Research Title:

An integrated model for shared mobility systems that considers endogenous demand and travel times

Primary Investigator:

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This research develops an integrated modeling framework for ridesharing systems with endogenous demands and travel times. Specifically, the interactions between travelers, ridesharing companies, and transportation networks are explicitly considered.

In the proposed modeling framework, travelers are assumed to make various decisions based on travel times in the network and ridesharing service qualities, which in turn also impact ridesharing operations and network congestion. Ridesharing companies balance decisions between drivers and passengers based on ridesharing demands and travel times, whose decisions affect travelers' ridesharing experiences, and indirectly impact travel times in the network through matching.

Under this setting, an efficient dynamic tree algorithm is developed to solve the ridesharing matching problem, whose outputs to the drivers are a set of passengers and their pickup and drop-off sequences. An agent-based simulation model is developed to capture the dynamic interactions between drivers, passengers, and the ridesharing companies. This simulation model focuses on the short-term operation of a multi-passenger ridesharing, where drivers and passengers can make order cancellation (before/after being matched) and matching acceptance/rejection decisions for the options provided by the ridesharing companies.

For analyzing the long-term equilibria in the presence of multi-passenger ridesharing and traffic congestions, a general network equilibrium problem is formulated using a hyper-network approach, and the existence of an equilibrium is shown under mild assumptions. Long-term traveler route choice behaviors are also studied, in which data-driven machine learning methods are developed for the choice set generation problem.

The details of the model framework and implementation can be found in the PhD dissertation of Rui Yao.