Impact assessment of autonomous Demand Responsive transport (DRT) systems

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mobil.TUM 2018

Motivation

- Developments in AV technology may sooner or later lead to new taxi-like services using Shared Autonomous Vehicles

- But what‘s the impact on smaller cities?
  - City of Cottbus as an example

- City of 100 000 inhabitants in Southern Brandenburg
  - Roughly 100km SE of Berlin

- Germany‘s smallest *metropolitan area, 80th biggest city by population size*

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Transport in Cottbus

- Public transport network consists of
  - 5 tram lines
  - 11 bus lines

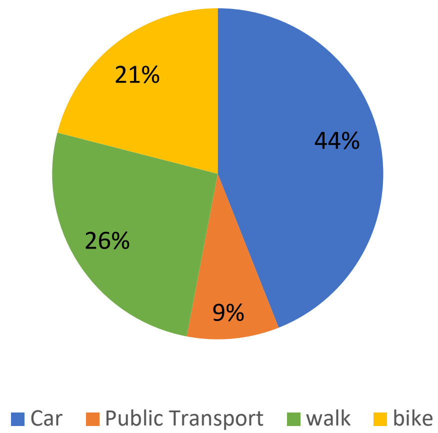
- Headways of 20-30 minutes during weekdays, with reduced frequency during nighttimes and on weekends

- Modal share of public transport is rather low

- Roughly *pt* 30 000 trips per day

- Most distances can easily covered by bike and walk
- City does not suffer from congestion

Modal Split in Cottbus (2008)



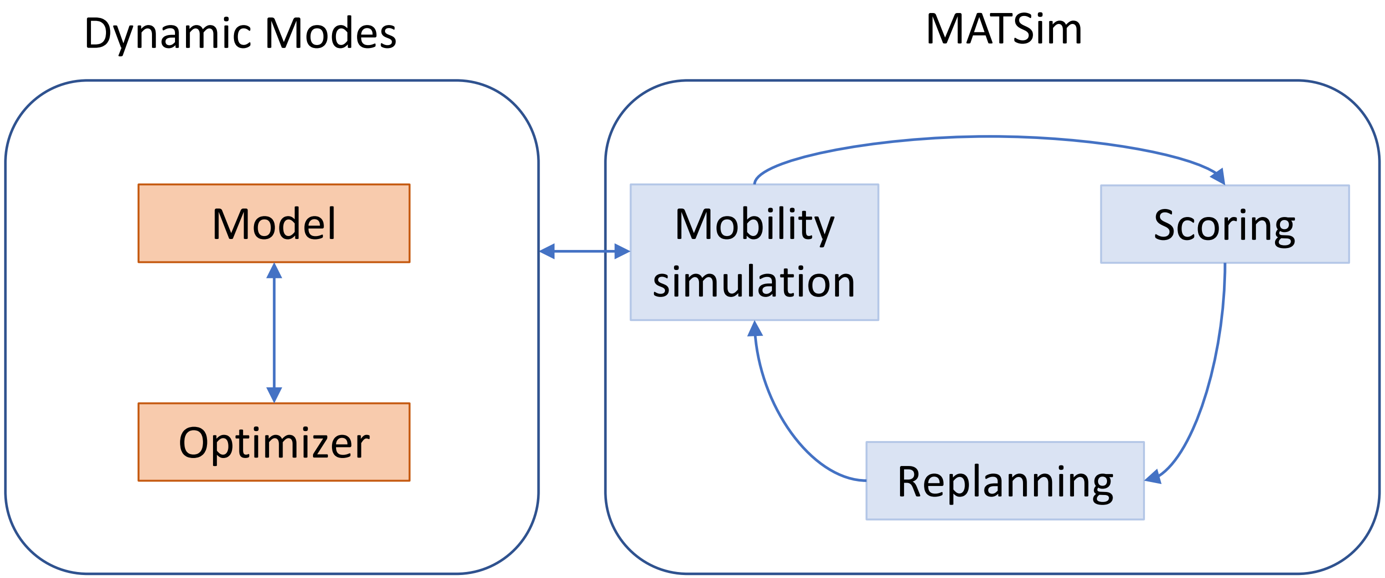
SrV, 2008

Von Joeb07 (Johannes Kazah) - Eigenes Werk, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=8380936

BVG, 2018

Methodology: MATSim

- MATSim allows the simulation of agents along their daily activity chains
- Open source, written in JAVA and well-documented
- Multiple iterations with behavioral changes in between allow agents to maximize their utility
- Dynamic modes, such as (shared) taxis directly operate within the traffic simulation runtime



Simulation experiments

- Based on an existing multi-modal MATSim model for Cottbus
- Reference year 2010

- Three diferent experiments:

1. Base Case:
   - Uses current public transport Schedule
2. Door to Door Scheme
   - DRT vehicles pick up and drop off passengers at their activity locations
3. Stop based service
   - Passengers need to walk to and from designated stops
   - 400 Stops clustered using k-means approach

- Eight seat vehicles, No pre-bookings of vehicles, maximum detour of 1.5x direct trip, less than 1 % of trips should be rejected

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Results: Fleet size

- Based on the defined service criteria:

  - 550 vehicles for door to door service

  - 250 vehicles for stop based service

  (Current fleet: 48 busses, 21 trams)

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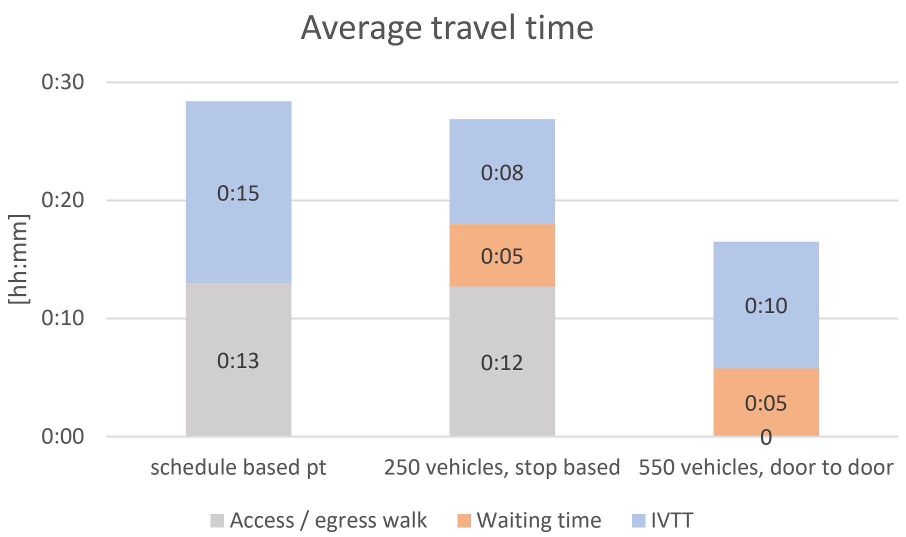
Travel times

- Per person travel times may be significantly reduced
- In vehicle travel time reduces by 50 %
- Average waiting time for DRT vehicles of around 5 minutes
- Stop based mode: Vehicle is only called once passenger reaches stop → Room for improvement
- Waiting time of pt trips neglected (including for transfers) in figure below



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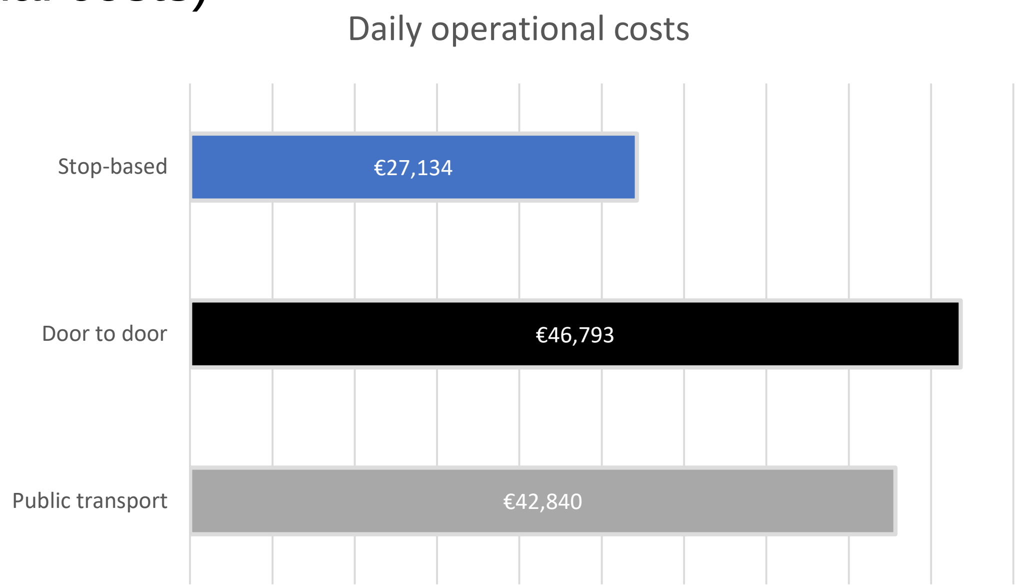
Cost analysis

- Cost models for SAV are available
- Based on Bösch, et al, 2017: 0.25 € / pkm (incl. procurement)
- For public transport: 2,38 € / km (operational value from Potsdam; pure operational costs)



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Conclusion

- Automated Demand Responsive Transport may be a viable alternative to Schedule based public transport systems in smaller cities
- DRT systems will reduce travel times for a majority of users
- Their operation may be cheaper than classical transport systems in those areas, if stops are used for bundling
- A combination of stops and door to door may increase ridership even further
- Mode choice experiments should be made

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Thank you for your attention!

Questions?

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