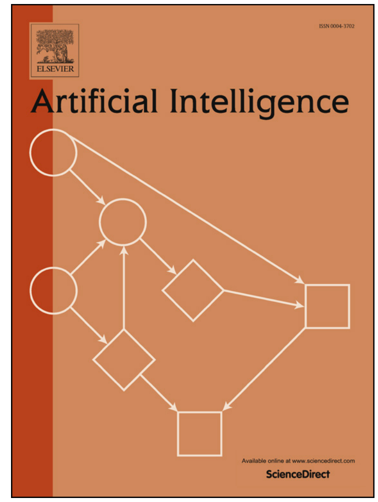
Accepted Manuscript



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PII: S0004-3702(18)30319-9
DOI: https://doi.org/10.1016/j.artint.2018.06.006
Reference: ARTINT 3081

To appear in: *Artificial Intelligence*

Received date: 17 July 2016
Revised date: 14 February 2018
Accepted date: 10 June 2018

Please cite this article in press as: E.S. Rigas et al., Algorithms for Electric Vehicle Scheduling in Large-Scale Mobility-on-Demand Schemes, *Artif. Intell.* (2018), https://doi.org/10.1016/j.artint.2018.06.006

Algorithms for Electric Vehicle Scheduling in Large-Scale Mobility-on-Demand Schemes

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Abstract

We study a setting where Electric Vehicles (EVs) can be hired to drive from pick-up to drop-off points in a Mobility-on-Demand (MoD) scheme. The goal of the system is, either to maximize the number of customers that are serviced, or the total EV utilization. To do so, we characterise the optimisation problem as a max-flow problem in order to determine the set of feasible trips given the available EVs at each location. We then model and solve the EV-to-trip scheduling problem offline and optimally using Mixed Integer Programming (MIP) techniques and show that the solution scales up to medium sized problems. Given this, we develop two non-optimal algorithms, namely an incremental-MIP algorithm for medium to large problems and a greedy heuristic algorithm for very large problems. Moreover, we develop a tabu search-based local search technique to further improve upon and compare against the solution of the non-optimal algorithms. We study the performance of these algorithms in settings where either battery swap or battery charge at each station is used to cope with the EVs' limited driving range. Moreover, in settings where EVs need to be scheduled *online*, we propose a novel algorithm that accounts for the uncertainty in future trip requests. All algorithms are empirically evaluated using real-world data of locations of shared vehicle pick-up and drop-off stations. In our experiments, we observe that when all EVs carry the same battery which is large enough for the longest trips, the greedy algorithm with battery swap with the max-flow solution as a pre-processing step, provides the optimal solution. At the same time, the greedy algorithm with battery charge is close to the optimal (97% on average) and is further improved when local search is