A Price-Based Strategy to Coordinate Electric Springs for Demand Side Management in Microgrids

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Electric springs (ESs) have proven effective for integrating renewable generation into power systems. An ES connected in series with a non-critical load forms a smart load whose consumption can be dynamically controlled for voltage regulation and demand side management. In most existing applications, smart loads have been devoted to providing services to the grid
without accounting for their own interests. The novelty of this paper is to propose a price-based strategy to coordinate the operation of multiple ESs in microgrids. Smart loads consisting of ESs connected to electric water heaters are modeled as rational agents that locally optimize their own objectives by adjusting their consumption schedules in response to price/control signals. Such signals are determined at the microgrid central controller (MGCC) when solving the microgrid operation scheduling problem formulated to minimize the microgrid operation cost taking into account the smart loads' consumption schedules. An iterative optimization algorithm determines the equilibrium between the microgrid and smart loads' objectives requiring only the exchange of price/control signals and power schedules between the local controllers and the MGCC. Case studies show the effectiveness of the proposed strategy to economically benefit both the microgrid and smart loads when scheduling their
operation.

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