Adaptive Robust Optimization with Dynamic Uncertainty Sets for Multi-Period Economic Dispatch under Significant Wind

Abstract:
The exceptional benefits of wind power as an environmentally responsible renewable energy resource have led to an increasing penetration of wind energy in today's power systems. This trend has started to reshape the paradigms of power system operations, as dealing with uncertainty caused by the highly intermittent and uncertain wind power becomes a significant issue. Motivated by this, we present a new framework using adaptive robust optimization for the economic dispatch of power systems with high level of wind penetration. In particular, we propose an adaptive robust optimization model for multi-period economic dispatch, and introduce the concept of dynamic uncertainty sets and methods to construct such sets to model temporal and spatial correlations of uncertainty. We also develop a simulation platform which combines the proposed robust economic dispatch model with statistical prediction tools in a rolling horizon framework. We have conducted extensive computational experiments on this platform using real wind data. The results are promising and demonstrate the benefits of our approach in terms of cost and reliability over existing robust optimization models as well as recent look-ahead dispatch models.