Optimal Operational Schedule of Appliances with Energy Comfort Trade off in Smart Grid

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Abstract

This research is motivated by *Demand Response* (DR) applications in Smart Grid. DR programs are to adjust the load according to the supply during peak hours. In the existing power grid, the meter is an end entity for any home/building which gives the information of energy consumption for any utility company. With the introduction of real time pricing (Time of Use rates) by utilities in some countries, the type of appliance and time of operation are also important factors to consider for energy billing. *Fine grain level of monitoring and control at the appliance level* is possible with the advances in sensing systems, smart appliances and smart meters, which give rise to new optimization problems in this space.

The objectives in this problem are to minimize the energy bill and at the same time not compromising much on the comfort of the consumers even by participating in the demand response programs, which is termed as *energy-comfort trade off*. In our model, we came up with general constraint specification method for various appliances with validity/ invalidity specified by the consumer. Example constraints can be: Delay cannot be more than 2 time slots after the arrival of request; Appliance A cannot run along with appliance B; Appliance types C and D should run together etc… By taking all these inputs and priority of the appliances from the consumer, we came up with the *optimal operational schedule to have energy and comfort trade off* in the smart grid. Several case studies are considered in this. First, we assume that the energy requirement of appliances is known in advance. Next, we relax this assumption to come up with the sub optimal algorithms for optimal operational schedule. The nature of the problem is *mixed Integer Linear Programming*. Size of the problem is few thousands of variables/appliances.

Keywords:
Operational schedule, schedule of appliances, optimization in smart grid, demand response, demand side management, smart appliances