Challenges in Using OSM for Robotic Applications

Nico Huebel
nico.huebel@kuleuven.be

Sebastian Blumenthal
blumenthal@locomotec.com

Lakshadeep Naik
lakshadeep.naik@smail.inf.h-brs.de

Herman Bruyninckx
Herman.Bruyninckx@kuleuven.be

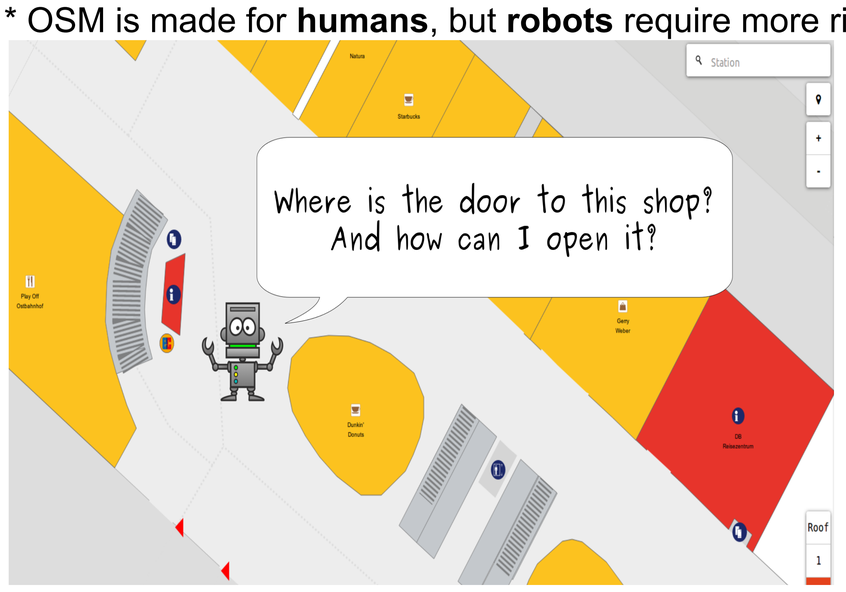
Introduction

This work discusses how to use OSM for robotic applications and aims at starting a discussion between the OSM and the robotics community. OSM contains much **topological** and **semantic** information that can be directly used in robotics and offers various advantages:

* **Standardized format** with existing tooling.
* The **graph structure** allows to **compose** the OSM models with domain-specific semantics by adding custom nodes, relations, and key-value pairs.
* Information about many places is already **available** and can be used by robots since it is driven by a **community** effort.

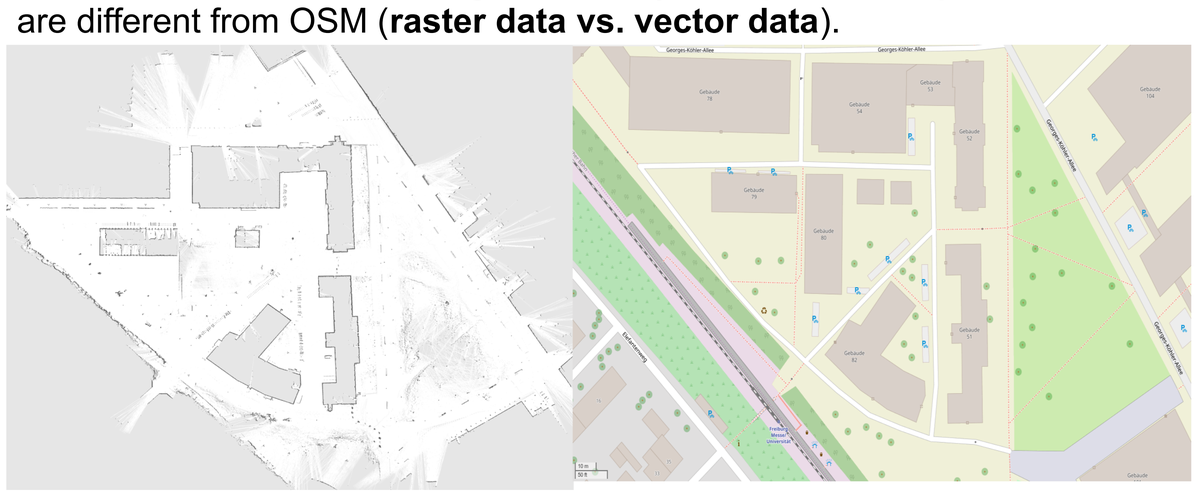
Problem

* OSM is made for **humans**, but **robots** require more rigorous modelling.



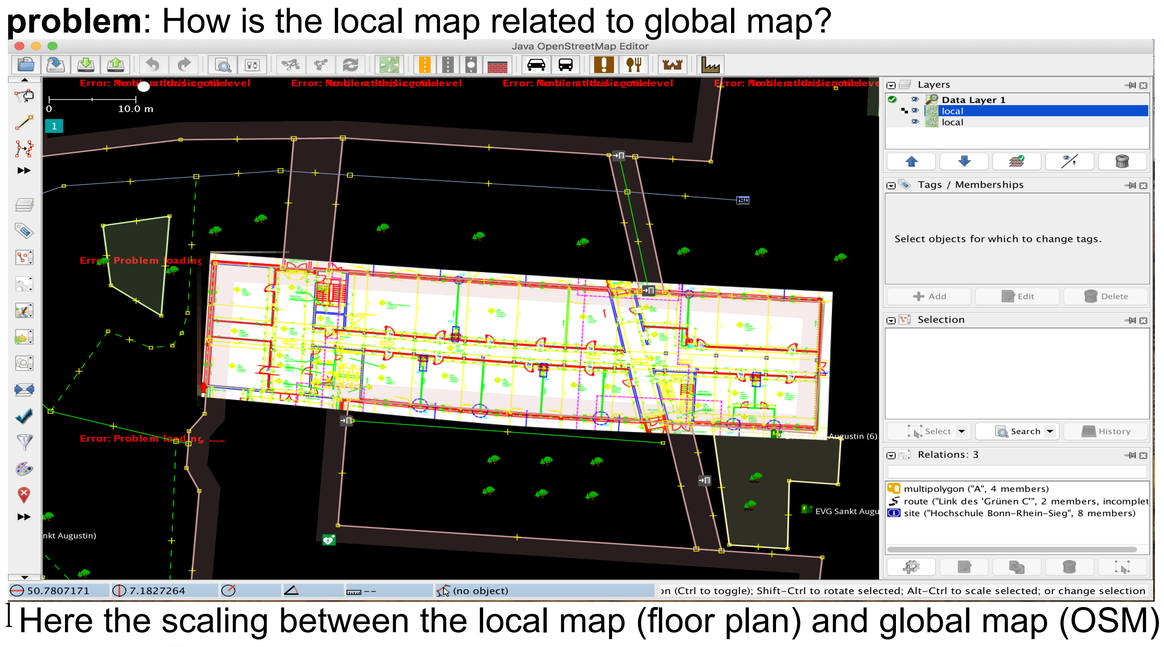
Map of Berlin Ostbahnhof taken from [1]. Humans will find the doors to the stores. A robot has to know the location and type of doors.

* Most robotic localisation algorithms rely on **specific map formats** that are different from OSM (**raster data vs. vector data**).



The left map was taken from [2]. The right one is the corresponding map from OSM.

* OSM uses **absolute coordinates** (lon, lat), while robotic problems are typically formulated in **relative coordinates** (Euclidean). **Registration problem**: How is the local map related to global map?



Here the scaling between the local map (floor plan) and global map (OSM) is wrong. Transformations are typically unknown.

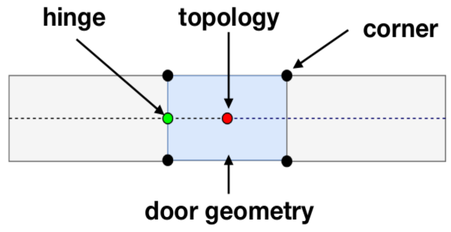
Acknowledgement

This work was supported by the European Union's Horizon 2020 projects ROPOD (grant agreement No 731848), RobMoSys (grant agreement No 732410), and the FP7 project SHERPA (FP7-600958).

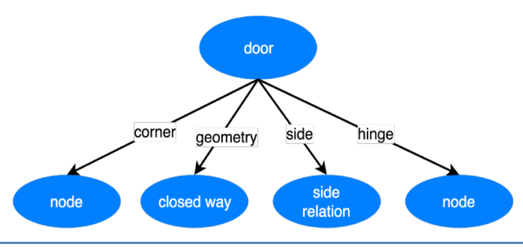
Suggestions

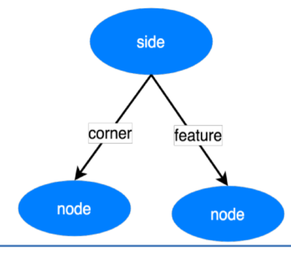
* Composition with robotic-specific **extensions** to existing OSM models.

Example - Door

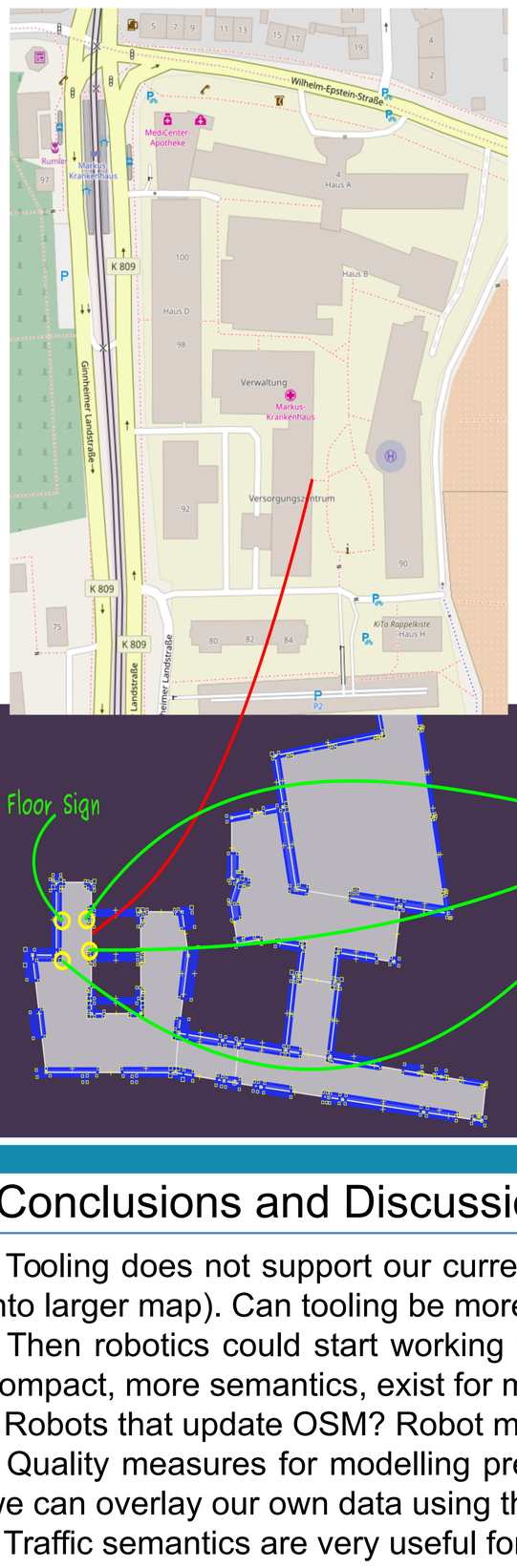


Extension to the Simple Indoor Tagging schema [3] of OSM.





* Generating robotic map formats from OSM maps (rasterization).
* Tool support for **anchor points** and new node types using relative coordinates (TopoJSON or GeoJSON). Anchor point: perceivable features + GPS



Measurable anchor points between maps. The red connection shows the relation between an outdoor OSM and an indoor OSM map through a building entry. GPS allows localisation on the map outdoors. Indoors, perception features (denoted in yellow) like wall geometry or signs have to be used.

Conclusions and Discussion

* Tooling does not support our current workflow. (create map, then register it into larger map). Can tooling be more open (e.g. plugins)?
* Then robotics could start working with graph based maps like OSM (more compact, more semantics, exist for many places).
* Robots that update OSM? Robot maps vs human maps?
* Quality measures for modelling precision? If positions are precise enough, we can overlay our own data using the unique node Ids.
* Traffic semantics are very useful for robotics and already are in OSM.

References

[1] www.openstationmap.org
[2] Giorgio Grisetti, Cyrill Stachniss, and Wolfram Burgard: "Improved Techniques for Grid Mapping with Rao-Blackwellized Particle Filters", *IEEE Transactions on Robotics,* Volume 23, pages 34-46, 2007
[3] Simple Indoor Tagging - https://wiki.openstreetmap.org/wiki/Simple_Indoor_Tagging