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Real-time Pricing for LQG Power Networks with Independent Types: A Dynamic Mechanism Design Approach☆

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Abstract

We investigate dynamic integration mechanisms for a power network system using a technique from economic theory. We represent a power network consisting of agents who are the generators and consumers and one public commission, called the utility, as a dynamic game. The game has a prescribed dynamic mechanism and each agent exercises private control to minimize the costs according to a personal cost functional, while the utility chooses prices to minimize the costs according to a public cost functional and manages information transmission. The model of this paper is a generic linear Gaussian power network model in which each agent has a type parameter representing private information. In this setting, inspired by the pivot function from mechanism design theory in economics, we design dynamic mechanisms that integrate the strategic determination of private controls by rational agents into the optimal public controls with real-time pricing and monetary transfer costs. Two dynamic integration mechanisms, which together achieve all of social welfare maximization, incentive compatibility, and individual rationality, are proposed based on the cost functional and the Hamiltonian.

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