Capacity Area B1 Task 2.3 Deliverable 2

Algorithm for multi-modal and energy-efficient transportation modes

Current popular multi-modal routing systems often do not move beyond combining regularly scheduled public transportation with walking, cycling or car driving. Seldom included are other travel options such as carpooling, car-sharing or bike-sharing, as well as the possibility to compute personalized results tailored to the specific needs and preferences of the individual user. Partially this is due to the fact that the inclusion of various modes of transportation and user requirements quickly leads to complex, semantically enriched graph structures, which to a certain degree impede down-stream procedures such as dynamic graph updates or route queries.

In this deliverable, we provide an algorithm for multi-modal and energy-efficient transportation modes routing, which aims to reduce the computational effort and specification complexity of personalized multi-modal routing by use of a preceding heuristic, which, based on information stored in a user profile, derives a set of feasible candidate travel options, which can then be evaluated by a traditional routing algorithm (Bucher et al. 2017). The heuristic allows to pre-calculate a set of plausible routes (where each route is defined by a list of route segments, consisting of start and end point, and a transport modality), which can then be evaluated in more detail by a conventional route planner, in order to check for actual feasibility and user acceptance. In contrast to conventional route planning, our heuristic is easily adaptable to user preferences (e.g. with regards to modes of transport) or routing constraints (e.g. critical threshold values, such as maximum walking distances or excluded modalities), and, other than algorithms based on extensive graph pre-processing, does not require algorithm-dependent updates of the transport graph. The proposed heuristic evaluates the feasibility of different trip segments and used modes of transport based on their individual preconditions in combination with user preferences and constraints. Thus, for example, driving is only possible if a car is available at the current location of the user. Since all modes of transport are marked by an individual set of preconditions and outcomes, we formulate individual rules of the general form:

O[condition] → M[condition] → D[condition]: [outcomes]

where both the origin O and the destination D locations have to fulfill some conditions in order for the mode M to be potentially available to a user. An example for location conditions would be the availability of a car. We implemented the proposed heuristic for the city of Zurich, and tested it with various examples, including the one illustrated in Figure 1.

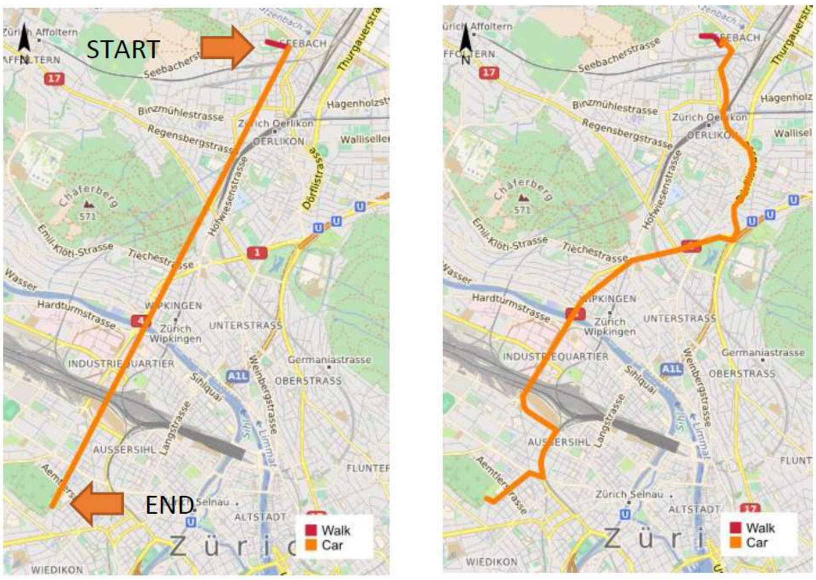

Figure 1. User A of case study one. The left figure shows the raw output of the heuristic, the right side the exact route. The red WALK segment in the beginning shows the distance walked to the car

References:

Bucher, D., Jonietz, D., Raubal, M. (2017): A Heuristic for Multi-Modal Route Planning. In: Progress in Location-Based Services 2016, Lecture Notes in Geoinformation and Cartography, 211-229.