A multi-objective optimization for relocating electric vehicles in car-sharing services

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Abstract

Nowadays, also thanks to the Information and Communication Technology, the sharing mobility represents a significant part of the sharing economy. In particular, the Car Sharing Services (CSSs), in which the user rents a car for short time, paying according to the time of use, support the sustainable mobility, reducing the number of parked vehicles and consequently, the traffic congestion, noise and air pollution. These two last advantages are more guaranteed in CSSs with Electric Vehicles (EVs). In fact, the EVs guarantee zero local $CO2$ emissions and are less noisy than the traditional combustion engine vehicles.

In particular, in One-way CSSs (OCSS), a user can drop off a vehicle in a parking station different from the pickup one. However, the OCSSs suffer of possible imbalances between the demand and the supply of vehicles, leading to a Vehicle RElocation Problem (VREP). We address a VREP in OCSSs with EVs in which the relocation is operator-based: the CSS operators relocate the EVs by directly driving them from a station of pickup to one of delivery and move from a station of delivery to one of pickup by folding bikes.

To balance the good quality of service assured to the users (maximizing the number of EV requests satisfied), the cost reduction and the load balancing among the operators, a multi-objective VREP is solved. Firstly, a set of feasible solutions is heuristically generated and then, through the epsilon-constraint method, a three-objective non-overlapping model is solved. Numerical results are carried out on some benchmark instances.

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