Isochrones in Multimodal Spatial Networks

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Isochrones are a new query type in spatial networks that can be used for reachability analyses using various transportation systems, even if these systems are combined within one travel route. In a multimodal spatial network isochrones are defined as a possibly disconnected subgraph that covers all points that are reachable within a given time span [IN11]. One disadvantage of isochrones is that the computation is a non-trivial, time intense task and that the calculation time depends heavily on the size of the network. Major improvements have been made in the area of isochrones calculation at the Free University of Bolzano in 2013 to resolve this issue. In order to increase the overall calculation performance, two algorithms that minimize memory usage during calculation were developed in [IN13].

One remaining drawback of isochrone calculation is that for every isochrone the computation has to be done from scratch. Since new travel points can become reachable when increasing the travel time from any (internal) network connection hub (which in reality can be any station of the public transportation system) it is not sufficient to expand a known isochrone from its border points.

In this poster we present two innovative ideas: incremental calculation of isochrones, which by now is not possible at all, and the calculation of isochrones with fixed points. The first approach decreases the time needed for calculation even further while the second one will be examined to push isochrones into a new field of application. Incremental isochrones will enable large travel times to be calculated on the basis of smaller ones. This will reduce the costs of calculation to a minimum, especially if the results of several travel times are cached and used as incrementation basis.

A new application where isochrones seem appropriate is the planning of city round trips. When combining various reachability analyses with possible arrival times at a given point of interest the computation of an optimal sight-seeing tour through a city (in terms of time needed) can be realized. Problems that need to be addressed when expanding isochrones to this field are finding the optimal order of travelling points and minimizing the calculation time.

After revisiting the algorithms developed in [IN13] and implementing the incremental calculation approach, isochrones will be computable much faster and become utilizable for city round trip planning in multimodal spatial networks.

References:
[IN11] ... "Defining Isochrones in Multimodal Spatial Networks"; Markus Innerebner, Gamper Johann, Michael H. Böhlen, Willi Cometti; CIKM2011
[IN13] ... "Isochrones in Multimodal Spatial Networks"; Innerebner Markus, 2013; PhD thesis