On finding optimal charging station locations in an electric car sharing system

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Abstract

Recent technological advancements have made electric vehicles a more reasonable choice in many applications where conventionally powered vehicles have been used previously. One such application is urban car sharing, where customers rent cars for short periods of time to move around within a city.

However, the range of most electric cars is still fairly limited, and recharging them takes longer than refueling cars with an internal combustion engine. Therefore, a network of charging stations must be built within system's operational area, where the cars can be recharged between trips. Since building these stations is very costly, their locations must be chosen carefully to optimize the system's operational efficiency.

We present several integer linear programming formulations for solving the problem of optimally placing charging stations within the network's operational area, as well as finding their optimal size. Given a limited budget, our objective is to maximize the profit gained from the estimated customer demand that can be satisfied by the constructed stations. To improve flexibility, customers can pick up a car at any sufficiently close station, as well as return it to any station near their destination (subject to the availability of a car and free charging slot, respectively).

The empirical performance of these models is compared on a set of benchmark instances that are based on artificial as well as real-world data.

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