Comparing centralized and decentralized repositioning strategies for ride-sharing applications

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Abstract

Ride-sharing services such as Lyft Line and UberPOOL offer a promising way of reducing urban traffic. One challenge faced by operators of these services is the repositioning of idle vehicles to anticipate future demand. In systems with independent drivers, this is generally achieved by providing incentives for drivers to reposition towards areas with a discrepancy between supply and predicted demand.

In this talk, we compare two approaches for solving the idle vehicle repositioning problem. Firstly, we present a novel way of modelling the problem, in which we aim to maximize coverage of forecasted demand locations by repositioning idle vehicles and minimize the travel duration for these repositioning movements. We compare this centralized strategy to a decentralized one. The latter consists of an agent-based approach, where drivers maximize their personal profit. Earning potential is increased in high-demand areas to incentivize drivers to reposition there. Both solution approaches are embedded into a framework for evaluating dynamic dial-a-ride-problems.

Based on real-world taxi trip records from New York City, we build a diverse set of test instances containing up to 400,000 trip requests per day. We evaluate our centralized and decentralized solution strategies on these instances regarding the number of rejected trip requests and the travel duration for repositioning movements. In addition, we compare them to solutions with a simple reactive repositioning approach and no repositioning at all. Lastly, for our forecast-based method we assess the impact of the forecast quality on the solution quality.

Keywords: dial a ride problem, ride sharing, mobility as a service, repositioning, dynamic

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