FIPSE-6 Short Presentation 3c

Integrated Production Planning-Scheduling in Smart Grid Systems

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ABSTRACT

On one hand, production planning and scheduling are two important problems in chemical production operations. Production planning aims to satisfy the production targets based on the demand profile over a mid-term horizon, while production scheduling decides the optimal task assignments and sequences following the production planning over a short-term horizon. On the other hand, the concept of a smart grid introduces bidirectional flows of energy and information, enabling great opportunities for alternative energy, emission reduction, and carbon neutrality. Considering the smart grid system with renewable power, where uncertain factors play important roles, it is a difficult problem to integrate the optimization of production planning and scheduling.

Traditionally, integrated production planning scheduling can be achieved by certain linking constraints between the two levels, which help to avoid infeasible or suboptimal solutions caused by overestimating the production capacity of the scheduling level. With the various renewable energy technologies introduced in the smart grid system, there are lots of uncertain factors involved, including, but not limited to, the demand volatilities of chemical products, solar/wind/tidal energy supply fluctuations, energy market prices under various regulations, and chemical production process unsteadiness. Therefore, the decision-making process must incorporate the new requirements and the accompanying uncertainties. In our opinion, the open problem for integrated production planning-scheduling in a smart grid system is at least threefold: problem-bound definition and layering for the decision-maker, mathematical modeling for various uncertain factors, and computational difficulty in obtaining online solutions. First, the traditional planning-scheduling- RTO-control hierarchical framework may not be directly applicable, considering that the decisions involving the renewable power generation system, storage system, utilities, and production system may or may not be coordinated seamlessly, depending on the ownership or other reasons. Second, the smart grid is a competitive multi-agent system with many uncertain factors to be considered, and what attributes and parameters in this stochastic system should be explicitly or implicitly modeled is not an easy question to answer. Last but not least, the computational cost often becomes a significant burden when many uncertain factors exist, and how the rapidly upgrading machine learning integration could improve the calculation is an essential open problem.

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