Robust formulation alternatives of power system problems

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Résumé

This paper works with the unit commitment problem to show how robust optimization can be applied to a wide variety of power system problems. It reviews related research and applications of robust optimization. It also presents how a standard deterministic formulation of the unit commitment problem[1] can be robustified to take into account the stochastic nature of the power system. The discussed robust counterparts illustrate multiple aspects of the robust optimization framework described by Ben-Tal/Nemirovski[2]: how to reformulate uncertainty as deterministic constraints and also how to deal with recourse variables in this framework.
The goal of the standard unit commitment problem is to schedule the startup and shutdown of power generating units such that sufficient power generation capacity is available whilst minimizing the total cost. The problem formulation typically uses two sets of variables: one set defines the (discrete) startup and shutdown decisions, and the other set defines the power generation level of the units. Multiple robust versions of this problem have been studied depending on what data is considered uncertain. When the demand or the generation capacity is uncertain, a robust formulation aims at determining the startup and shutdown variables in such a way that even for the worst possible forecasted load there will be no need to modify the startup or shutdown decisions.

Finally, this paper presents two extensions of the standard unit commitment problem. The first one takes into account electrical storage and renewable power sources, and the second one focuses on strategic unit scheduling and outage planning[3].

References:

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Mots-Clés: Robust Optimization, Power Systems

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