Routing on rails with OpenStreetMap

Michael Reichert (Nakaner)


RAILS

Current solutions
Travic

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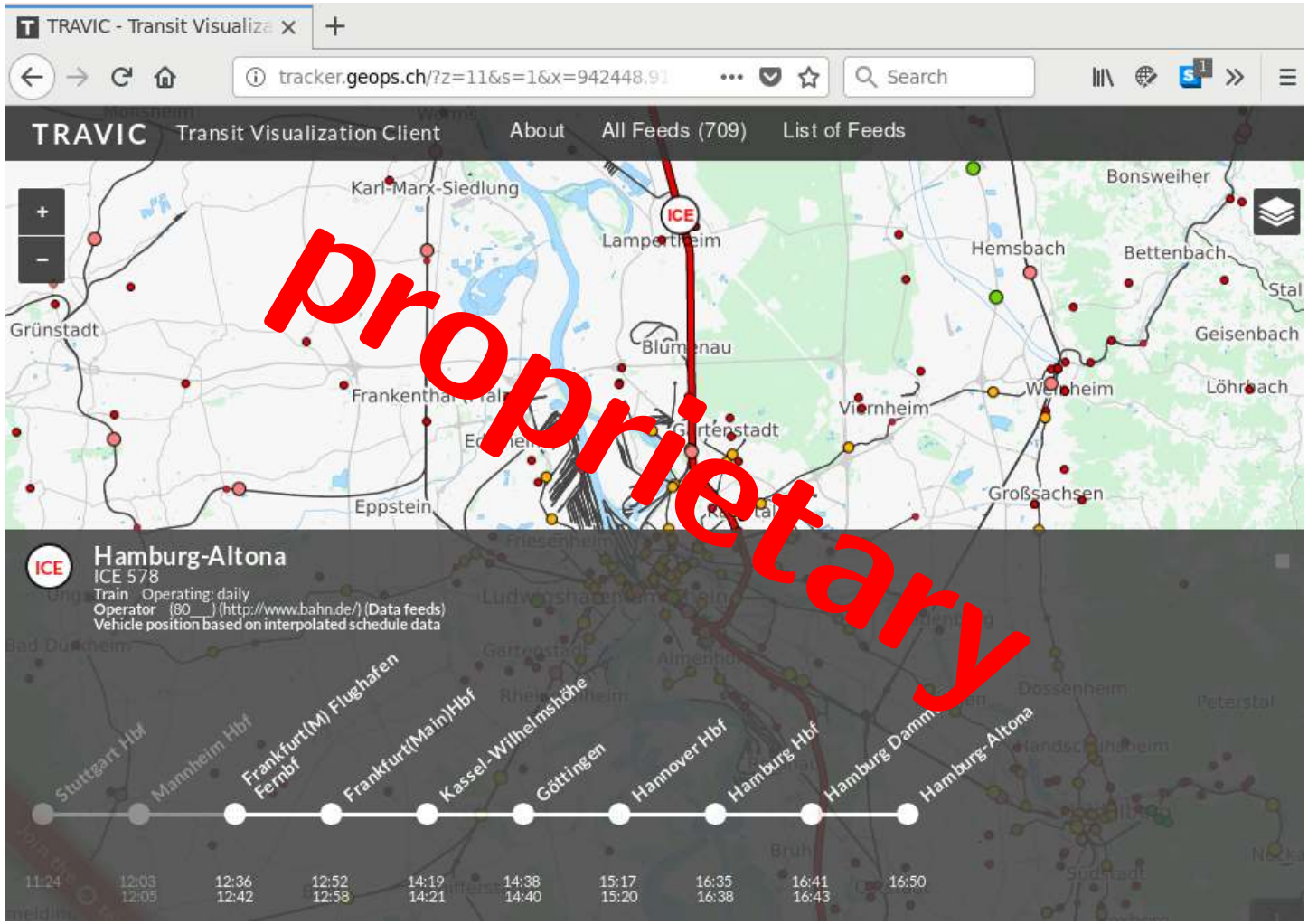

Current solutions
Mentz

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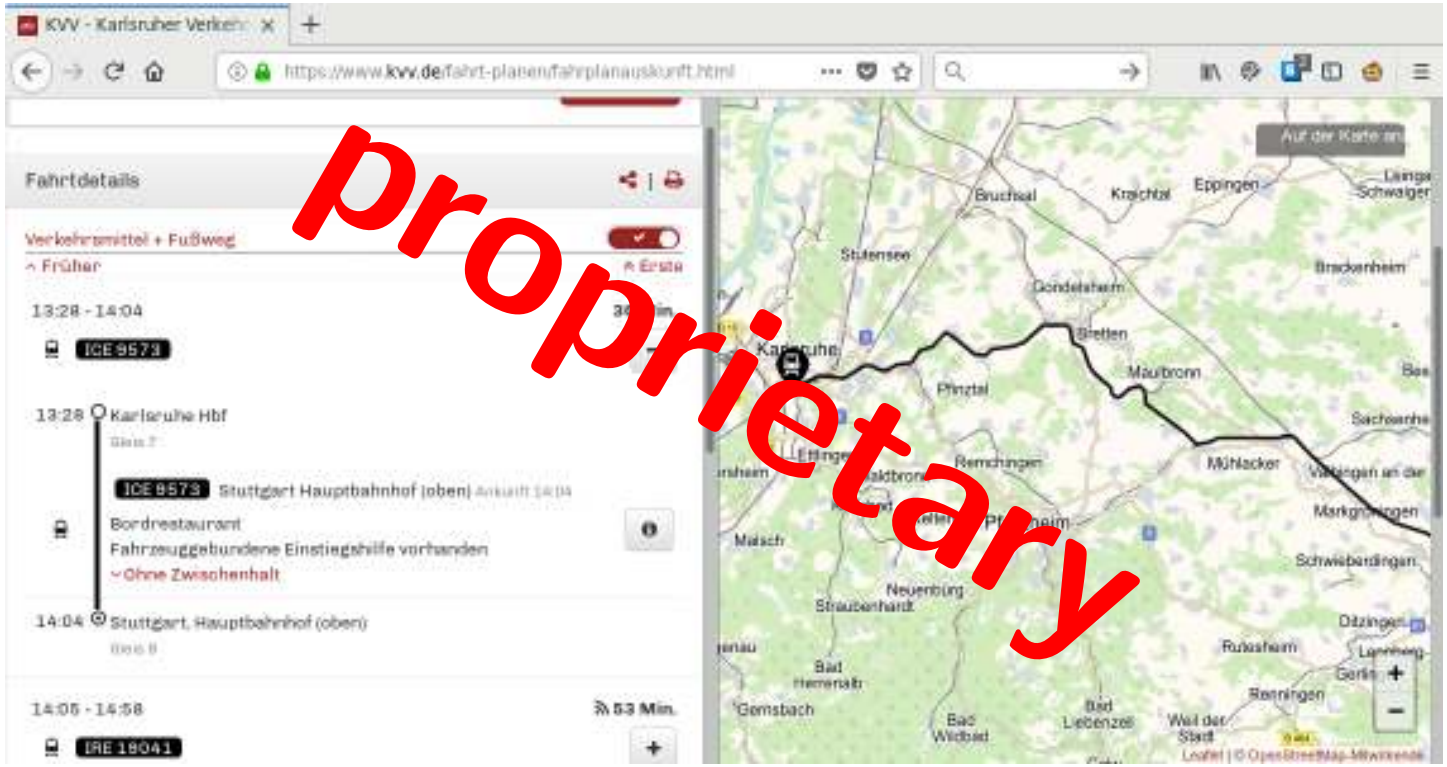
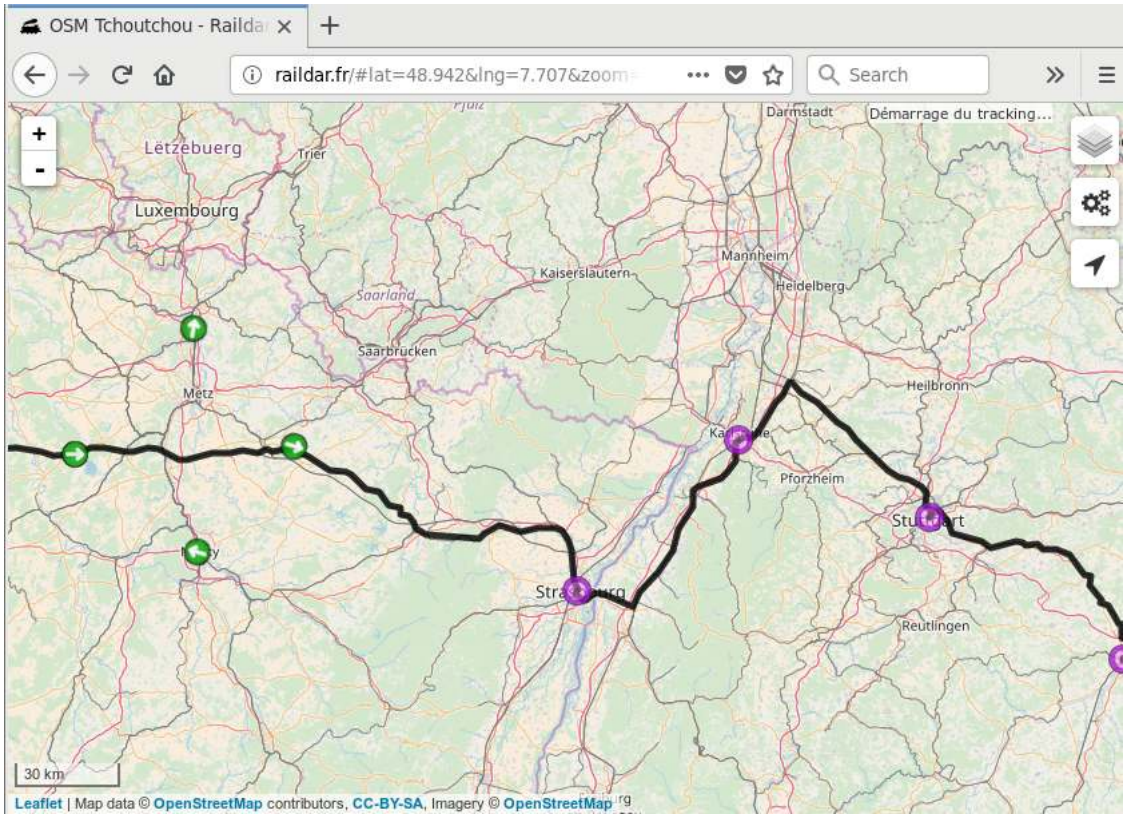


Current solutions
Raildar.fr

Michael Reichert (Nakaner)



filtering the planet using osmfilter, routing with OSRM, rumours about tag replacement

Current solutions
Signal.eu.org

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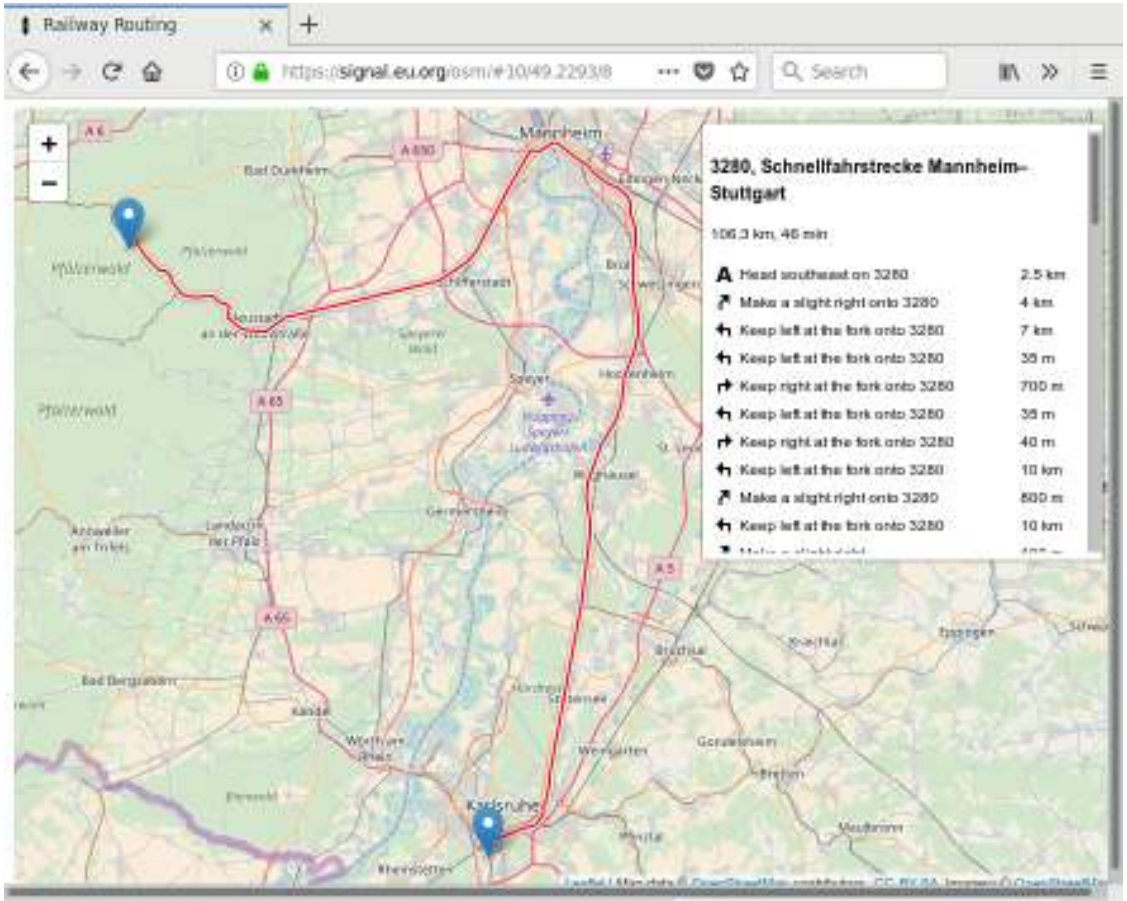

OSRM, support of left/right track, reversing

Railway tracks in OpenStreetMap

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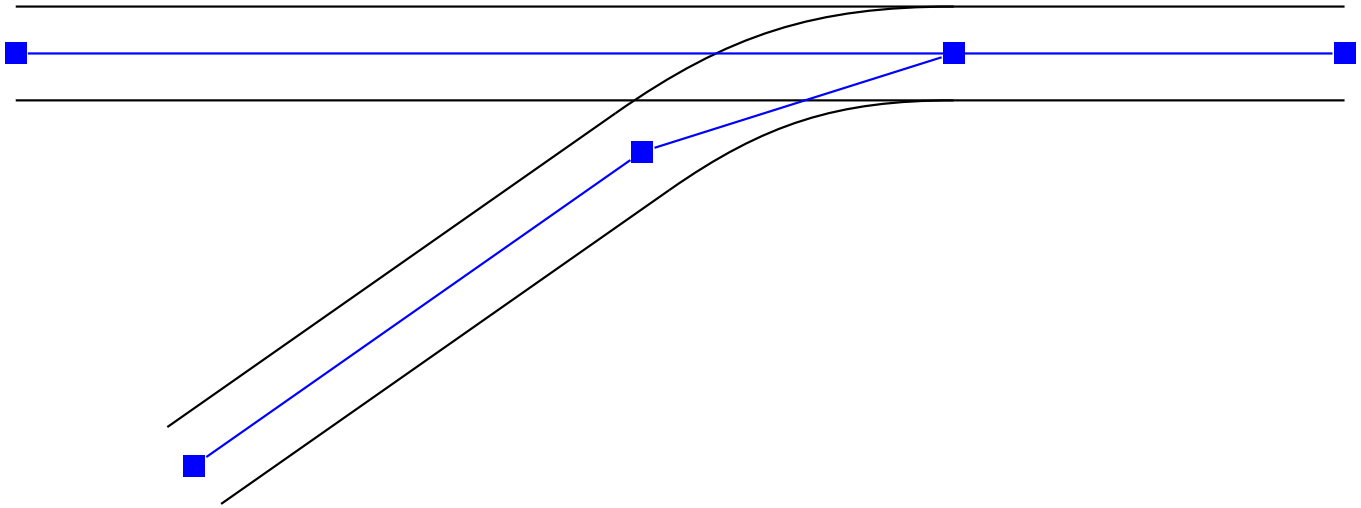
- connected
- one way per track
- 1 841 430 km tracks (608 055 km in Europe)
- 1 239 753 possible points (634 524 in Europe)
- 289 423 points tagged with `railway=switch` (208 078 in Europe)

Railway tracks in OpenStreetMap

Simple points



Railway tracks in OpenStreetMap
Slip points

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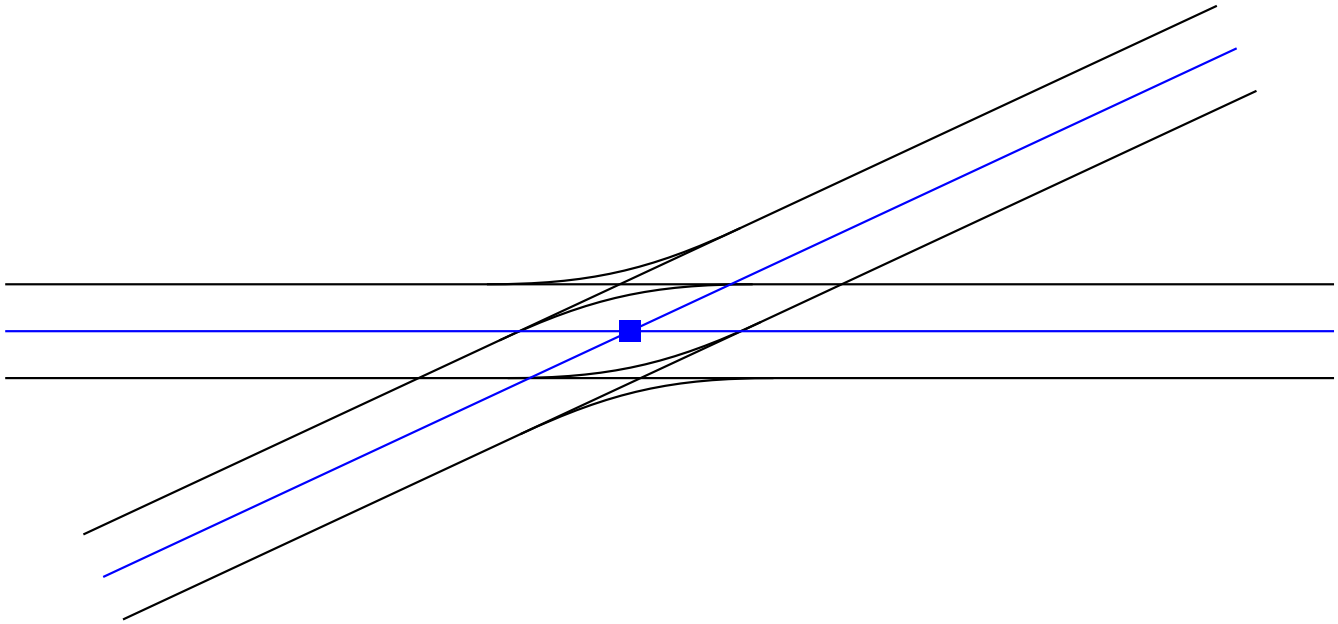

double slip point (`railway=switch` + `railway:switch=double_slip`)

Railway tracks in OpenStreetMap
Slip points

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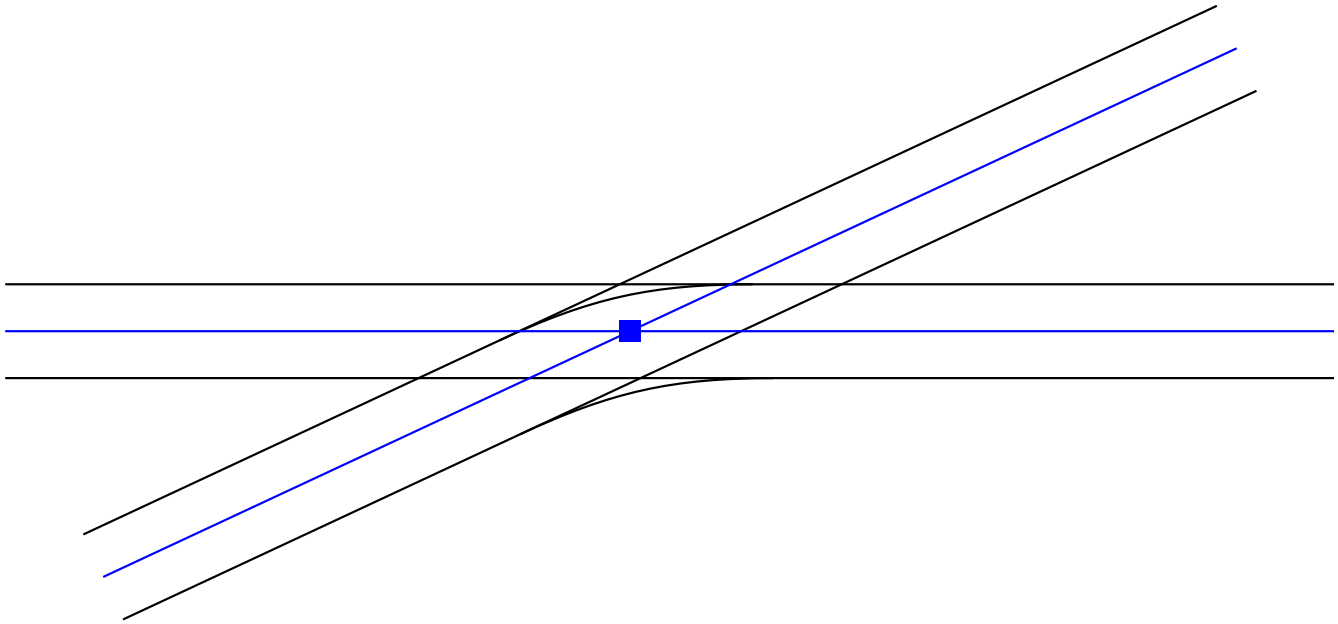

single slip point (`railway=switch` + `railway:switch=single_slip`)

Railway tracks in OpenStreetMap
Slip points

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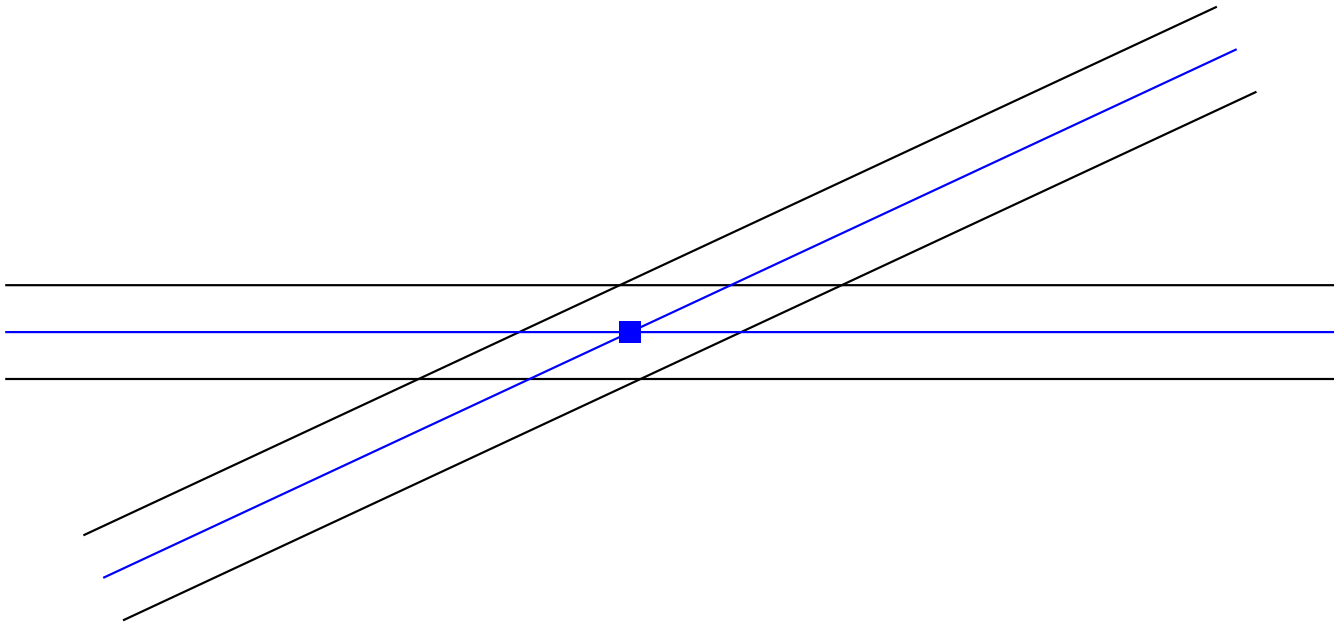

crossing (`railway=railway_crossing`)

Railway tracks in OpenStreetMap
Tags

- `railway=rail/light_rail/tram/subway/narrow_gauge`
- `gauge=*`
- `electrified=no/yes/contact_line/rail`
- `voltage=*`
- `frequency=*`
- See Railways at OpenStreetMap at SotM 2016 for more.

Features

- power systems
- gauges
- preconfigured profiles
  - freight train and TGV profiles for France and Germany/Austria/Switzerland
  - universal diesel train (any gauges), max. 120 kph
  - universal electric train (any gauges, any power system), max. 140 kph
- profile customization via YAML file
- reversing
- reduced default speeds for crossovers and other slower tracks
- map matching (CSV, GPX)

Demo

Performance

- `osmium tags-filter -o planet-rail.osm.pbf planet.osm.pbf nw/railway` 6 minutes on a fast server, 1–2 GB RAM
- 168 MB .osm.pbf file
- import: about 1 minute, 1200 MB RAM without contraction hierarchies
- graph: 204 MB
- 2450 routes through Germany
  - 2352 successfull routes
  - 2 minutes 8 seconds, 1 thread
  - average length per route: 409 km

Implementation

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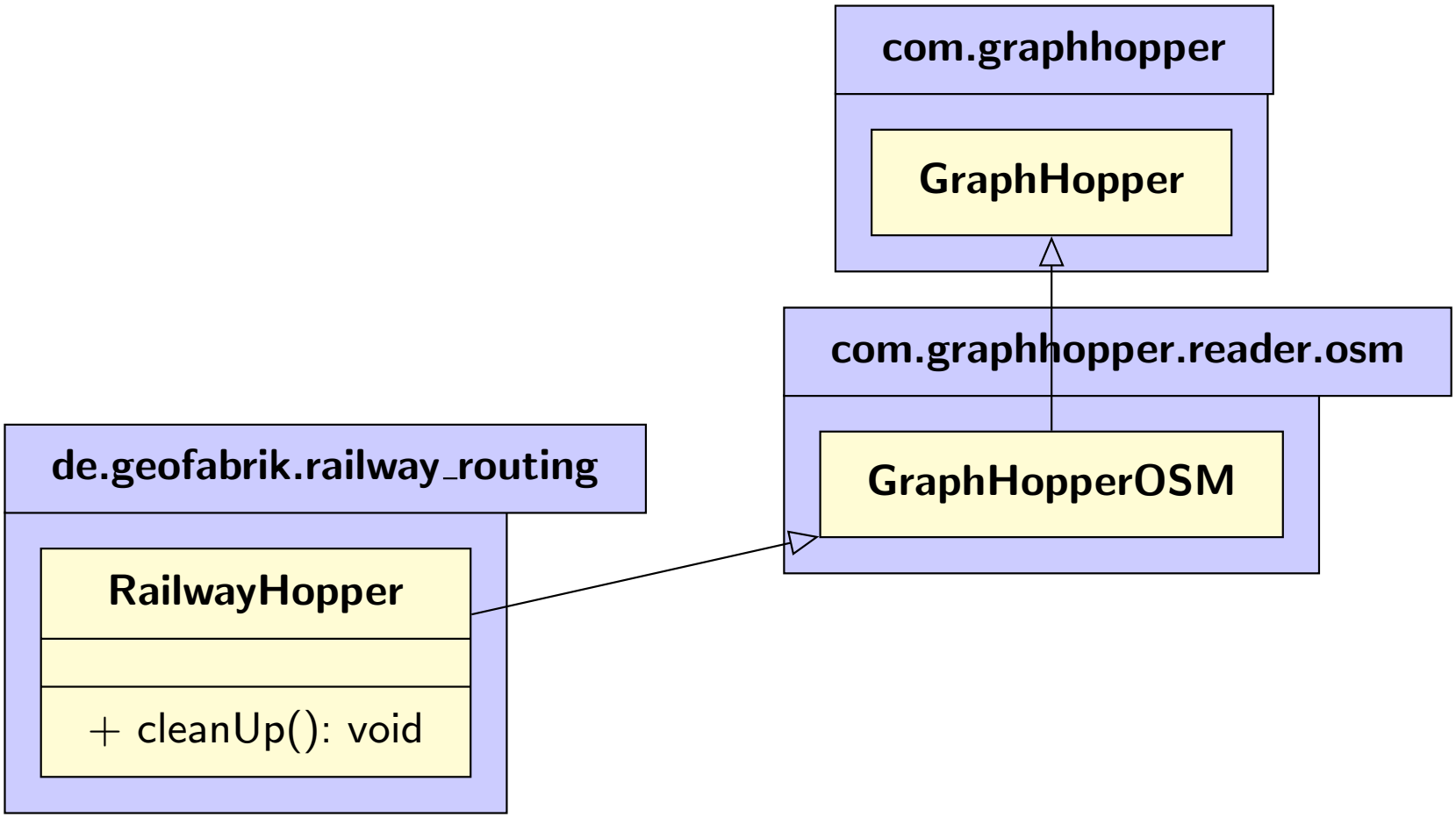
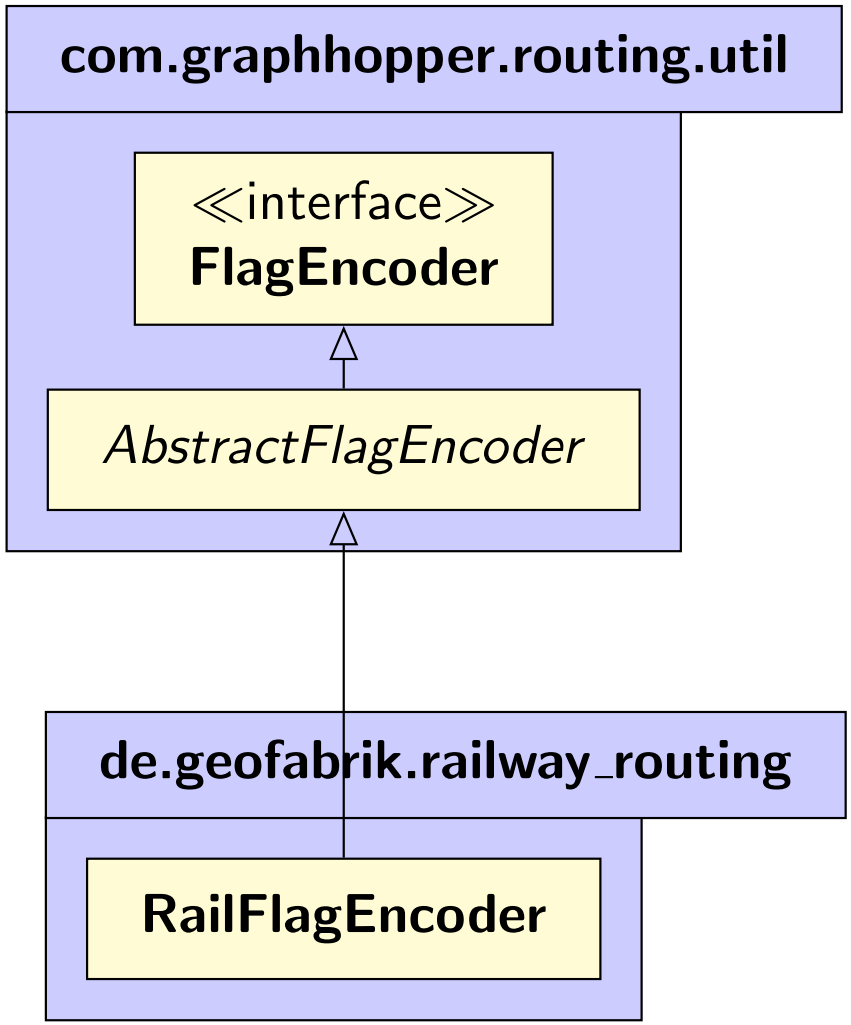
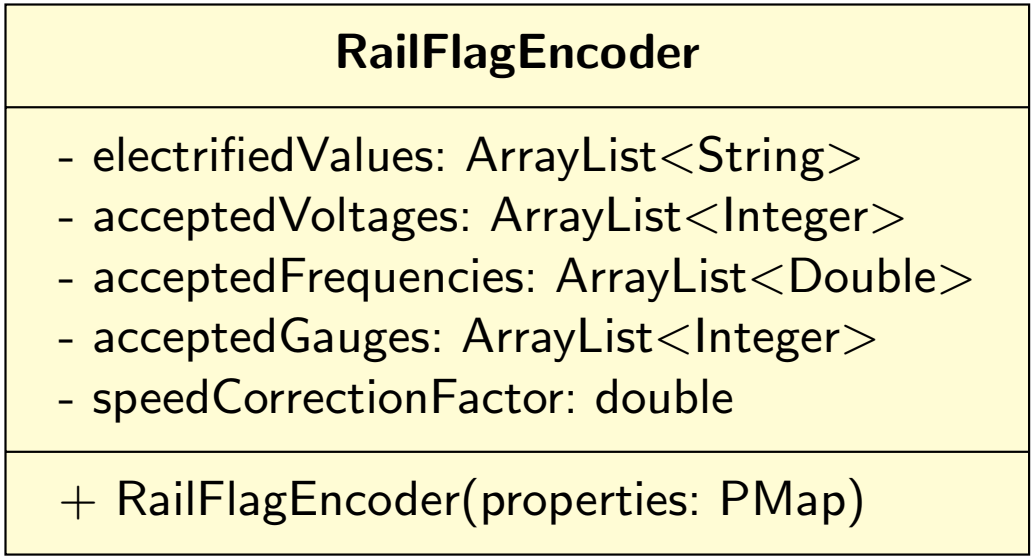


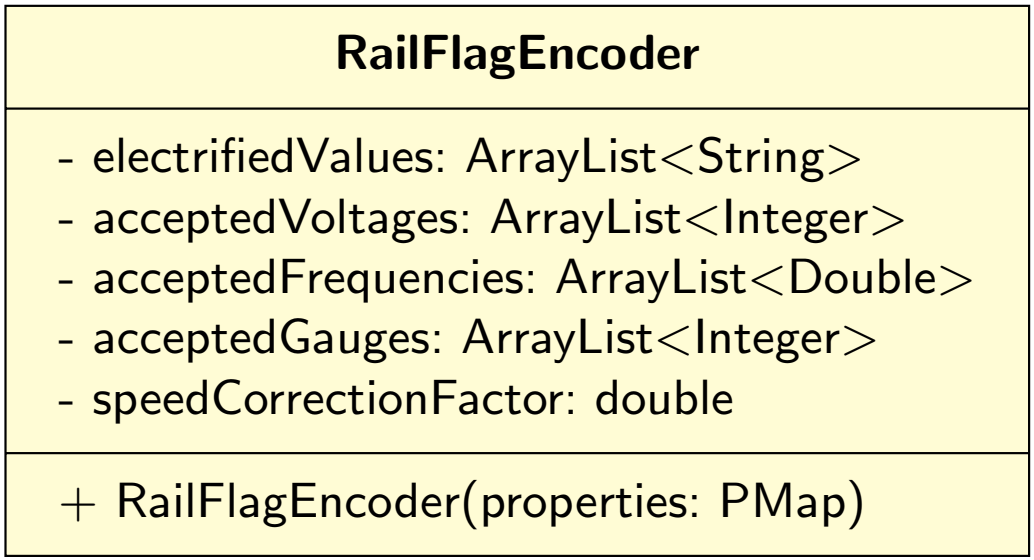
Implementierung
FlagEncoder



Implementierung
RailFlagEncoder



Implementierung
RailFlagEncoder



YAML config

name
electrified
voltages
frequencies
gauges
maxspeed
speedFactor

Experiences with GraphHopper

+ suitable for routing on any routeable OSM network
– introduction into FlagEncoder could be more verbose
– ~~TurnCostExtension without good documentation~~ → misconceptions
– no different penalities for reversing for each FlagEncoder
– a library for car routing only
  - flag encoders designed to be extensible
  - addition of turn restrictions not designed to be extensible
  - reading of OSM files not extensible → fork of GraphHopper
+ forum
- Read the unit tests!

Space for improvement
Left/right track on double-tracked lines

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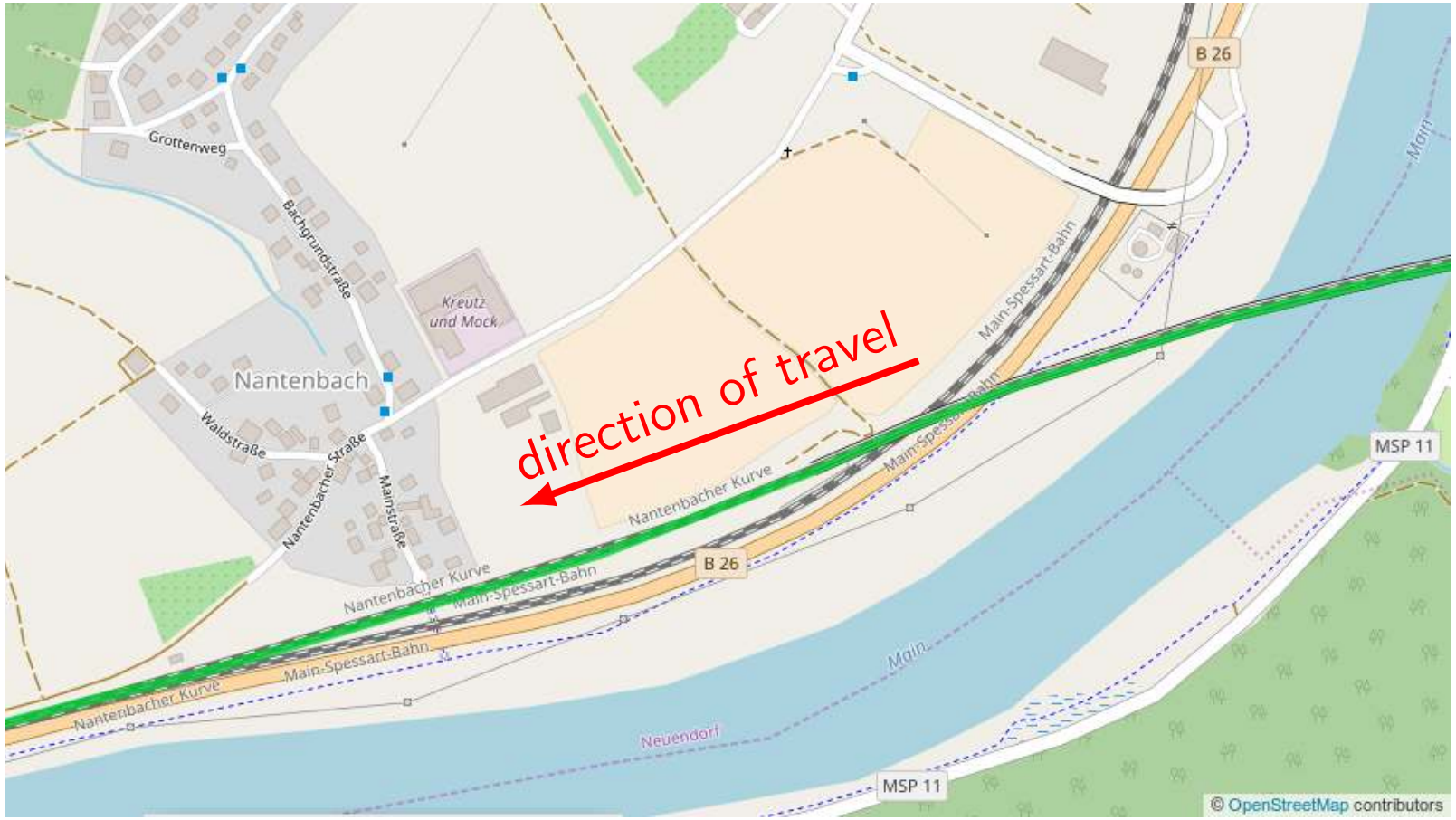

Space for improvement

Tag to distinguish left and right tracks

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`railway:preferred_direction=forward/backward`

Space for improvement
Estimation of travel times

currently $0.9 \cdot$ speed limit

Space for improvement
Estimation of travel times

currently $0.9 \cdot$ speed limit

Comparison of timetables of nonstop IC trains using the TGV profile (max. 160 kph due to old infrastructure)

	timetable	**routing**
IC Koblenz–Mainz	1:05	0:50
IC Magdeburg–Dessau	0:42	0:36

Space for improvement
Specify heading direction

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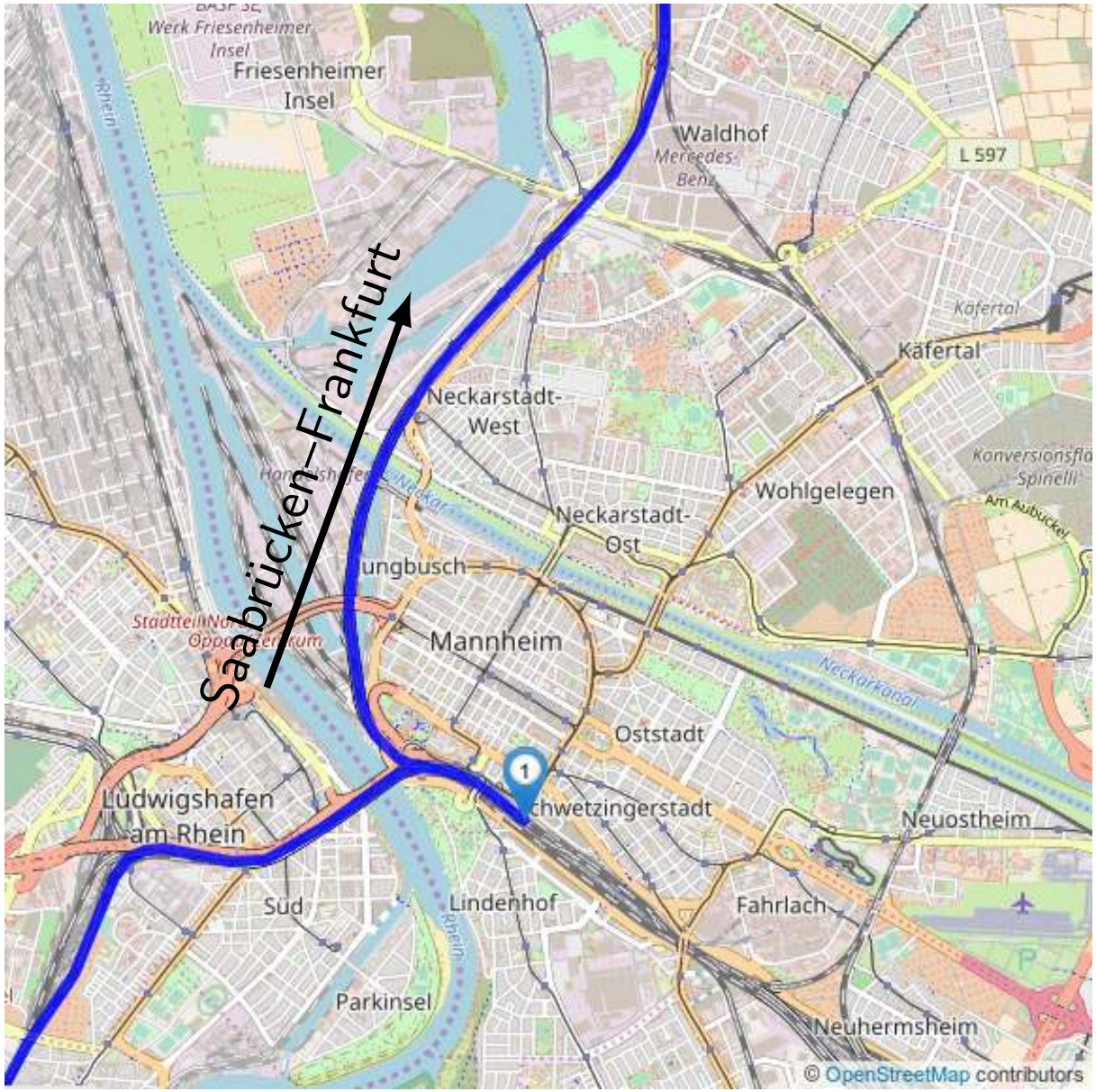

Space for improvement
Specify heading direction

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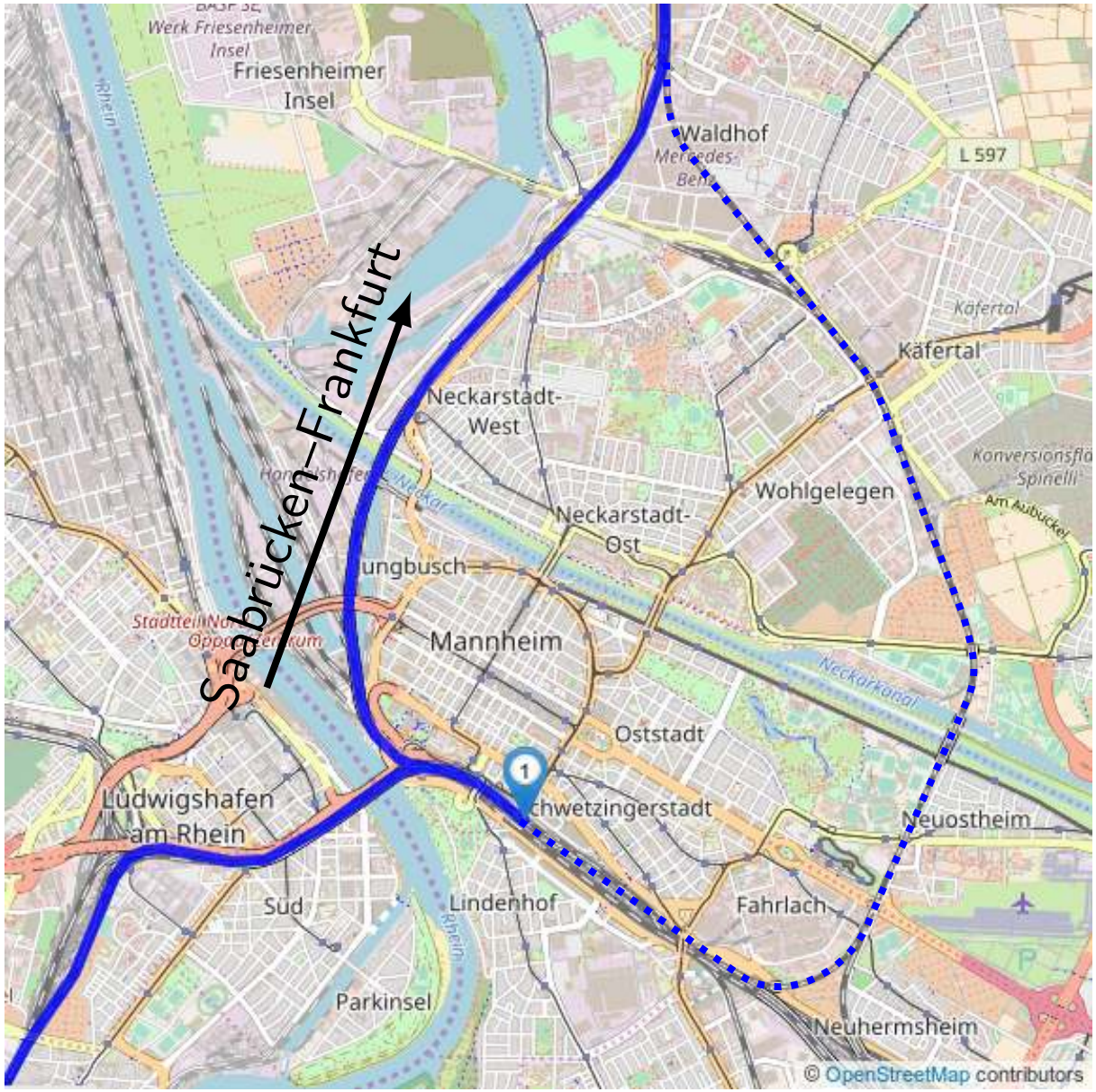

Missing data
Gradients

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Problems

- SRTM resolution too low
  - cuttings and embankments in SRTM data
  - narrow valleys
  - vertical precision

Missing data
Gradients

Problems

- SRTM resolution too low
  - cuttings and embankments in SRTM data
  - narrow valleys
  - vertical precision

Solutions?

- Use railway lines to correct elevation data?
- elevation profiles provided by operator of infrastructure
- Measure elevation profiles data ourselves?

Missing data

Lines for special purpose (S-train, RER, . . .), diesel engine bans

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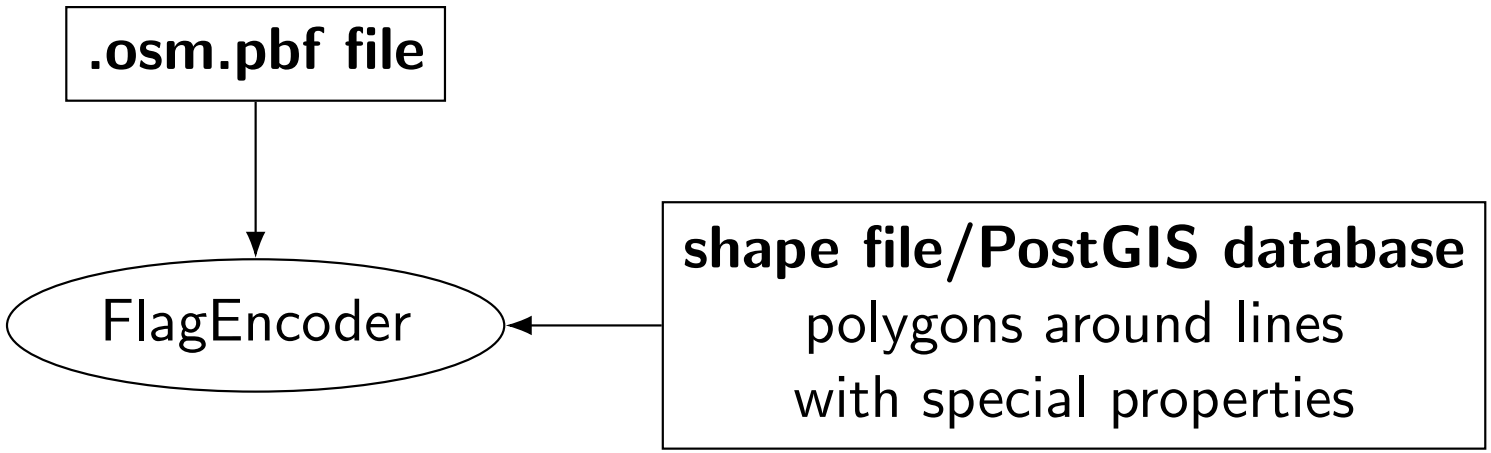
Missing data
Loading gauge

Missing data
Loading gauge



The development of this software has been sponsored by

Source code:
`https://github.com/geofabrik/railway_routing`