SEMINAR
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MODELING SHARED-USE URBAN MOBILITY SYSTEMS TO INCREASE SYSTEM PERFORMANCE

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Abstract

Shared-use mobility systems, which enable users to have short-term access to transportation modes on an on-demand basis, have experienced tremendous growth over the last decade. However, most of the existing systems suffer from two co-founding issues: the lack of modeling tools to understand, simulate and predict their behavior and the lack of integration with the existing transit network. To address those issues, this dissertation focuses on investigating the operational challenges of bikesharing systems, with an emphasis on the rebalancing operations and the modeling of a new mobility concept, Car2work, which builds upon existing carsharing ideas and successfully integrates with existing transit networks. A methodological framework to solve the bikesharing rebalancing problem is proposed. The novelties of the approach are that it is proactive instead of reactive, as the bike redistribution occurs before inefficiencies are observed, and uses the outputs of a demand-forecasting technique to decompose the inventory and the routing problem. The decomposition makes the problem scalable, responsive to operator inputs, and able to accommodate user-specific models. Simulation results based on data from the Hubway bikesharing system show that system performance improvements of 7% in the afternoon peak could be achieved.

Car2work main goal is to connect commuters with workplaces while leveraging the line-haul capabilities of existing public transit systems and guaranteeing a trip back home, efficiently tackling the “last mile” problem that is a limiting characteristic of public transit. It differs from the traditional dynamic-ridesharing approaches because it is designed for recurrent commuting trips where commuters announce their (multiple) trips in advanced and an automated all-or-nothing matching strategy is performed, guaranteeing a ride home. The problem is formulated as a pure binary problem that is solved using an aggregation/disaggregation algorithm that renders optimal solutions. The solution approach is based on decomposing the problem into a master problem and a sub-problem, reducing the number of decision variables and constraints. As a result, various instances of the problem can be solved in reasonable amount of time, even when considering the transit network. The model could be used to simulate a large-scale implementation of the concept.