Routing Electric Vehicles on Congested Street Networks

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Freight distribution with electric vehicles (EVs) is a promising alternative to reduce the carbon footprint associated with city logistics. Algorithms for planning routes for EVs should take into account their relatively short driving range and the effects of traffic congestion on the battery consumption. With this presentation, we propose new methodologies and illustrate how it can be applied to solve an electric vehicle routing problem with stochastic and time-dependent travel times, and with battery capacity chance-constraints. First, a new method for generating network-consistent (time and space correlated) and time-dependent speed scenarios is introduced. Secondly, a new technique for applying branch-and-price on instances defined on the real street network is developed. Computational experiments demonstrate the effectiveness of the approach for finding optimal or near-optimal solutions in instances with up to 133 customers and almost 1500 road links. With a high probability, the routes in the obtained solutions can be performed by EVs without requiring intermediate recharging stops. An execution time control policy to further reduce the chances of stranded EVs is also presented. In addition, we measure the "cost of independence", which is the impact on solution feasibility when travel times are assumed statistically independent. Lastly, we give directions on how to extend the proposed framework to handle recourse actions.