UNIVERSITY OF FLORIDA

Optimization, robustness, and equilibrium modeling for the Florida Smart Grid

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Description: The purpose of this research is to develop models and algorithms for optimal design and functioning of the nation's next generation power transmission and distribution system that will incorporate the new realities of the grid. Our goal is to create innovative real time capabilities for 1) optimal functioning of renewable energy sources (location, charging, discharging of batteries, etc.), 2) detecting and preventing instabilities and outages, and 3) operating models including generalized Nash equilibrium.

Budget: $30,000
University: UF

Progress Summary

We propose a game theoretic approach for electricity market participants with storage devices by formulating a Nash equilibrium problem and proposing extensions for generalized Nash equilibrium. While the theory of the generalized Nash equilibrium is well developed, its computation is a challenge. The difficulty stems from the fact that the Nash equilibrium is a fixed point of an appropriate mapping, and its calculation goes beyond the optimization theory. In the simplest case, our model presents a Nash equilibrium problem with quadratic cost functions. It is attacked with several methods recently developed. With electricity prices changing continuously over day storage devices can be used to reduce electricity consumption during peak-hours as well as reducing electricity prices, carbon emissions and peak transmission loads. However, if everyone shifts their demand toward a period when electricity is cheaper, that will have an inevitable effect on electricity price and will not lead to significant reduction of a peak demand but rather shift it for another period of the day. The goal is to develop "smart batteries" – a plan for charging and discharging batteries in such a way that every participant will enjoy the maximal possible gain.

Activities

Organized conference:
Systems and Optimization Aspects of Smart Grid Challenges
April 28-30, 2011 Gainesville, Florida, USA

Presented talk: "**Game Theoretic Approach for Micro-storage Management in the Smart Grid",** by Pando Georgiev, Alexey Sorokin, Marco Carvalho and Panos Pardalos.

Working towards publishing the results of this talk in a journal paper.
Ongoing work focuses on data mining in energy for detecting and preventing power grid instabilities and outages.