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A novel adaptive robust model for scheduling distributed energy resources in local electricity and flexibility markets

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Summary

Aggregators, as intermediaries between consumers, prosumers, and local market operators, manage their clients' resources for participation in the multi-markets. Various resources of consumers and prosumers have different technical characteristics, which shall be considered in the scheduling strategy. The fast response and controllability of some resources may increase the profit of aggregators and improve the flexibility of distribution grids. Therefore, aggregators need a scheduling strategy to determine their participation level in different markets. However, the expected profit of aggregators can be affected by uncertainties in some resources such as PV generation or consumption of prosumers. This work provides a decomposed bi-level strategy approach for aggregators to deploy the resources of prosumers in the local energy and flexibility markets. The upper and lower sub-problems determine the optimal commitment status of the aggregator's resources and the participation level in the local energy and flexibility markets, respectively. In the proposed model, the adaptive robust optimization (ARO) is addressed to model uncertainties of consumption and generation of renewable resources based on the worst-case realizations of uncertain parameters. In addition, impacts of consumption control programs such as load-shifting and load reduction are considered in the proposed model. Through a case study and different scenarios, the performance and efficiency of the proposed model are validated.

Highlights

- An adaptive robust model is proposed for aggregating the flexible resources.
- The characteristics of flexible resources are considered in the proposed model.
- The objective function is formulated as min–max-min problem.
- The strong duality theorem and decomposition techniques are used to solve the problem.

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