Integrating Options for Wheelchair Users into an Open Route Planning Service: State-of-the-art and Open Challenges

Hahmann, S., Bakillah, M., Mobasheri, A., Rousell, A.
Chair of GIScience, Department of Geography, Heidelberg University, Germany

1 Motivation

Despite the obvious motivation to provide wheelchair users with a tool that computes routes tailored to their needs [1], the goal of the CAP4Access[1] project is also **raising awareness** about **potential barriers** in our daily lives: Thus a route service that is capable of computing and visualizing accessible routes may also contribute to an increasing awareness for the needs of people with restricted mobility (also including parents with pushchairs, and the elderly).

Current popular route planning services available on the World Wide Web such as Google Maps or Bing Maps do not provide **specialized options** for **pedestrians with restricted mobility**. Our research aims at filling this gap by integrating route planning options that reflect the special needs of this group of people into an **open route planning service**. Within the recent years a considerable amount of research and development has been conducted relating to the implementation of routing services which provide routes specifically targeted at wheelchair users [2,3]. However, particularly in the implementation there still remain open challenges that we want to illustrate in this contribution.

[1] Collective Awareness Platforms for Improving Accessbility in European Cities and Regions

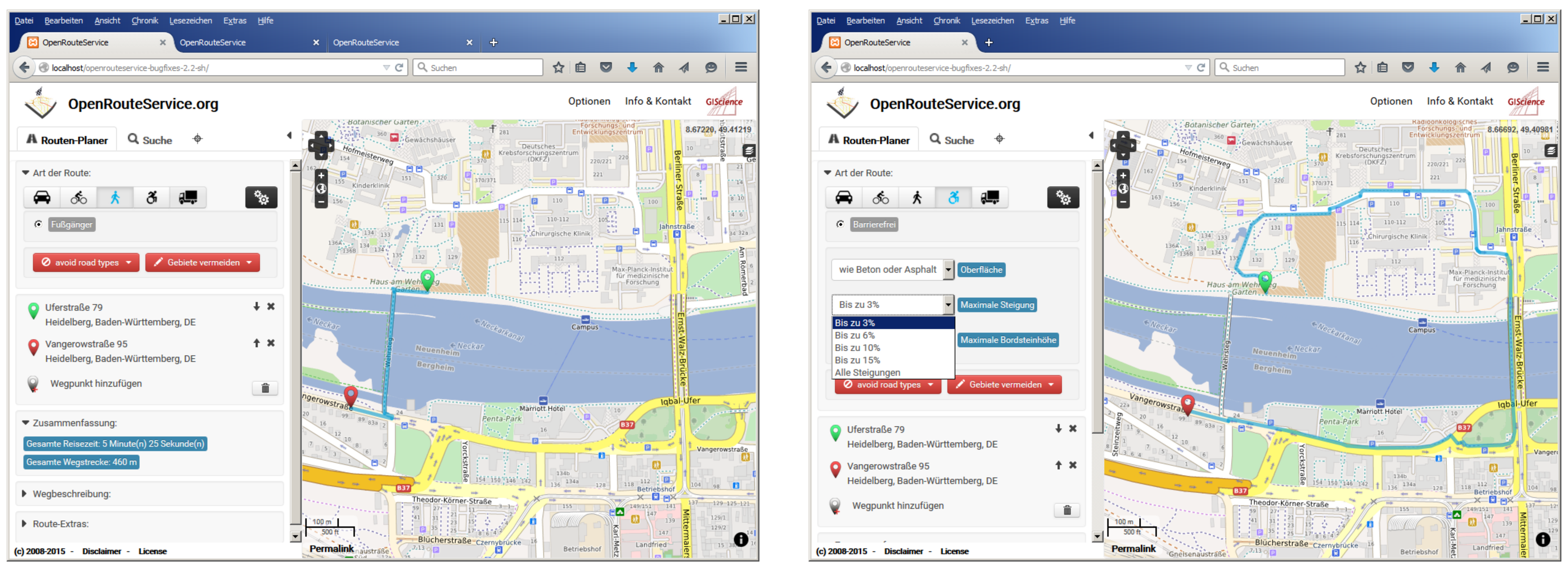
2 State-of-the-art

In order to allow **free usage** of the route planning service, we apply open source software, open data – in our case OpenStreetMap (OSM) – and implement open standards, such as the **OGC OpenLS** specification [4]. The route planning service is implemented as a web service. A complementary web based navigation service and mobile application on the Android platform are currently under development.

In the current routing system[2,3] a number of parameters which impact wheelchair users have been included in the graph generation process. These are steps, maximum incline, maximum height of sloped curbs, surface type, smoothness of surface, and track type. Moreover, users can choose between shortest and fastest route and may specify areas they would like to avoid.

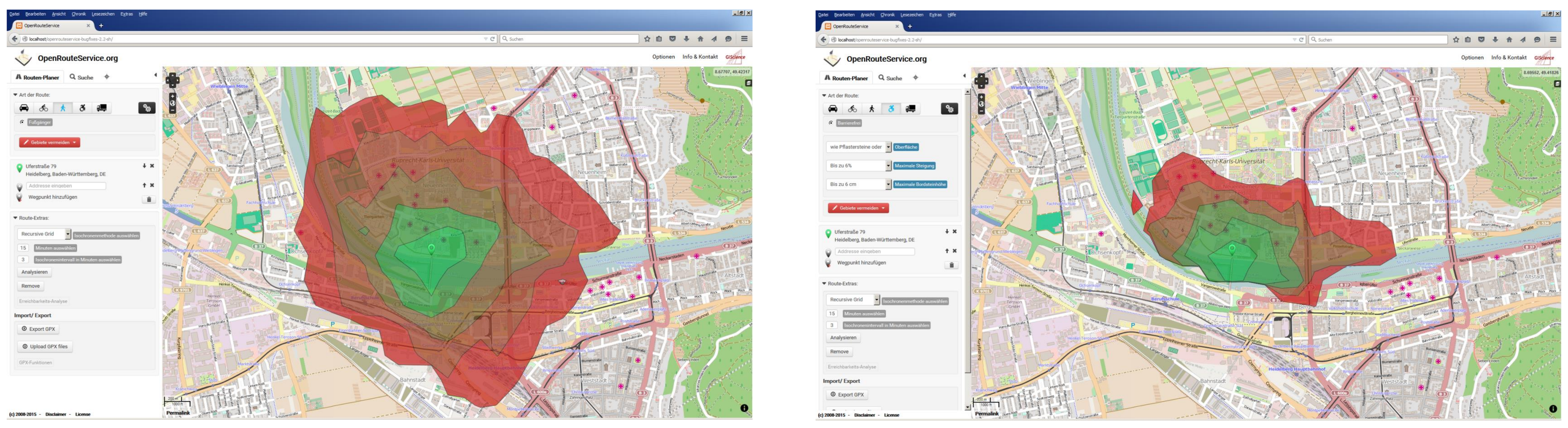
[2] OpenRouteService.org: http://openrouteservice.org/
[3] OpenRouteService.org, wheelchair profile (Beta version): http://openrouteservice.org/wheelchair-2.1

2.1 Pedestrian vs Wheelchair Routes



Route for pedestrian profile — Route for wheelchair profile

2.2 Pedestrian vs Wheelchair Accessibility Analyses

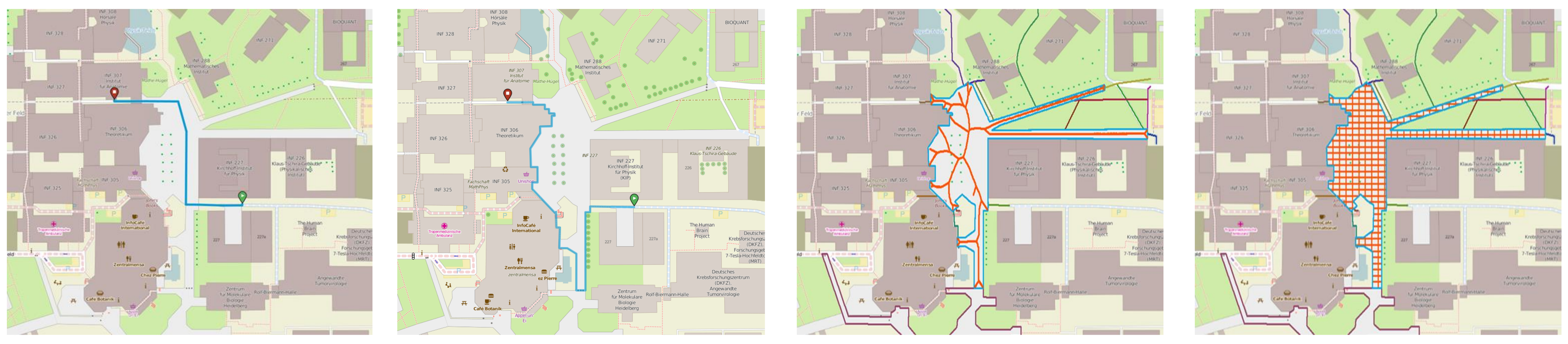


Accessibility analysis for pedestrian profile — Accessibility analysis for wheelchair profile

3 Open Challenges

3.1 Route Planning Through Areas

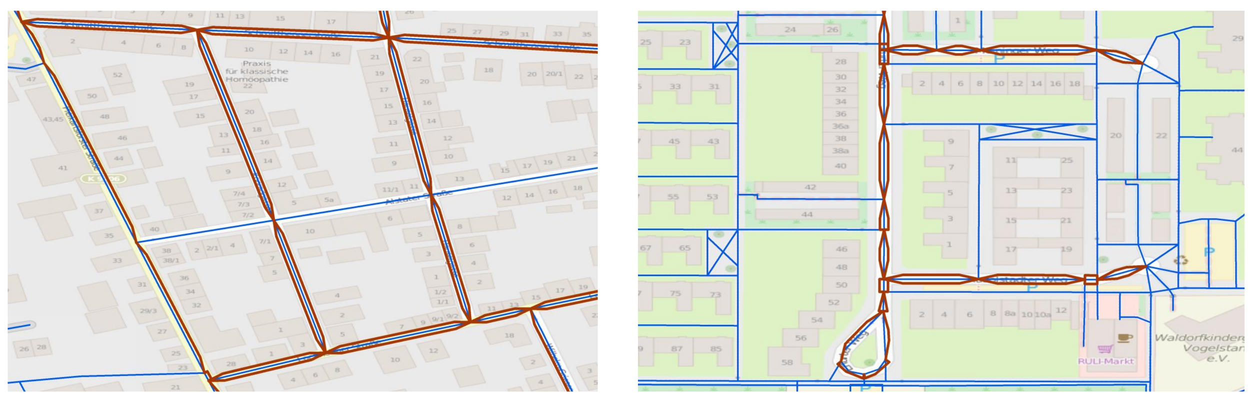
In OSM places such as pedestrian zones or market squares may be modelled as polygons. The simplest solution to integrate polygons into a graph is using its outline (b). However, this results in poor route plans – cf. a) for a desired route plan. Alternatively, skeleton- (c), grid- (d), and line-of-sight-approaches may be used to generate suitable subgraphs within the polygons.



a) Desired route through a polygon; b) Outline of a polygon as part of a graph; c) Skeleton of a polygon as a subgraph; d) Interpolated grid as a subgraph

3.2 Separate Graph for Pedestrian / Wheelchair Users

Particular for navigation purposes, network graphs should be made available that model sidewalks separately in order to give better navigation instructions (e.g. "cross the road here", "use sidewalk on left/right side of the road"). In some areas the OSM community captures sidewalks as separate geometries. However, depending on the characteristics of the street and the sidewalks, the relevant information may also be attached as an attribute to the corresponding street. For the latter cases routing engines could compute an internal graph for pedestrian routing that include separate sidewalks that have been generated based on the given semantic information [1].

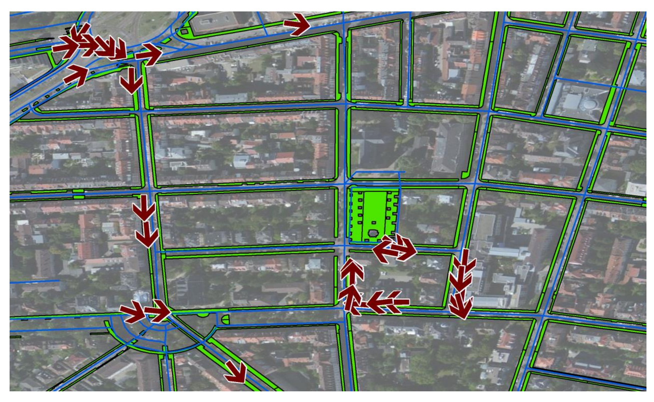


Base map, road network (blue lines) and derived sidewalk geometry (red lines).

3.3 Information About Sidewalks

The OSM contributor community in general is focused on attributes that may be seen in one of the main maps. As information about sidewalks (including surface, width, height of sloped curbs) is highly specific, it is in general not drawn on the maps. Thus, there is huge lack of this information in the OSM database. Additional crowdsourcing approaches, such as the georeferenced street level imagery provided via the platform Mapillary.com[4] and the citizen science community active on Crowdcrafting.org[5] may support the collection of information.

Crowdsourcing task to collect information about sidewalks

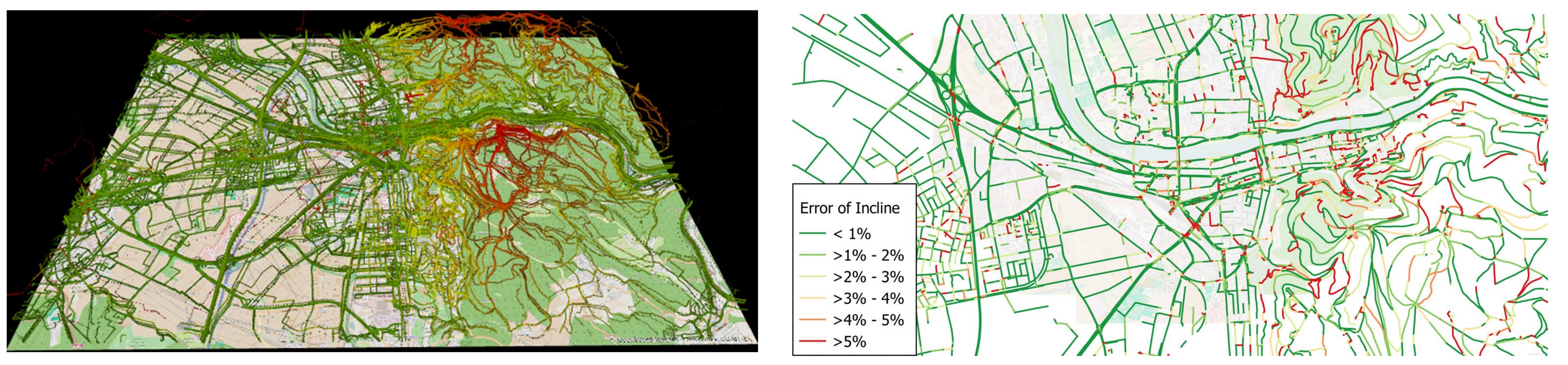


Analysis of responses (green areas = reference data, blue lines = OSM streets, red arrows = Mapillary images)

[4] Mapillary.com user contributed street level imagery: http://www.mapillary.com/
[5] Experiment - Detect sidewalks from street level imagery on Crowdcrafting.org: http://crowdcrafting.org/app/detectsidewalkinformationfromstreetlevelimages/

3.4 Information About Incline

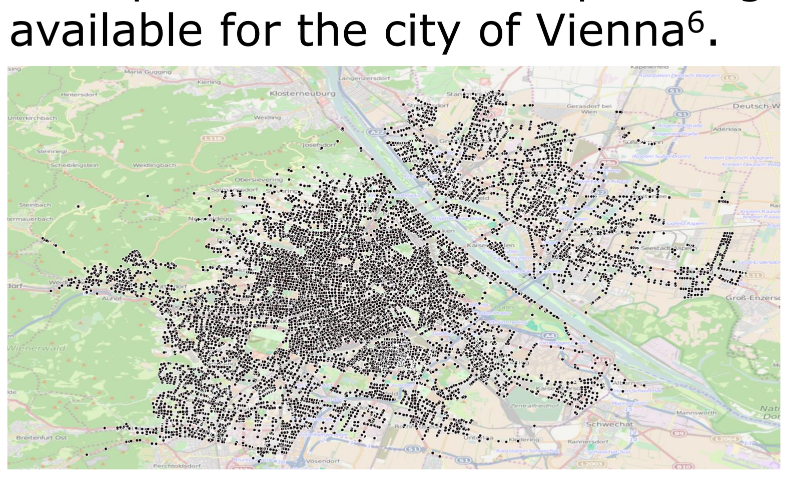
Pedestrians with restricted mobility often have to and/or want to avoid steep ways. Thus, there is a need for the information about the incline of the ways. In order to allow large-scale integration of this information, ideally it should be derived via low-cost approaches and/or open data. A current research example is presented by [5].



Visualization of OpenStreetMap GPS traces and derived incline values.

3.5 Integration of Open Data / PSI

There is an increasing amount of open data available that can be incorporated into OSM, but currently it is held in separate datasets. Efforts should be made to import this information so that it can be used by the OSM community. An example related to route planning for wheelchair users is the set of curb data available for the city of Vienna[6].



Visualization of dropped kerb data of Vienna

[6] Dropped kerb data of Vienna available at: https://www.data.gv.at/katalog/dataset/5349b414-5069-45be-8869-7d94261d4936

References

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[2] Neis, P. and Zipf, A. (2008): OpenRouteService.org is Three Times "Open": Combining OpenSource, OpenLS and OpenStreetMap. In: GISRUK '08.
[3] Müller, A., et al. (2010): Ein Routenplaner für Rollstuhlfahrer auf der Basis von OpenStreetMap-Daten. Konzeption, Realisierung und Perspektiven. In: AGIT 2010, pp. 258–261.
[4] Open Geospatial Consortium Inc. (2008): OpenGIS Location Services (OpenLS): Core Services.
[5] John, S., Hahmann, S., Zipf, A., Bakillah, M., Mobasheri, A., Rousell, A. (2014): Towards deriving incline values for street networks from voluntarily collected GPS data. In: GI_Forum.

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