. Besides constructing the regular deterministic uncertainty set, uncertainty budget constraint is added into the robust optimization problem to control conservativeness of the model. Linear decision rule (LDR) approach is considered to solve adjustable robust optimization model in this research.

The modified IEEE reliability test system (RTS-1996) is used to test the security and economy of the proposed method. Finally, the computational results indicate that the proposed adjustable robust optimization method for generation scheduling provides sufficient ramping capability and improves the security of the large-scale power grid system.