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Decision Support for Short-Distance and Ad-Hoc Ridesharing Based on Passively Recorded Tracking Data

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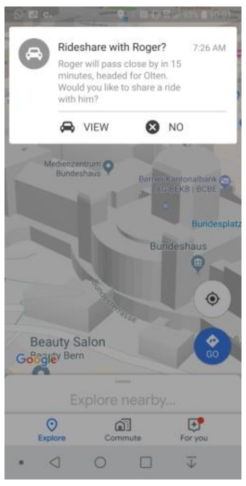
Setting average car utilization (in Switzerland) 1.56 people per trip, 1.1 for commutes [1]; ridesharing could increase this utilization; however, lack of supporting technology (for short-distance ad-hoc sharing) leads to large planning overhead and thus few shared rides.

Developed Methods 1) Smartphone app for tracking and providing human-in-the-loop recommendations. 2) Generalized inter-modal routing system able to integrate ridesharing and station- and area-based transport by using geographical properties.

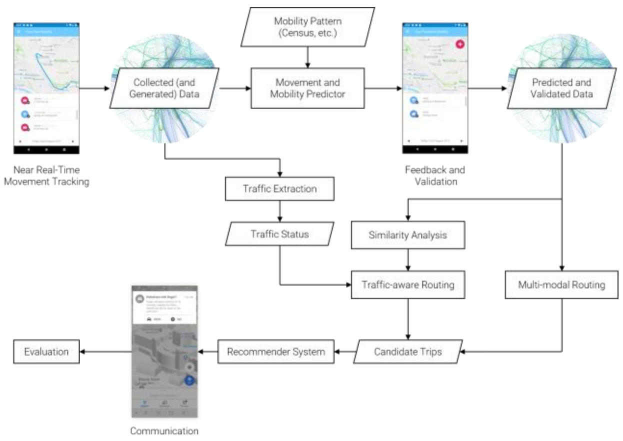
3) Routing system expandable with probabilities learned from previously tracked behavior to provide personalized route recommendations. 4) Novel traffic-aware rideshare candidate identification method incl. evaluation using a large taxi dataset.

Motivation



Ridesharing is primarily employed for long-distance travels or regular commutes (carpooling). Short-distance and ad-hoc ridesharing only received limited support by technological means. Well-aware of the non-technical reasons why someone would not want to rideshare (and the danger of it substituting public transport), we argue that simplified finding of potential ridesharing partners can increase the attractiveness of this form of travel, and thus lead to a reduction of the ecological impacts of mobility. To this purpose, we developed various methods and technologies to record and process mobility data, with the aim of providing ridesharing decision support to travelers.

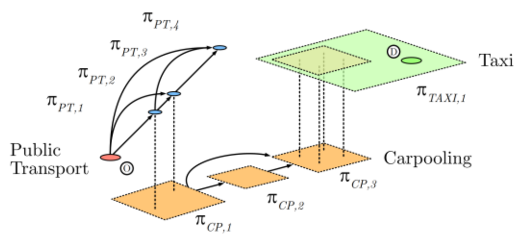
Smartphone Apps for Tracking



Starting from data collected passively using a person's smartphone, we predict likely future movements, present it to a user for validation, and evaluate which people move along a similar route. Finally, based on the same tracking data, we determine likely transport modes for a given route and give recommendations.

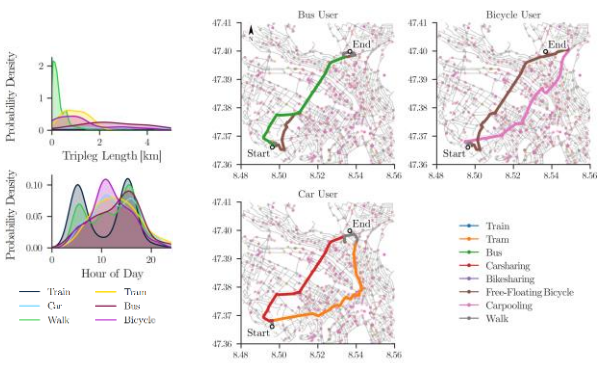
Intermodal Routing

Transport offers usually are either point-to-point (car, bicycle, …), station-based (public transport, car rentals, …), or area-based (free-floating scooters, …). Computing intermodal routes requires the preparation of a specific routing graph that must be adapted for each transport mode individually. We developed a generalized method that can incorporate all commonly used forms of transport and generate routing graphs based on their geographical relations. In the figure below, public transport, carpooling, and taxi offers are combined within an inter-modal routing graph. [2]



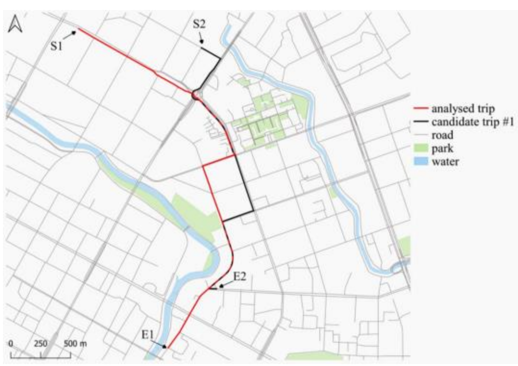
Personalized Recommendations

To prevent unmeaningful recommendations, we developed an approach that uses the characteristics of previously recorded mobility to determine which transport mode a person would likely use in a given situation. For example, the length of a trip or the hour of the day indicates when a certain transport mode is likely used (left). An evaluation using data from 140 people in Switzerland shows the differing recommendations (right). [2]



Traffic-Aware Candidate Extraction

The identification of potentially shareable trips usually requires either a similarity analysis or the evaluation of several routing paths. By developing an efficient similarity measure, we can greatly reduce the number of candidate trips for which the (more expensive) routing must be performed. Our approach also computes the traffic state directly from the recorded mobility data and thus leads to a more realistic representation of the transport situation. [3]



Expected Impacts / Outlook

Studies have found that there would be a large potential for people to share rides, especially in densely populated regions where many people travel in the same direction [4]. Our studies have confirmed that roughly 9% of the CO_2 emissions could be avoided without large delays for individual people (note that these numbers were computed based on a taxi dataset). However, as our assessment of the influence of traffic state has shown, it is very important to realistically depict the situation in which a person (and a transport system) is. Including the traffic state in the assessment of a ridesharing system decreased the CO_2 reductions from 13% to 9% [3]. The methods developed for personalized recommendations further provide an important step into this direction of having a more meaningful representation of reality: by analyzing in which situations a person would potentially use a certain transport mode, we can prevent wrong recommendations and thus also increase the reliability of assessments of ridesharing systems.

References

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[4] Agatz, Niels, et al. "Dynamic ride-sharing: A simulation study in metro Atlanta." Procedia-Social and Behavioral Sciences 17 (2011): 532-550.

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