Some Optimization Problems in Electricity Markets

Felix Wu
Center for Electrical Energy Systems
The University of Hong Kong

Recent restructuring of the electric power industry has introduced electricity market to foster competition in order to improve economic efficiency. Electricity markets are fundamentally different from other commodity markets and need new mathematical foundations. In this talk, we raise two fundamental issues and suggest the formulation of two optimization problems to tackle them.

The first one is related to the cyclic nature of load demand and its impact on electricity markets. Traditional optimal bidding strategy is based on a static optimization formulation. We propose to model the interaction among participants in the market as a dynamical system and the optimal bidding as an optimal control problem.

The second major issue that is unique in electricity market is the congestion in the transmission network where the physical laws governing electricity make the effect of congestion felt all over the system. Because of that, a two-level optimization is used. The top level centralized optimization is performed by an Independent System Operator to ensure operational security of the transmission system. The lower-level optimization is performed by individual participants independently to maximize their profits. The equilibria of such two-level optimization is analyzed and the effect of congestion is studied.