

# A map data based assessment of potential routes for autonomous shuttles

## Master's Thesis of Ayashwarya Ramesh Prabhu

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## 1. Background & Motivation

- The transportation system is expecting major changes with the rise of new technologies such as automated driving and connected mobility alongside innovative concepts like MaaS.
- Current literatures are aimed at route planning for autonomous vehicles in areas of perception, user acceptance, policy and legal management.
- Route selection for the shuttle is also a critical aspect which is not explored in depth and is the focus of the thesis.

## 2. Research Question

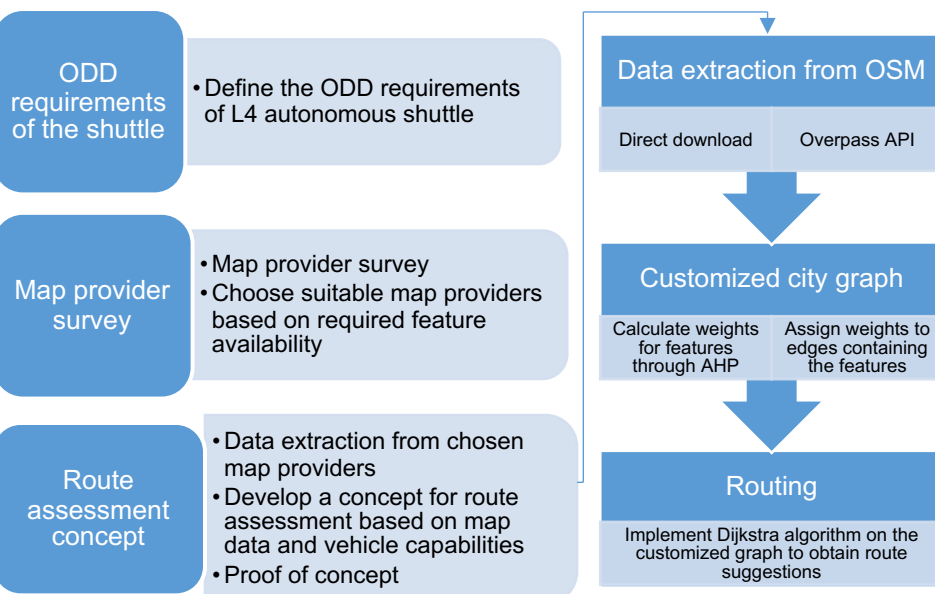
How can maps and map related databases be used for finding suitable routes for autonomous shuttles?

What are the capabilities and limitations of a level 4 autonomous vehicle?

What is the current status of the map providers in delivering the required information?

How can custom routes be found for autonomous shuttles based on available data?

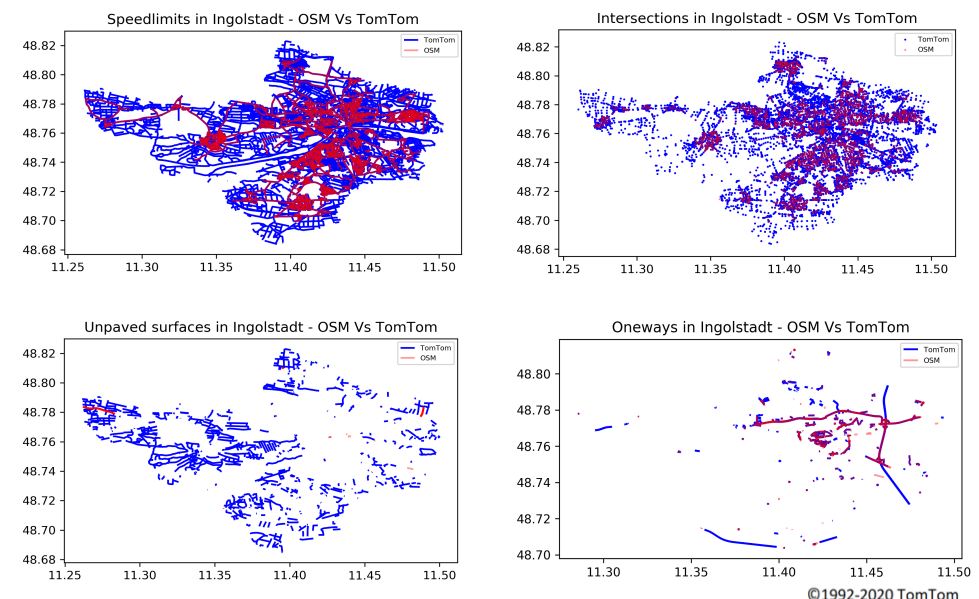
## 3. Methodology



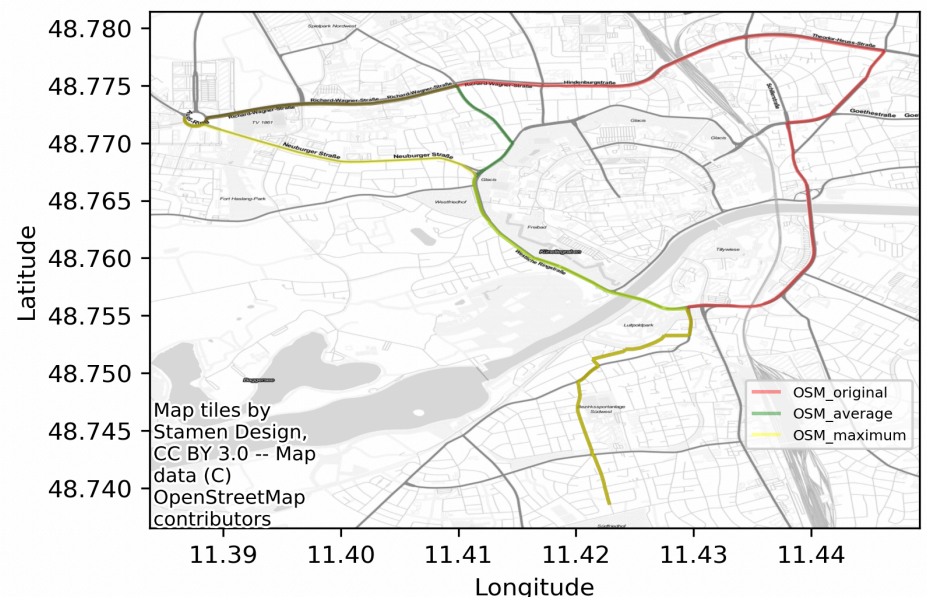
## 4. Outcomes

- The features that were in categories of road geometry (intersections, roundabouts, bridges, tunnels, bus stops and pedestrian crossings), road surface (unpaved surfaces), sidewalks, number of lanes, direction of traffic, speed limits and traffic signs (stop, priority, yield) were proposed as the ODD features under consideration.
- A survey was designed which asked the respondents to choose the most difficult feature for an L4 autonomous vehicle to handle in a pairwise comparison manner. Based on the responses, the Analytical Hierarchy Process (AHP) was used to calculate the weights of the features which were later used to create the custom weighted graph.
- Several map providers like HERE, Google, TomTom and OSM were researched but access was attained only to proprietary data provider TomTom and the open source provider OSM.
- A feature to feature comparison between OSM and TomTom was made for the city of Ingolstadt.

## 5. Feature to feature comparison – OSM Vs TomTom



## 6. Sensitivity analysis of test route with OSM



## 7. Key Results

- The weighted routing concept was implemented in OSM and TomTom and the results were studied for two test routes in Ingolstadt.
- Both TomTom and OSM had missing information.
- Data imputation aided in understanding the sensitivity of the missing information in the route suggestions.

## 8. Conclusion

- Maps and databases, both voluntary and proprietary still continue to have missing information because the data that is being recorded is widespread and changes on a frequent basis. They will however provide with some information about the features that are needed and can facilitate in choosing a suitable route.
- The routes suggested for the autonomous shuttle from the custom routing can be a good starting point but the reliability can be increased only when the information in the source database is accurate and complete.