Optimization of DRT concepts using the SUMO simulation software:

How can the service quality be improved? - Findings of the project RealLab Hamburg

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for David, Evnika; Kurt, Filiz; Scheier, Benedikt; Mittag, Saskia

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RealLab Hamburg is developing digital mobility solutions for Hamburg and the larger metropolitan region

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RealLabHH's innovative projects embrace environmentally-minded and climate-friendly mobility systems.

32 partners from Hamburg and the metropolitan region as well as scientific institutions and companies from all over Germany.

10 subprojects

You may know:

But there is more in ReallabHH, e.g.:

Autonomous shuttle in the Hafencity, inner city of Hamburg

Autonomous on-demand shuttle in Bergedorf, a suburban area of Hamburg

Federal Ministry for Economic Affairs and Climate Action

RealLab Hamburg

# Simulation of an autonomous on-demand shuttle in suburban area

a.k.a. Demand-responsive Transport (DRT)

Research Question

? How can autonomous on-demand vehicles be used in suburbs like Hamburg-Bergedorf to improve the connection of such suburban areas to the existing public transport system?

The aim of the research was to find out what quality of service can be achieved with on-demand transport in Bergedorf and how it can be optimised in terms of users.

This is where Bergedorf is located:

Hamburg, Germany

Suburb Bergedorf approx. 11 km²

https://de.wikipedia.org/wiki/Hamburg-Bergedorf
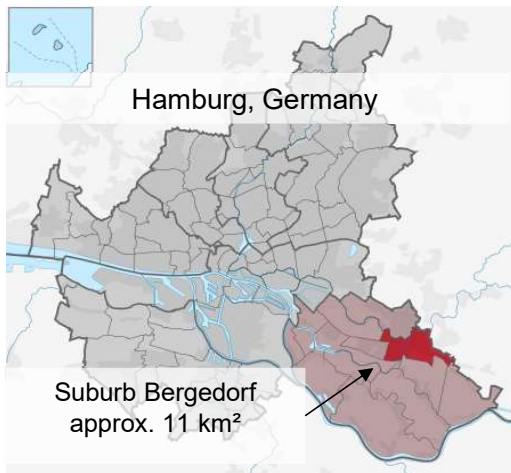
This is the S-Bahn-Station we wanted to connect:

https://de.wikipedia.org/wiki/Bahnhof_Hamburg-Bergedorf

This is the simulation tool we used:

SUMO — SIMULATION OF URBAN MOBILITY

https://www.eclipse.org/sumo/
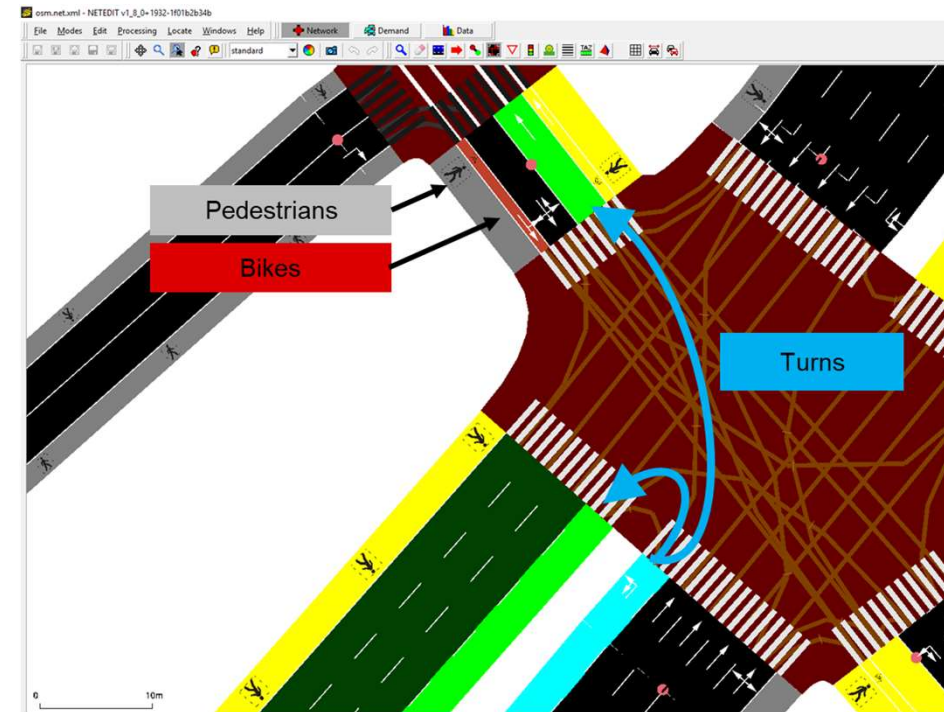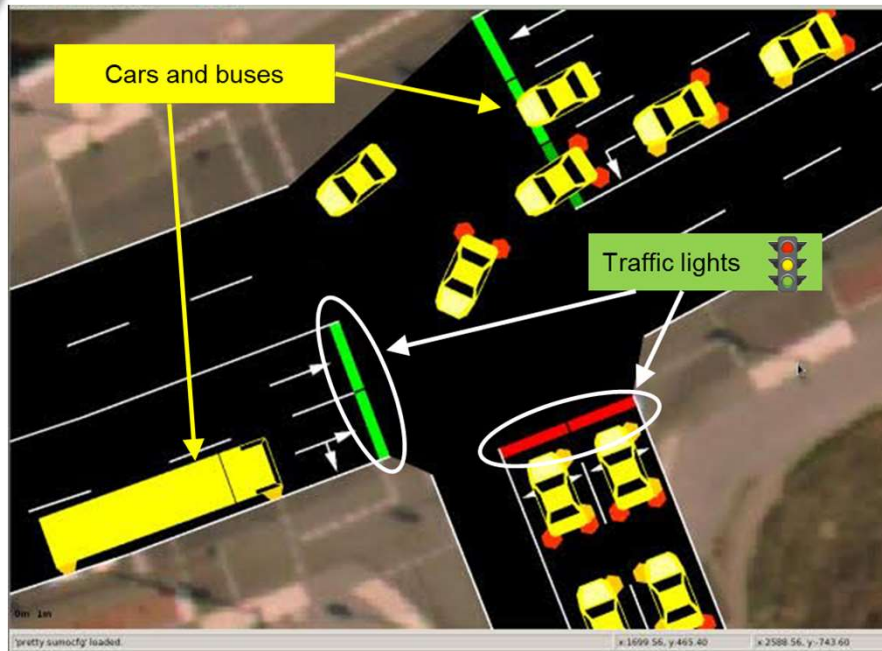
SUMO – a microscopic traffic simulation software

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It's Open Source! Check Eclipse!

https://www.eclipse.org/sumo/

Four Use Cases

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Four simulated Use Cases were varied and evaluated on the basis of determined key performance indicators (KPI):

of rejected requests, pre-booking time, travel time (ride + walk), average ride length in DRT, the total vehicle-kilometres, percentage of empty trips, occupancy rate.
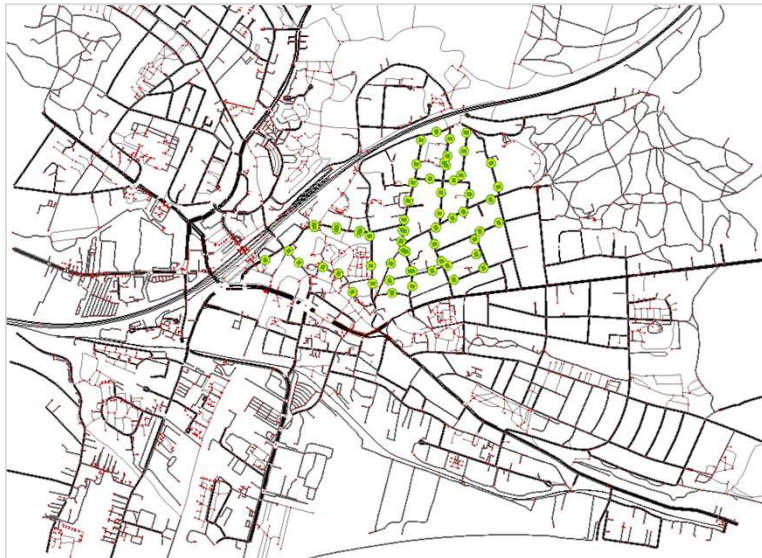
	Passenger demand	Assessment Time	Assessment Area	Number, speed and capacity of DRT vehicles	Direct-Route-Factor	Waiting time for the DRT system to pick up the request
Use Case 1	72 Passengers			2 DRT-vehicles with 5m/s and 6 seats/DRT		
Use Case 2		3 p.m. – 6 p.m.	central residential area of Bergedorf		1,5	300s
Use Case 3	430 Passengers		entire district of Bergedorf	13 DRT-vehicles with local speed and 6 seats/DRT		
Use Case 4	1426 Passengers	0 a.m. – 12 p.m.	central residential area of Bergedorf			

Examination of two of the Use Cases

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1

2 vehicles, 72 passengers, 3 hours of operation

The parameters we varied:

- speed (permissible speed instead of 18km/h)

- number of vehicles (6 instead of 2)

- direct route factor time (10 instead of 1.5)

2

13 vehicles, 430 passengers, 3 hours of operation

The parameters we varied:

- max. pre-booking time (30 min instead of 5 min)

- number of vehicles (27 instead of 13)

- direct route factor time (20 instead of 1.5)

What we learned

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? How can autonomous on-demand vehicles be used in suburbs like Bergedorf to improve the connection of such suburban areas to the existing public transport system?

The quality of service of on-demand-shuttles can be improved by higher vehicle speed (Use case 1) → pre-booking can be reduced by up to 50 %

The system efficiency* of on-demand-shuttles can be improved

- by higher direct route factors (Use case 1) → up tp 20%
- by higher demand (Use case 2) → up to 80%

👍 DRT shuttles as station feeder in these cases can achieve a good service-quality and vehicle-occupancy.

* Vehicle occupancy [passenger-km per vehicle-km]

Thank you!

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German Aerospace Center (DLR), Institute of Transportation Systems

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