Congestion Games for V2G-Enabled EV Charging

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Abstract

A model of the problem of charging and discharging electrical vehicles as a congestion game is presented. A generalization of congestion games – feedback congestion games (FCG) – is introduced. The charging of grid-integrated vehicles, which can also discharge energy back to the grid, is a natural FCG application. FCGs are proven to be exact potential games and therefore converge to a pure-strategy Nash equilibrium by an iterated better-response process. A compact representation and an algorithm that enable efficient best-response search are presented. A detailed empirical evaluation assesses the performance of the iterated best-response process. The evaluation considers the quality of the resulting solutions and the rate of convergence to a stable state. The effect of allowing to also discharge batteries using FCG is compared to scenarios that only include charging and is found to dramatically improve the predictability of the achieved solutions as well as the balancing of load.