



Luhao Wang



Biography: Luhao Wang is Ph.D. student in Electrical Engineering at University of Southern California. His research interests include smart grids, energy management and emerging device/circuit co-design.

Session Title: Online QoS-Aware Charging Scheduling in Battery Swapping Stations under Dynamic Energy Pricing

Abstract: Further popularization of electric vehicles (EVs) is hindered by their relatively short driving distance and long battery charging time. To overcome these shortcomings, the battery swapping station (BSS) has been proposed as a means of satisfying the increasing demands for fast EV battery recharging. At a BSS, and (partially) depleted batteries from EVs can be replaced with partially or fully charged ones almost instantaneously when EVs drive in. Recharging scheduling and maintenance of batteries are done by the operator of BSS, with the target of minimizing electrical energy costs while satisfying customer demands. In this paper, we consider a realistic BSS framework in which EVs can arrive at BSS with time of day dependent rates having different battery SoCs. We investigate the battery charging scheduling problem in the BSS under a dynamic energy pricing. The multilevel BSS system architecture is proposed. We formulate and solve (i) an online optimal BSS control problem to minimize the energy cost with a quality-of-service (QoS) guarantee for EVs, and (ii) an offline optimal BSS design problem to determine the optimal number of batteries stored in the BSS so as to achieve a desirable tradeoff between flexibility in battery charging and amortized battery costs. Our experimental results show that the total charging energy cost can be reduced significantly under different traffic scenarios.