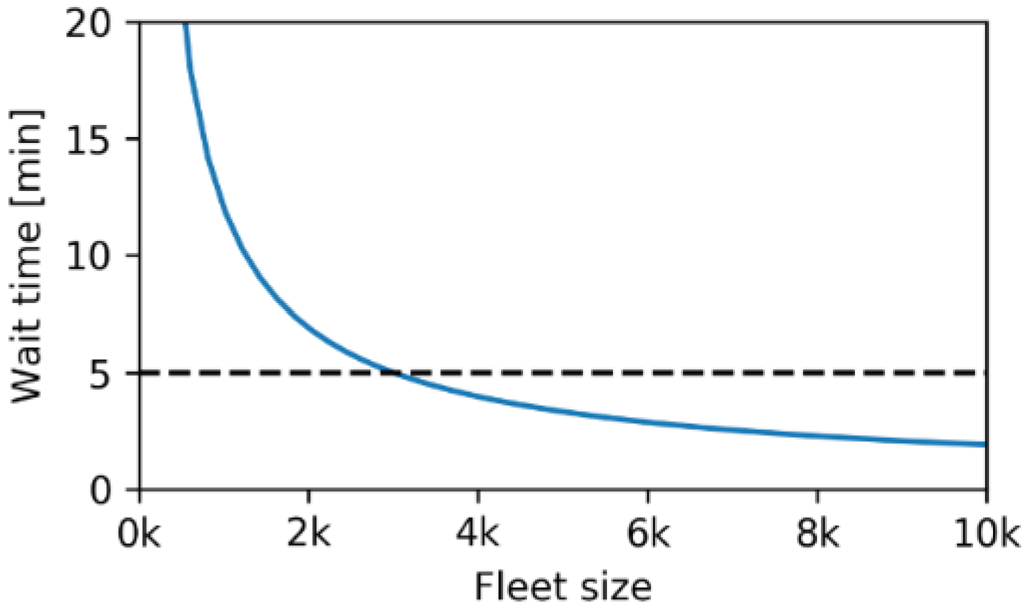
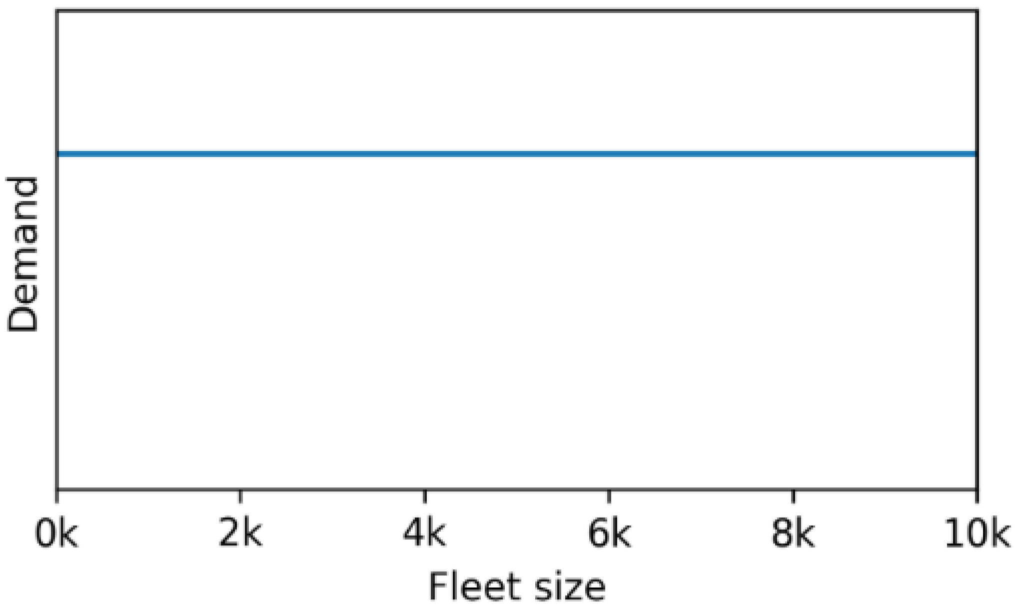
Modelling Shared Autonomous On-Demand (Transit) Services

Milos Balac

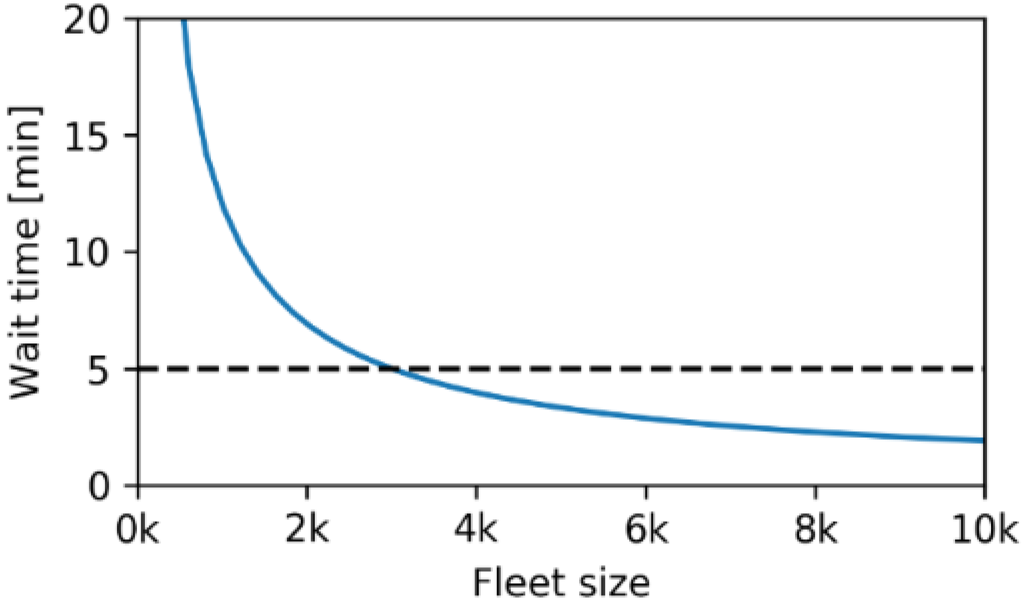
ITSC 2020

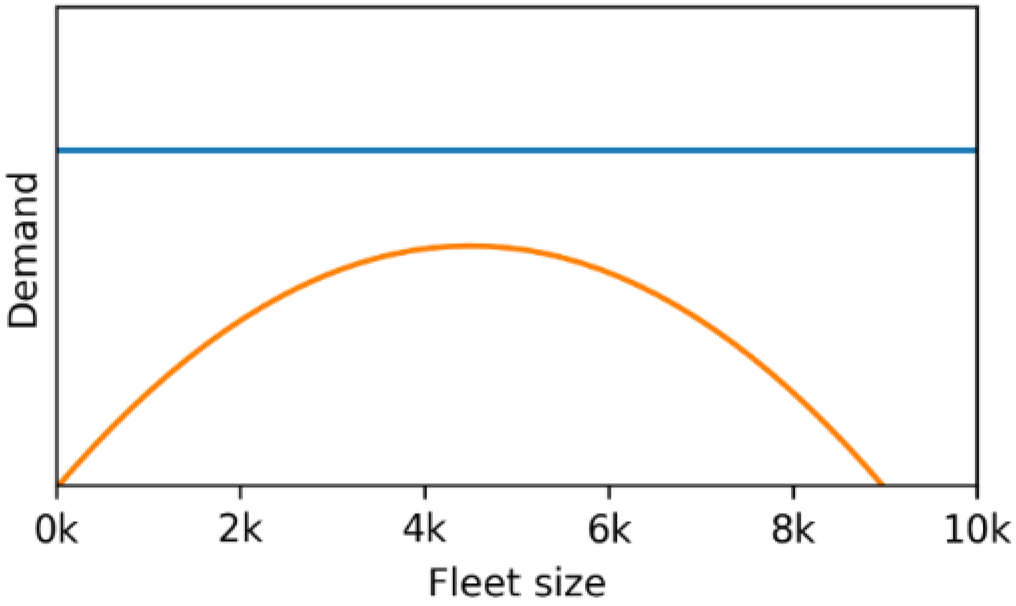
Modeling AV Demand





Modeling AV Demand





How can we model the dynamic demand?

Modeling AV Demand

1) Behavioral model
2) Cost of using the service
3) Simulation framework

Behavioral model - AV Survey

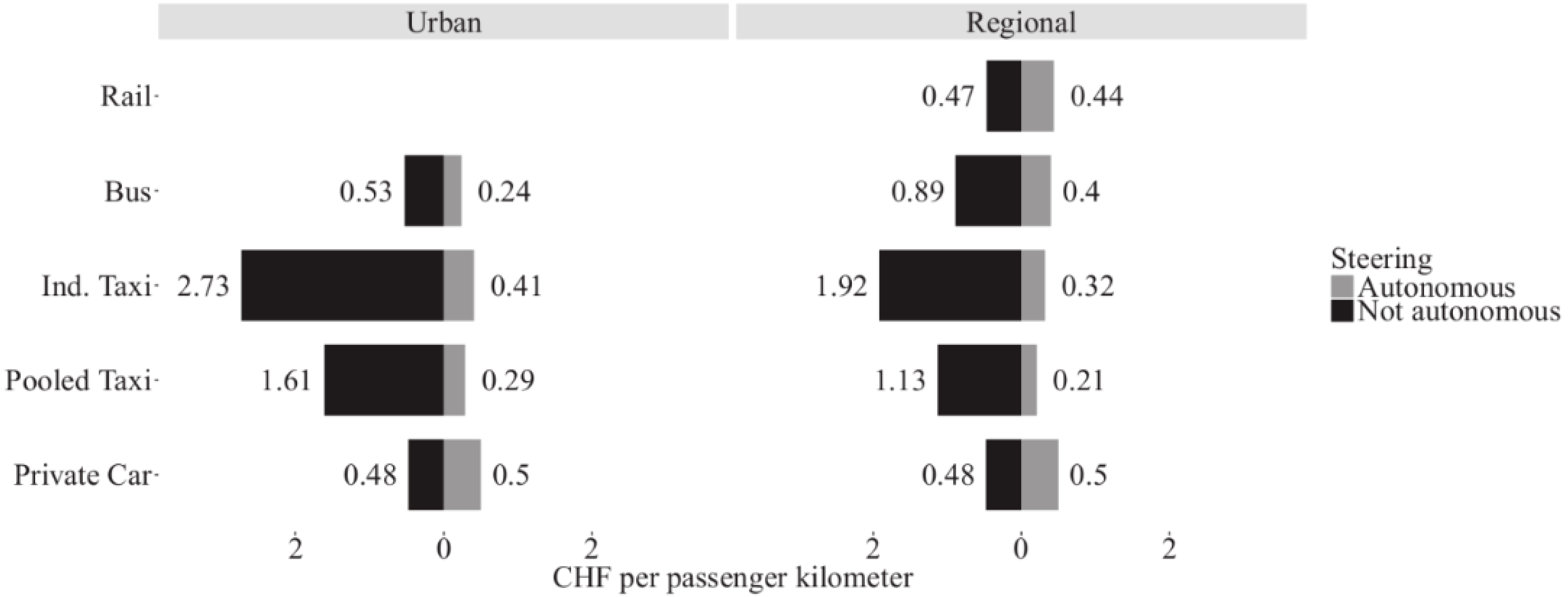
Fleet introduced	Weather	Mobility tools	Provided trip
Two weeks ago	20°C	Priv. aut. car, car, Half-fare card	Work

	Currently chosen	Automated		Automated	Automated
Main transport mode	Car	Private automated car	Train	Pooled-Service	Taxi-Service
Feeder			Bus / Tram		
Total travel time	00:30 h	00:30 h	01:08 h	00:44 h	00:25 h

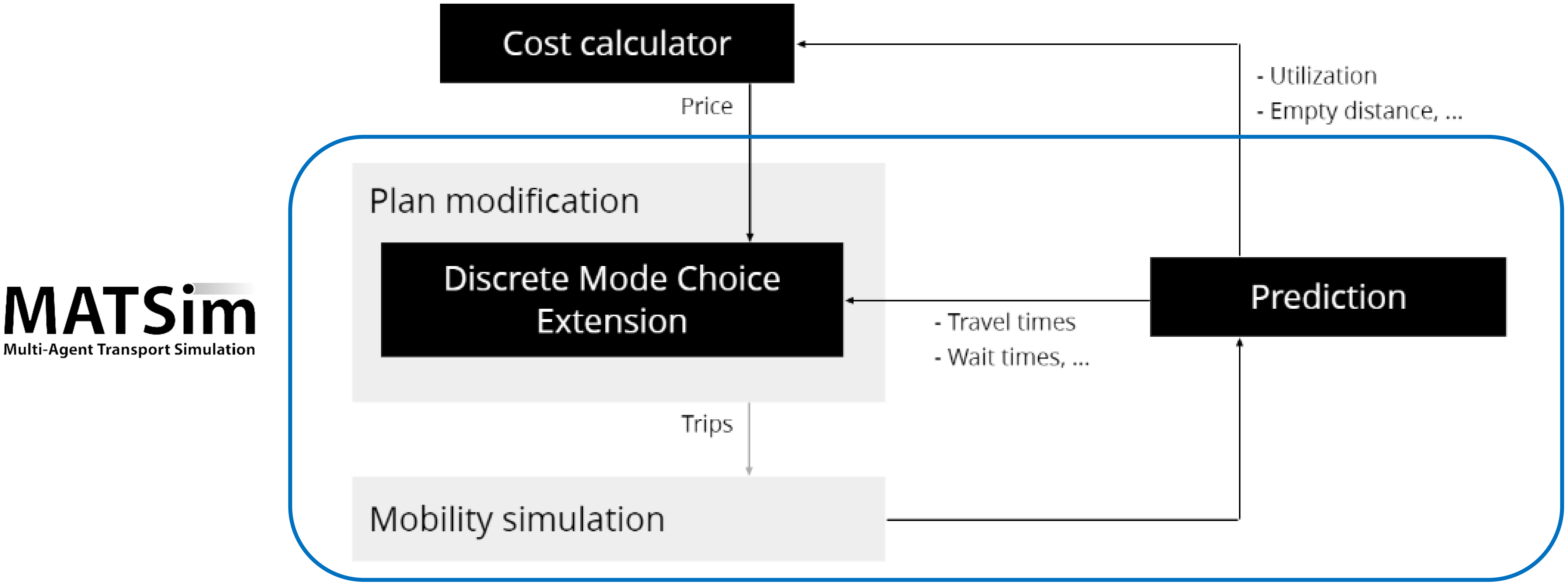
Time in main transport mode			00:06 h	00:40 h	00:20 h
Time in feeder			00:20 h		
Time waiting / transferring			00:12 h	00:04 h	00:05 h
Access and egress time			00:30 h		
Transfers			1		
Frequency			00:16 h		
Variable costs	7 CHF	7 CHF	3 CHF	7 CHF	12 CHF
Please choose	☐	☐	☐	☐	☐

AV Cost Estimation

Bösch, P.M., F. Becker, H. Becker and K.W. Axhausen (2018)
Cost-based analysis of autonomous mobility services,
Transport Policy, 64, 76-91



Simulation Framework



Single-occupancy AV Taxi Demand in Paris

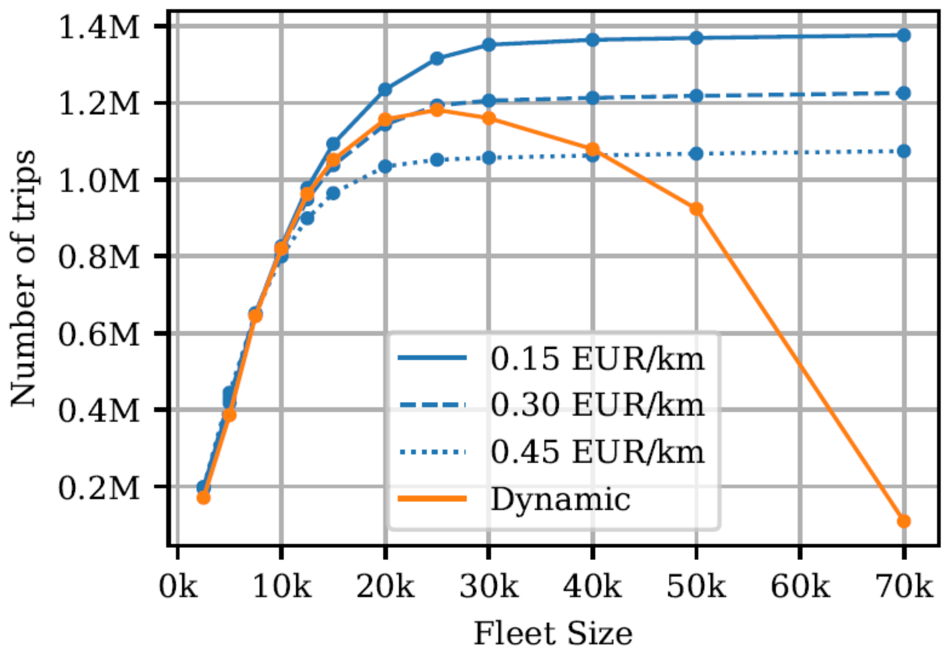
Setup:

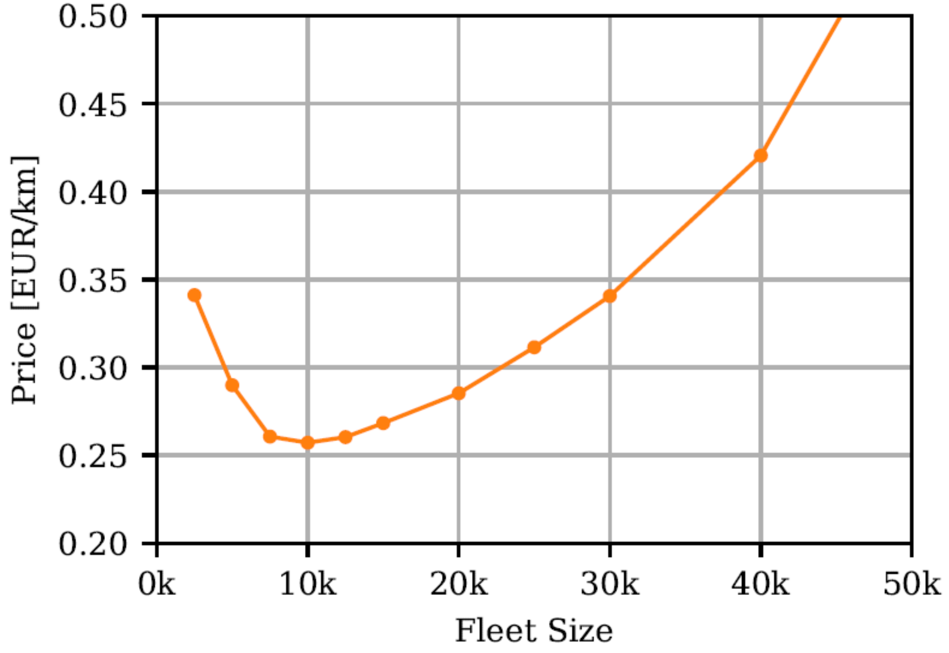
- 2.4Mil trips
- Mode-choice
- Cost estimate

Hörl, S., M. Balac and K.W. Axhausen (2019) Dynamic demand estimation for an AMoD system in Paris, paper presented at the 30th IEEE Intelligent Vehicles Symposium, June 2019, Paris, France.

Single-occupancy AV Taxi Demand in Paris

Results:





Single-occupancy AV Taxi Demand in Paris

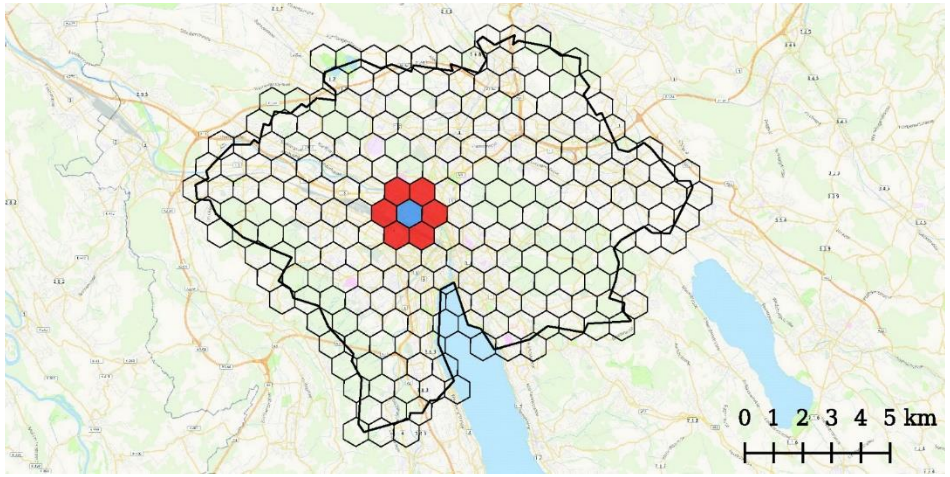
Results:

- Maximum demand of **2.3 Mil is never reached**
- **Optimal price** of 0.3 EUR/km **is very close to the marginal cost of car ownership**
- Currently, mode-share of car trips in the city of Paris is around 10%, which means that **AMoD service brings a substantial shift to car travel**, causing undesirable effects

Automated Transit on-demand Service

Service characteristics:
- PUDO locations
- No detours
- Defined frequency

Modelling characteristics:
- No mode-choice
- No cost
- Replacement of all car trips
- Optimization of fleet size and VKT



Balac, M., Hörl, S. and Axhausen, K.W., 2020. Fleet Sizing for Pooled (Automated) Vehicle Fleets. Transportation Research Record

Automated Transit on-demand Service

Results:

- Without pooling the **fleet** to serve the demand is **11-18 times smaller** (**VKT increases** between 3 and 24%)
- With max 2-person pooling, **fleet** can be **reduced by a factor of 20** (**VKT is slightly reduced** as well)
- Finally with a mixed fleet, the **fleet** can be **reduced by a factor of 27** (**VKT drops** as well by up to 10%)

Automated Transit on-demand Service

Service characteristics:

- PUDO locations
- No detours
- Defined frequency

Modelling characteristics:

- **Mode-choice (wait time, travel time, cost)**
- **Optimization of fleet size and VKT**
- **Two scenarios**

AToD Service – Now with mode-choice and cost estimates

Results:

- Scenario I: with pooling and mixed fleet, we have a **vehicle replacement rate of 4:1** (VKT increases by 6%), with total fleet reduction of 16% (with AToD mode share of 24%)

- Scenario II: if we protect areas with high PT accessibility, we can achieve a **vehicle replacement rate of 10:3** (VKT increases by 5%), with total fleet reduction of 6.4%

- Charging users more in the urban core the possibilities for pooling all but vanishes

Conclusion

- We urgently need to think about policies in the world of AVs
- The proposed framework can help us to better understand the impacts of those policies

Questions?