Precision of Electric Load Forecasting in Demand Response Programs

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Abstract

The overall goal of this project is to investigate the degree to which load forecasting uncertainties affect the benefits of demand response programs. Principle components in the electricity market (system operator, power generator, consumer and demand response agent) are considered as intelligent agents. A multi-agent system has been built first to model the interactions among these agents. The next step is to develop a forecasting model to observe how will the uncertainties associated with this model influence the demand response program.

Background

Demand response refers to an action that customers change their consumption behaviors according to the changes in electricity costs. This is an exceptionally practical idea since power plant is always at its lowest efficiency when the peak demand occurs.[1] By applying demand response, people can save electricity bills, and the power generation system can become more reliable at the same time.

Motivations and Objectives

Like any other forecasting model, there are always some uncertainties associated with the prediction. It was estimated that an increase of only **1%** in forecast error (in 1984) caused an increase of **10 million pounds** in operating costs per year for one electric utility in the United Kingdom.[2] Therefore, more attention should be given to the quantification of these uncertainties.

For electric load forecasting in demand response programs, there are two kinds of uncertainties: those caused by the model and those caused by the human behaviors. This project focuses on the uncertainties caused by the unpredicted human consumption patterns, hoping to find out a way to quantify and reduce them.

Methods

1. Apply Q Learning to model the intelligent agent in the multi-agent system

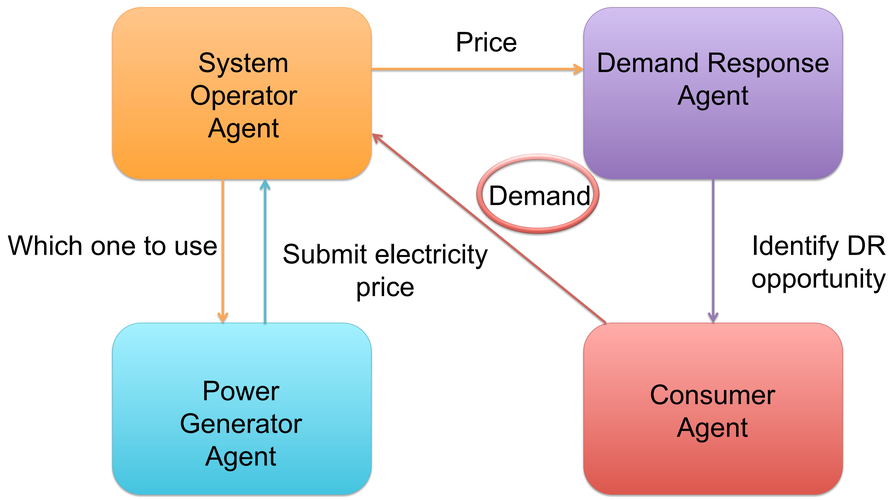


Figure 1: Q learning algorithm can be used to model the interactions among different agents in the electricity market

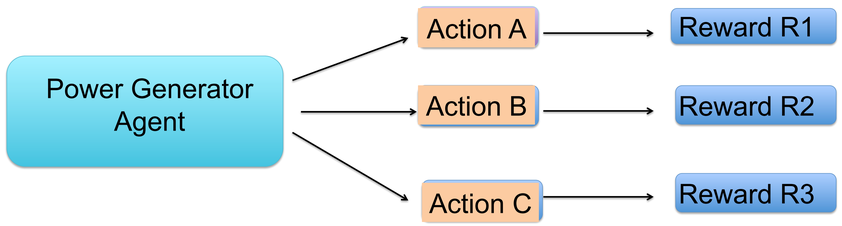
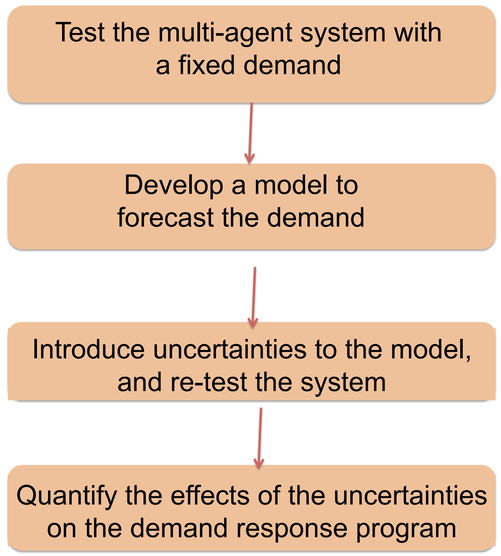


Figure 2: Apply Q learning algorithm to the power generator agent. The agent does not know anything about the environment. It will receive different rewards by trying different actions. The goal of the agent is to maximize the reward by learning from the environment.

2. Develop a forecasting model

Demand forecasting is used to decide the spot price. There are some unavoidable uncertainties associated with the forecasting due to unexpected human behaviors. Future works will focus on the quantification of the effects of these uncertainties.

Future Directions



References

1. Alt, Lowell. 2006 Energy Utility Rate Setting. P. 66

2. Chakhchoukh, Yacine, Patrick Panciatici, and Lamine Mili. "Electric Load Forecasting Based on Statistical Robust Methods." IEEE Trans. Power Syst. IEEE Transactions on Power Systems 26.3 (2011): 982-91. Web.

Acknowledgements

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