ETH MATSim developments

Other Conference Item

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ETH MATSim Developments

Milos Balac

Overview

MATSim Developments:

- Pipeline for scenario synthesis
- Discrete-mode-choice
- Modelling traffic lights without (much) data
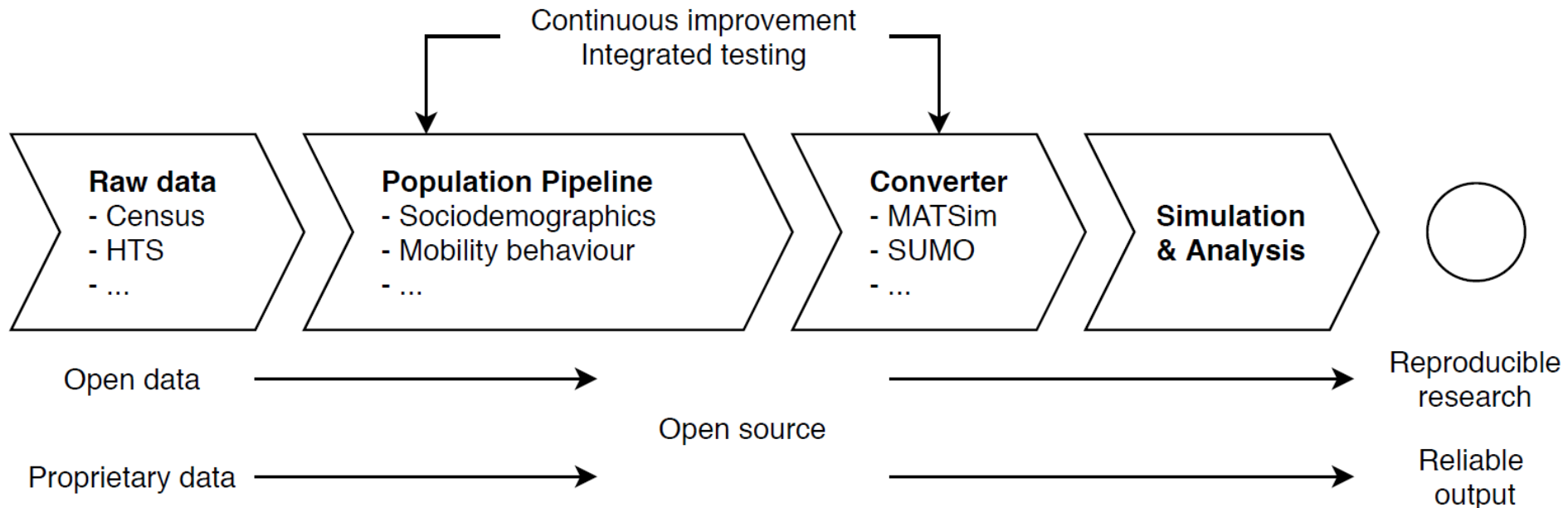- Equilibrium and Calibration

MATSim Studies:

- AVs in Zurich
- Congestion charging (externalities)
- Others

Eqasim

Eqasim

- An integrated pipeline from raw data to agent-based simulation:

Sebastian Hörl and Milos Balac (2021) Introducing the *eqasim* pipeline: From raw data to agent-based transport simulation, to be presented at ABMTRANS

Eqasim

- An integrated pipeline from raw data to agent-based simulation

- Implemented scenarios for Paris (and other places in France), Sao Paulo, California, Switzerland

- **https://github.com/eqasim-org**

Hörl, S., Balac, M. (2020) Open data travel demand synthesis for agent-based transport simulation. A case study of Paris and Ile-de-France, *Under Review*

Balac, M., Hörl, S. (2021) Synthetic population for the state of California based on open-data: examples of San Francisco Bay area and San Diego County, presented at *100th Annual Meeting of the Transportation Research Board*, Washington, D.C.

Sallard, A., Balac, M., Hörl, S. (2021) Synthetic travel demand for the Greater São Paulo Metropolitan Region, based on open data, *Under Review*

Discrete mode choice extension

- In cases when you have access to estimated MNL or NL models, these can now be integrated directly using the DMC extension

- It can be used to override the scoring mechanism of MATSim

- It is a default replanning mechanism in *eqasim*

Hörl, S., M. Balac and K.W. Axhausen (2018) A first look at bridging discrete choice modeling and agent-based microsimulation in MATSim, *Procedia Computer Science*, **130**, 900-907.

Hörl, S., M. Balac and K.W. Axhausen (2019) Pairing discrete mode choice models and agent-based transport simulation with MATSim, paper presented at the *98th Annual Meeting of the Transportation Research Board*, Washington D.C., January, 2019.

Discrete mode choice extension in eqasim
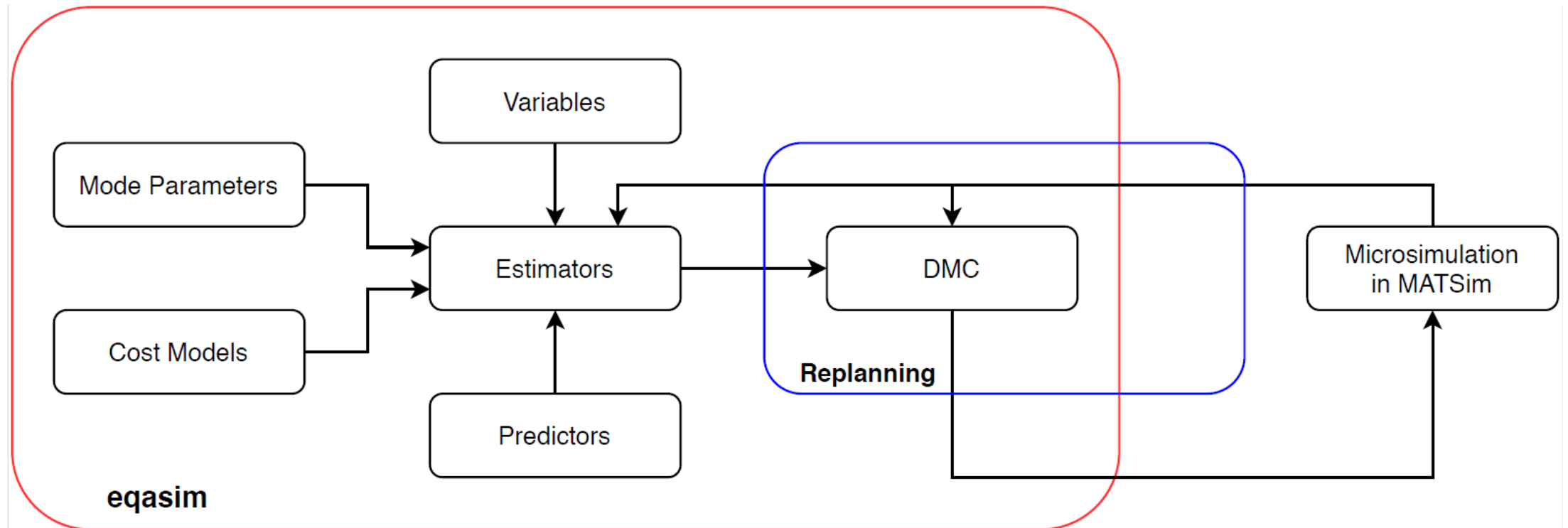
Sebastian Hörl and Milos Balac (2021) Introducing the *eqasim* pipeline: From raw data to agent-based transport simulation, to be presented at ABMTRANS

Implementing Traffic Lights in MATSim without (much) data

- Information on traffic lights is not easy to obtain

- Synchronization of traffic lights is important

- How can we model traffic lights when we only have information on the location of traffic lights?

Aurore Sallard and Milos Balac (2021), Modeling Crossroads in MATSim: the Case of Traffic-Signaled Intersections, to be presented at ABMTRANS

Implementing Traffic Lights in MATSim without (much) data

Webster's formula, introduced in (Webster, 1958)
- Computes the optimal cycle length at a traffic-signalized intersection and splits the green time among the incoming links
- Inputs: observed flows on each incoming link, saturation flow capacity of each link
- Used to derive the delay at the intersection according to an empirical formula presented in (Beckman et al., 1956).

Implementation in MATSim
- Use intersection capacity instead of link capacities
- Computed delay for the concerned crossroads
- Tests performed for the Zurich scenario.

Aurore Sallard and Milos Balac (2021), Modeling Crossroads in MATSim: the Case of Traffic-Signaled Intersections, to be presented at ABMTRANS

Implementing Traffic Lights in MATSim without (much) data
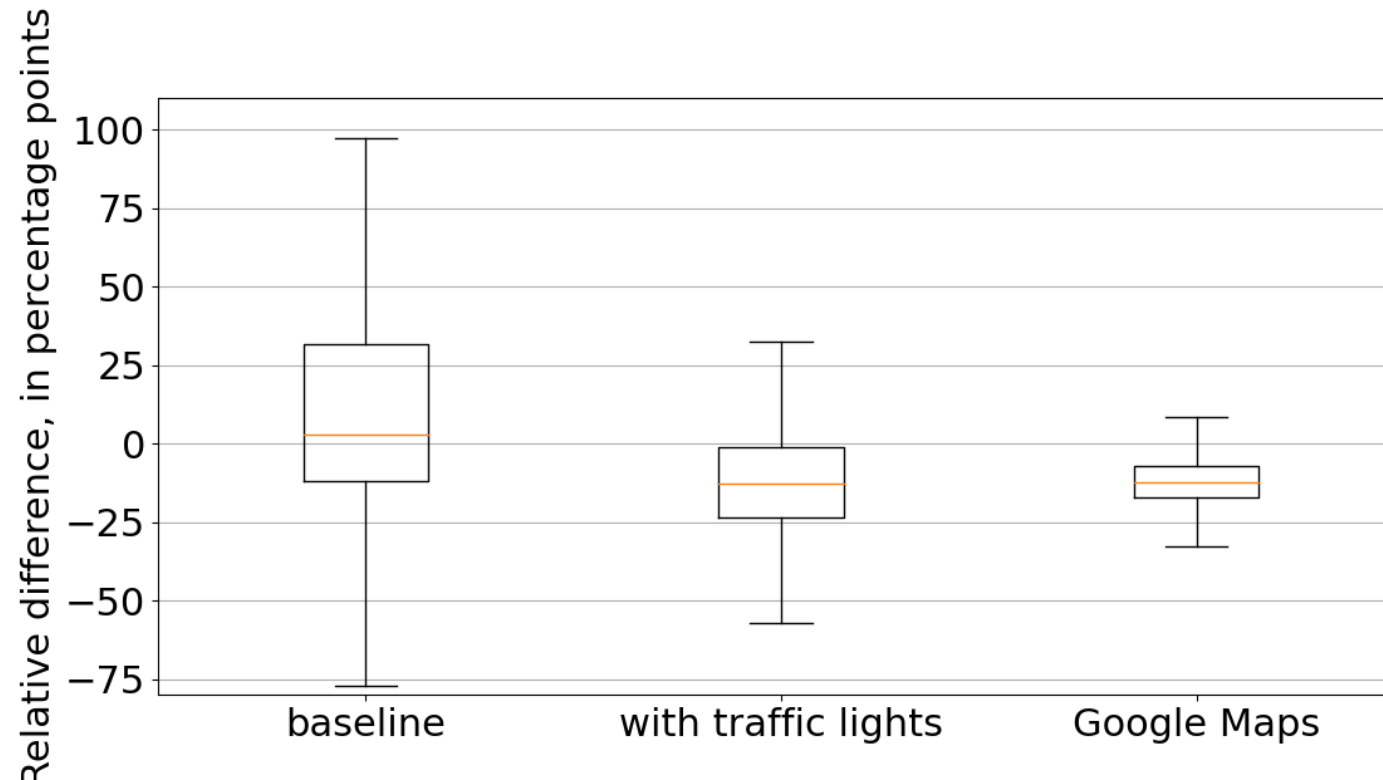
Aurore Sallard and Milos Balac (2021), Modeling Crossroads in MATSim: the Case of Traffic-Signaled Intersections, to be presented at ABMTRANS

High performance mobility simulation – Funded by Mobility Initiative

DEDALO – Detector of Equilibrium probability Distributions for a large-scale AB scenario
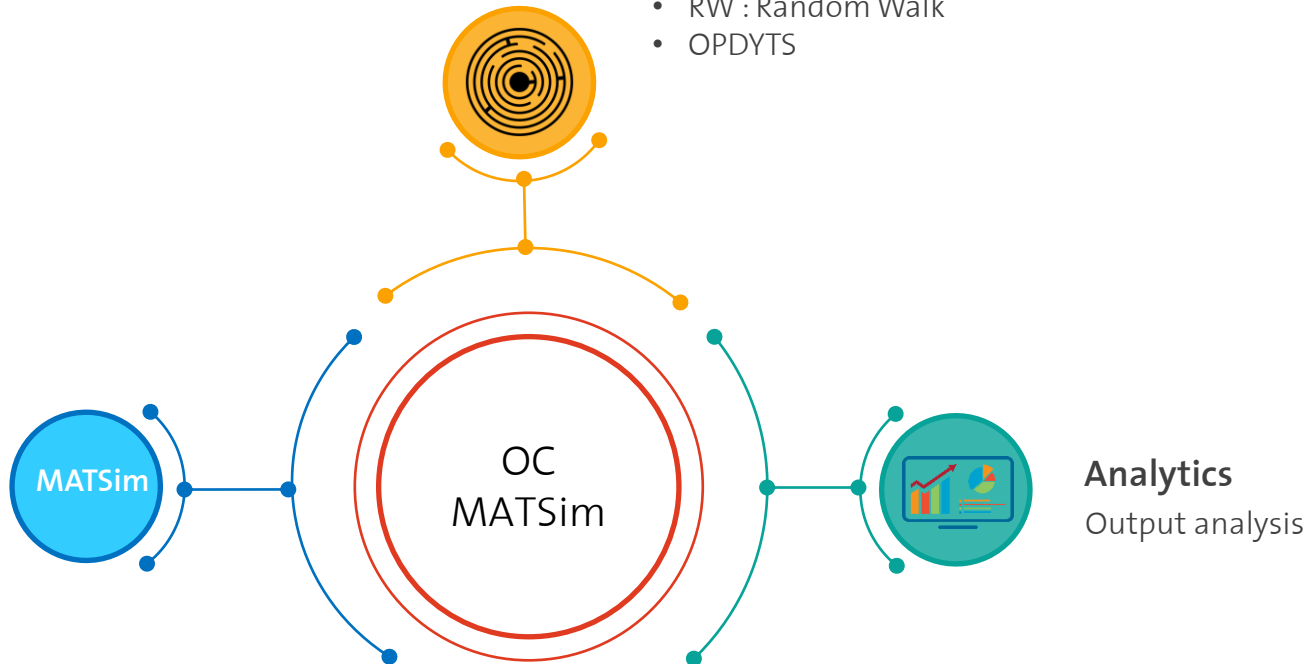- The aim of this work is to speed-up the search for the equilibrium in MATSim

Contact: Stefano Penazzi

Calibration
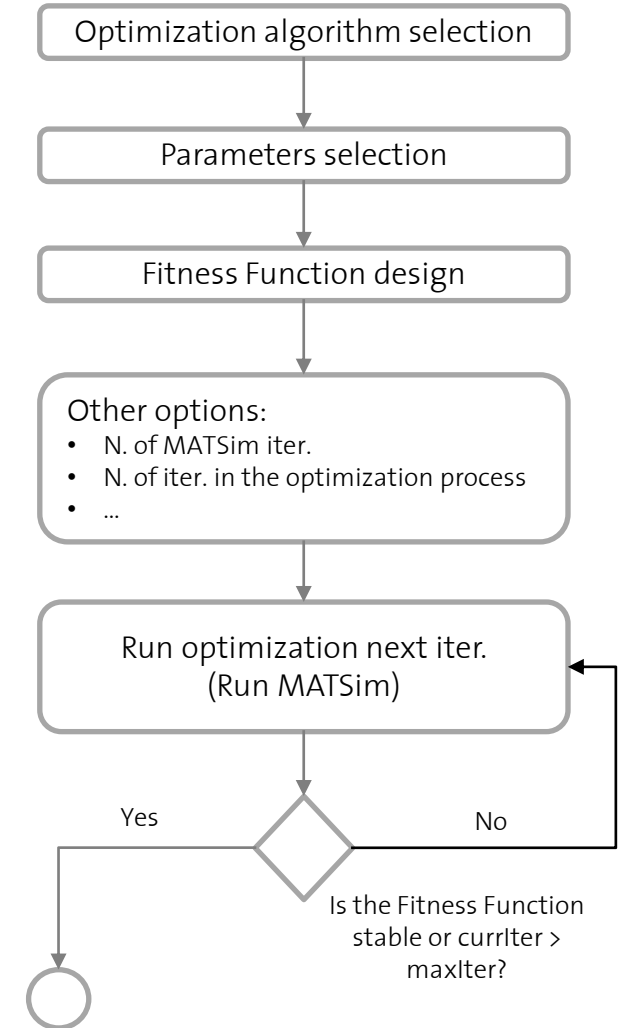
MATSim Calibration

Calibration

- CMA-ES : Covariance Matrix Adaptation Evolution Strategy
- FDSA : Finite Differences Stochastic Approximation
- SPSA : Simultaneous perturbation stochastic approximation
- RW : Random Walk
- OPDYTS

MATSim

OC
MATSim

Analytics
Output analysis

Contact: Stefano Penazzi, Sebastian Hörl

Code available: **https://gitlab.ethz.ch/ivt-vpl/oc-matsim**

Optimization algorithm selection

Parameters selection

Fitness Function design

Other options:
- N. of MATSim iter.
- N. of iter. in the optimization process
- ...

Run optimization next iter.
(Run MATSim)

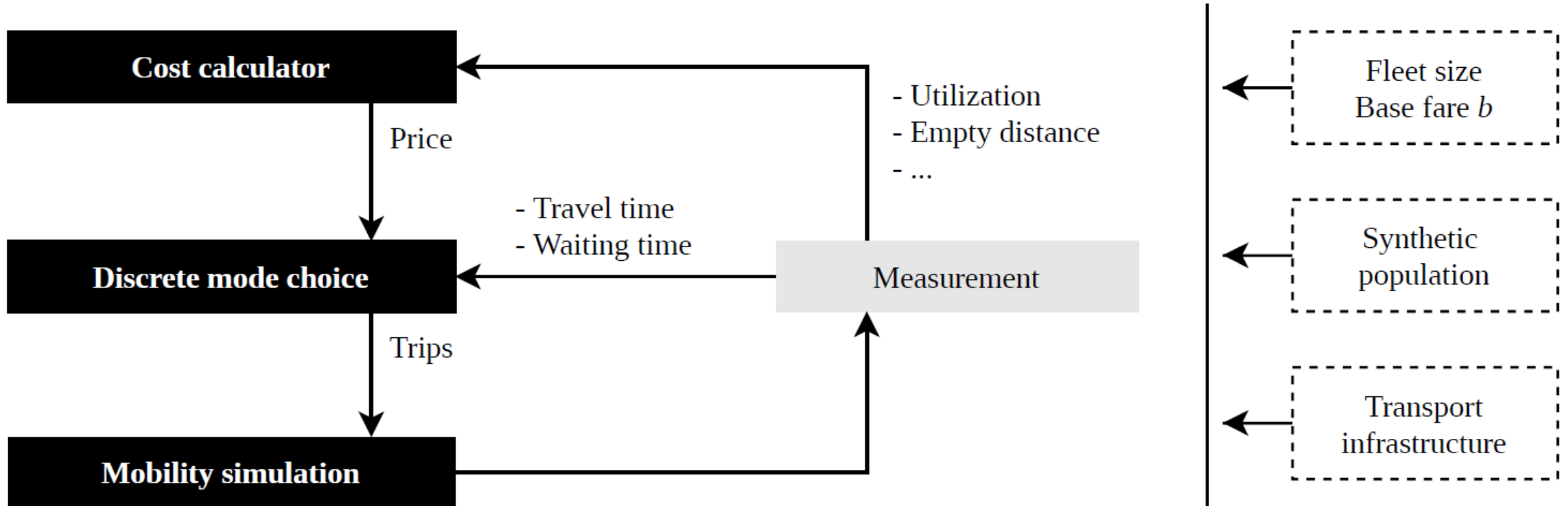Yes   No

Is the Fitness Function
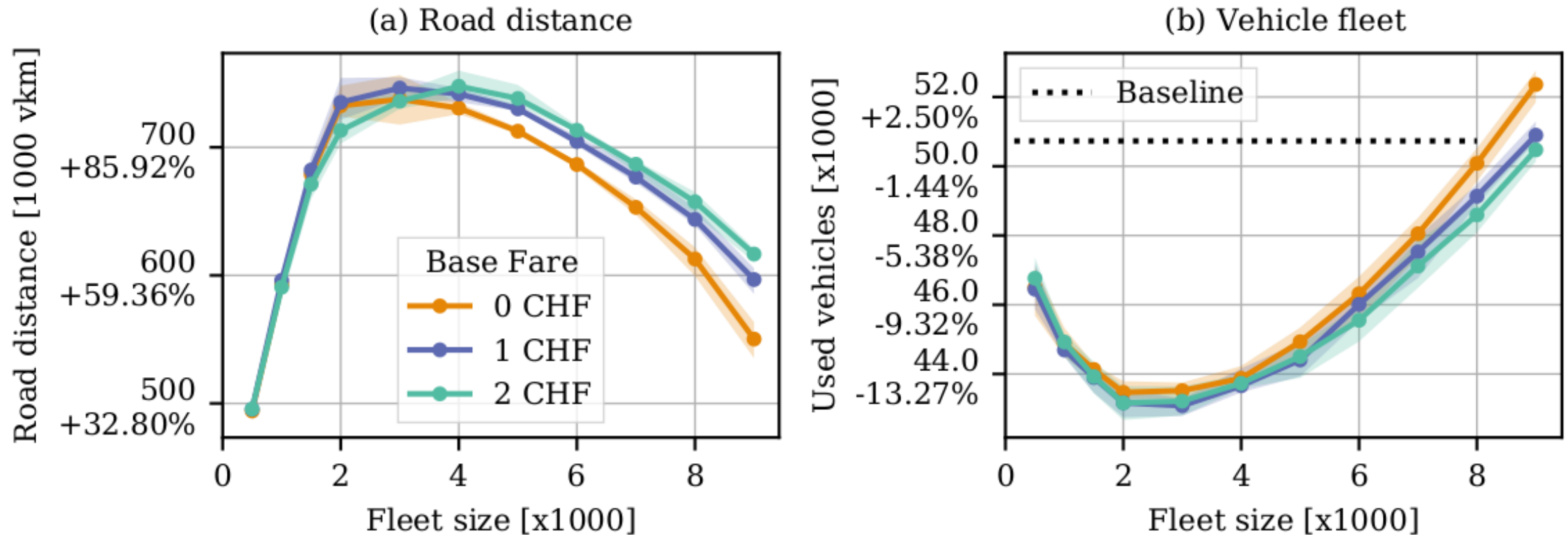stable or currIter >
maxIter?

Studies

AVs in Zurich

AVs in Zurich

Hörl, S., F. Becker and K.W. Axhausen (2021) Simulation of price, customer behaviour and system impact for a cost-covering automated taxi system in Zurich, *Transportation Research Part C: Emerging Technologies*, **123**, 102974.

AVs in Zurich

(a) Road distance

(b) Vehicle fleet

Hörl, S., F. Becker and K.W. Axhausen (2021) Simulation of price, customer behaviour and system impact for a cost-covering automated taxi system in Zurich, *Transportation Research Part C: Emerging Technologies*, **123**, 102974.

AVs in Zurich

a) Traffic volumes in the baseline   b) Traffic volumes in AMoD scenario (fleet size 4000, no base fare)
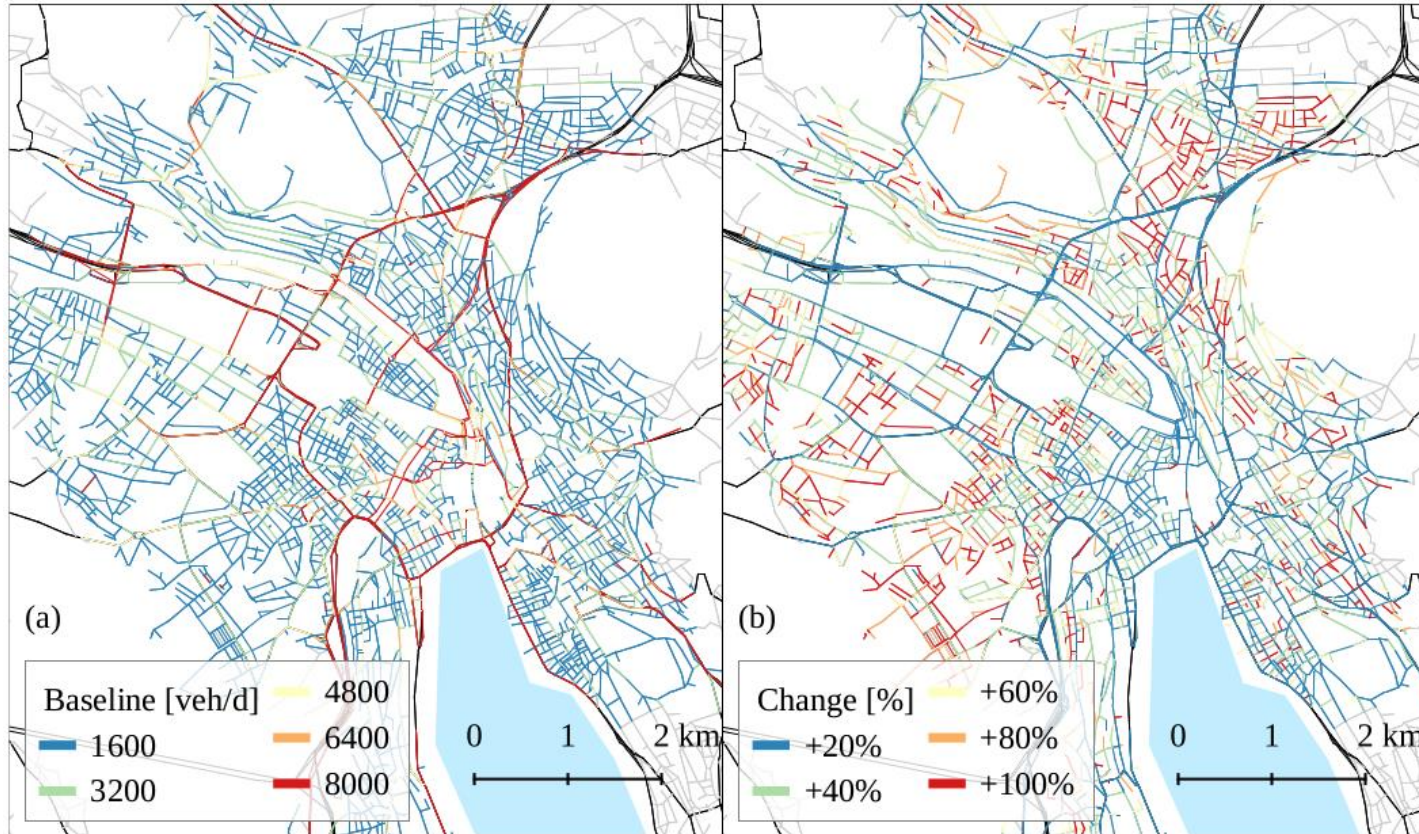
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MOBIS Study

- Record individual GPS traces (> 3,500 participants, started in Sept. 2019)

- Two 4-week periods (observation, treatment)

- 3 treatment groups (control, information, pricing)

- Impute produced externalities for each user

- Provide feedback to users and measure effect

- Detailed reports: **https://ivtmobis.ethz.ch/mobis/en/**

Joseph Molloy, Christopher Tchervenkov and Kay W. Axhausen (2021) Estimating the external costs of travel on GPS tracks, Under Review

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STILL ONGOING!

Joseph Molloy, Christopher Tchervenkov and Kay W. Axhausen (2021) Estimating the external costs of travel on GPS tracks, Under Review

MOBIS Study – External Costs Calculations

Emissions

- Emitted pollutant amounts based on HBEFA (Hülsmann et al., 2011; Kickhöfer and Nagel, 2016)
- All 4 HBEFA traffic states integrated

Congestion

- Congestion caused by agents on each link (Kaddoura and Kickhöfer, 2014)
- Averaged over all agents entering link in 15-min time steps, median over 30 iterations

Monetization

- Convert amounts/time to CHF using NISTRA / Swiss Standard SN 641 820

Detailed reports: **https://ivtmobis.ethz.ch/mobis/en/**

Other Studies

- Simulation of pandemic spreading using agent-based models – extensive work on improving the quality of the IVT Switzerland agent-based model and the use of Episim to simulate the pandemic spreading

- The impacts of AVs on VKM, PKM, congestion in Switzerland with different market penetration forecasts for years 2020, 2030, 2040, and 2050

Axhausen, Kay W., Livingston, Clarissa, Hörl, Sebastian, Bruns, Frank, Fischer, Remo and Bence Tasnady. 2020. Effects of automated driving: subproject 2; Traffic effects and infrastructure needs. 1683.

- Impact of DRT in Wayne County, MI; simulation of AV lanes, intermodal travel, and AV penetration rates

Kagho, Grace Orowo, Hensle, David, Balać, Milos, Freedman, Joel, Twumasi-Boakye, Richard, Broaddus, Andrea, Broaddus, Andrea and Kay W. Axhausen. 2021. Demand responsive transit simulation of Wayne County, MI. Paper presented at the 100th Annual Meeting of the Transportation Research Board (TRB 2021), online, 25-29 January 2021

Questions