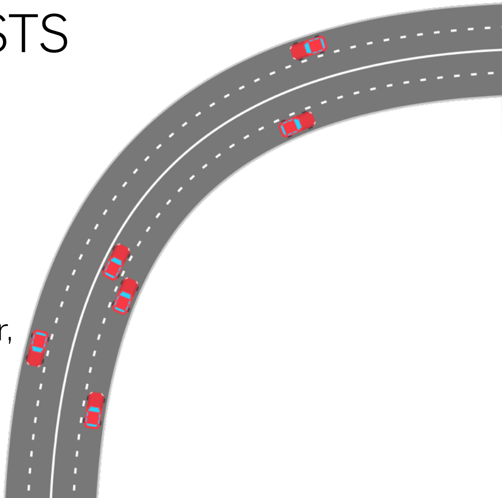
ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

THE INFLUENCE OF CYCLISTS ON TRAFFIC

19th December 2022



Nils Egger, Sophia Herrmann, Jan Hochstrasser, Jannick Schröer, Alexander Sotoudeh

ETH Zürich

Complex Social Systems: Modeling Agents, Learning, and Games

STRUCTURE

1. Motivation
2. Model
3. Results
4. Outlook
5. Q&A

MOTIVATION

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- Health Hazards
- Tangible Costs

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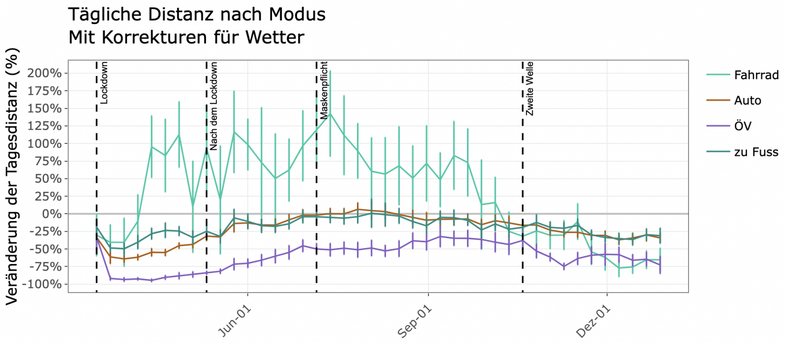
CORONA SURGE

Bicycling saw a huge surge in popularity post Covid-19.



Source: MOBIS-COVID19

VELOSTRATEGIE 2030

Zurich itself is pushing for more environment friendly modes of transportation.

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VELOSTRATEGIE 2030

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- currently around 10% bicycles [5]
- goal is to increase by 10 percent points [6]
- how does this affect traffic?

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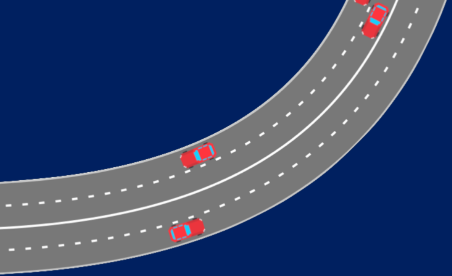
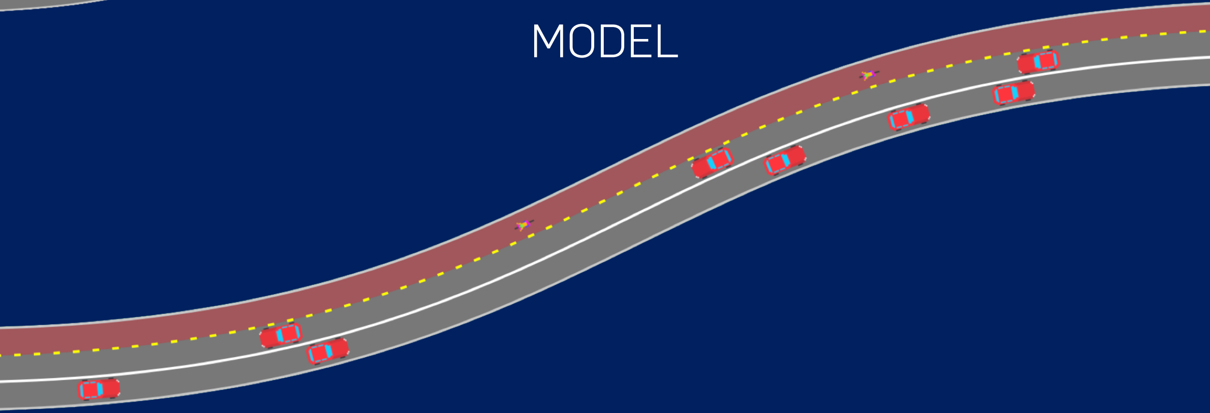


MODEL



OPEN STREET MAP

```
[out:json]
[bbox:47.36, 8.50, 47.42, 8.56];
    (
        way[highway=primary];
        way[highway=secondary];
        way[highway=trunk];
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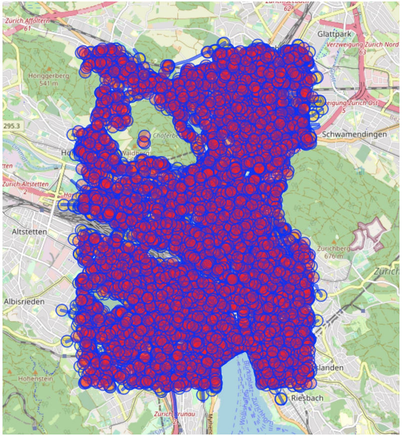

ENVIRONMENT

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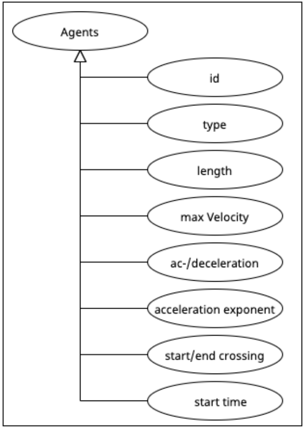
- lanes
- length
- speed limit
- if present: opposite street ID

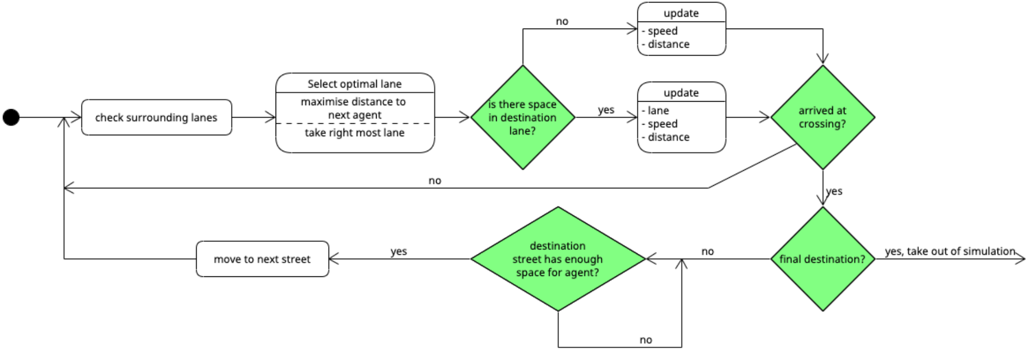
AGENTS

Agents can be of one of
two types, bicycles or cars. Both share the same attribute
types but they are chosen out of different intervals.

Attribute	Car	Bike
Length (m)	$[3.5, 5]$	$[1.5, 2.5]$
Max. Velocity (km/h)	$[100, 250]$	$[10, 35]$
Acceleration (m/s^2)	$[1.5, 5]$	$[0.5, 1.5]$
Deceleration (m/s^2)	$[2, 6]$	$[1, 3]$
Acceleration Exponent	$[8, 12]$	$[8, 12]$



VEHICLES BEHAVIOUR



DIFFERENCES BETWEEN CARS AND BIKES

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Cars:

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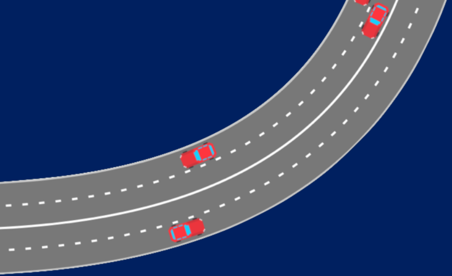
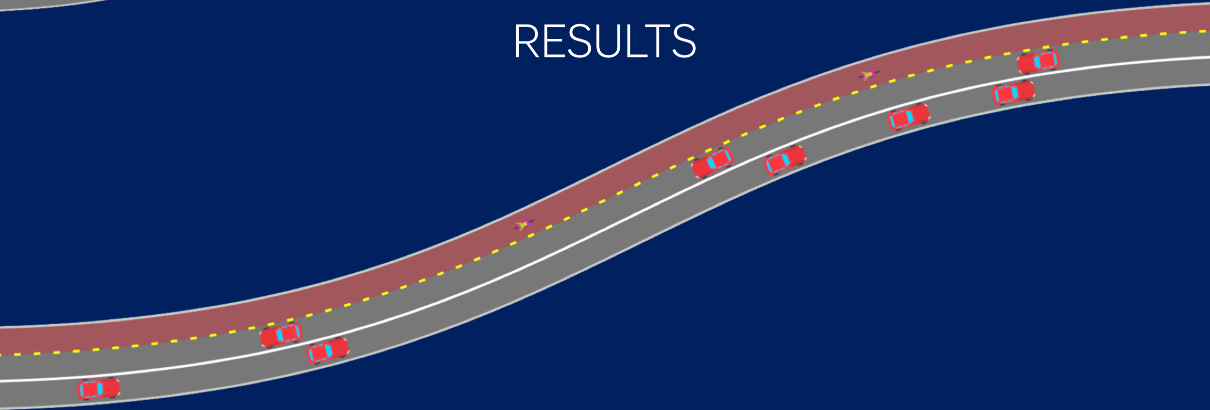
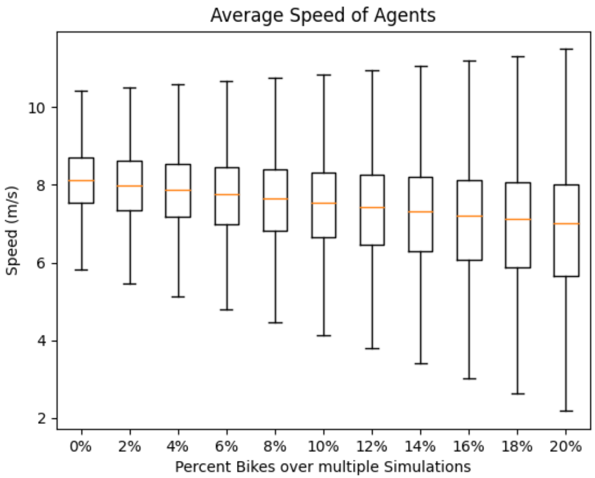
- Cars are larger
- Cars accelerate faster and have a higher max speed



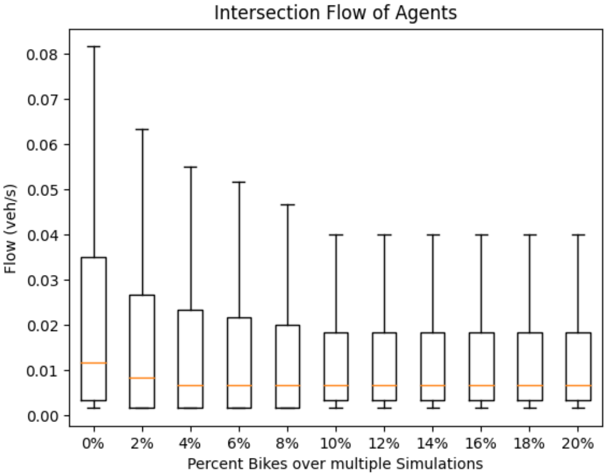
RESULTS



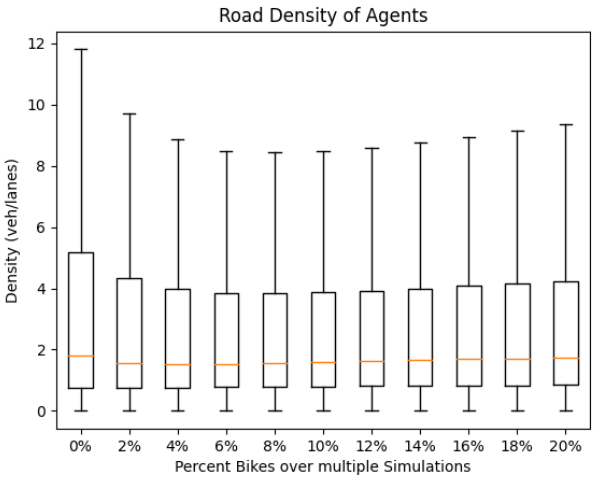
AVERAGE SPEED



TRAFFIC FLOW



TRAFFIC DENSITY



OUTLOOK

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- Model doesn't incorporate driving styles, lawfulness
- No consideration for extraordinary events: Accidents, Road Construction

CONCLUSION

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    - less environmental pollution
    - quieter city

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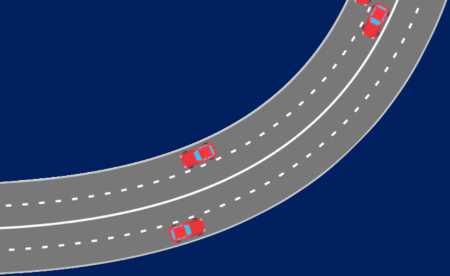
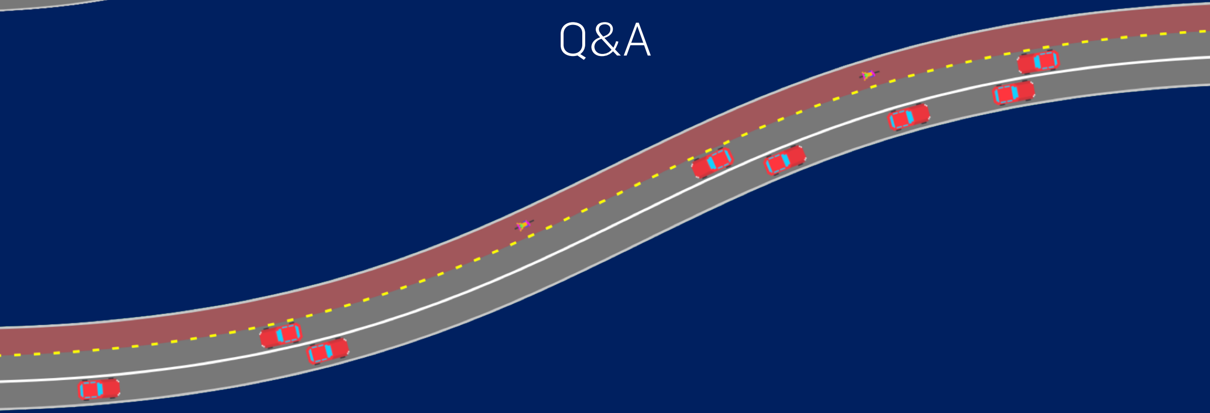
- Higher complexity for agent behavior, overtaking on opposite roads etc.
- Calculating the associated cost difference



Q&A



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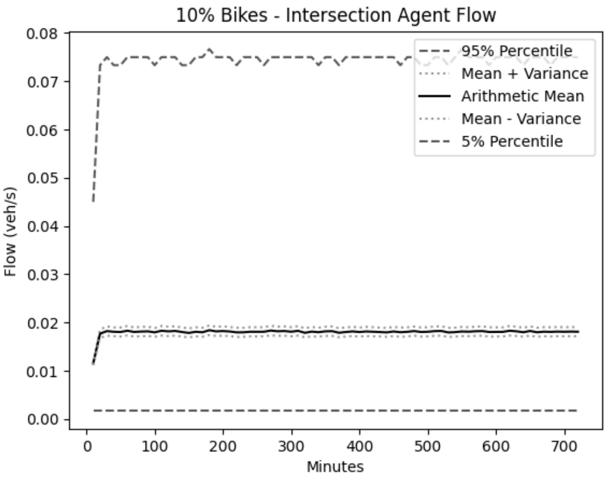
[2] Gholamreza Goudarzia and Mohammad Javad Mohammadi et al. “Estimation of Health Effects Attributed to NO2 Exposure Using AirQ Model”. In: Archives of Hygiene Sciences (2012).

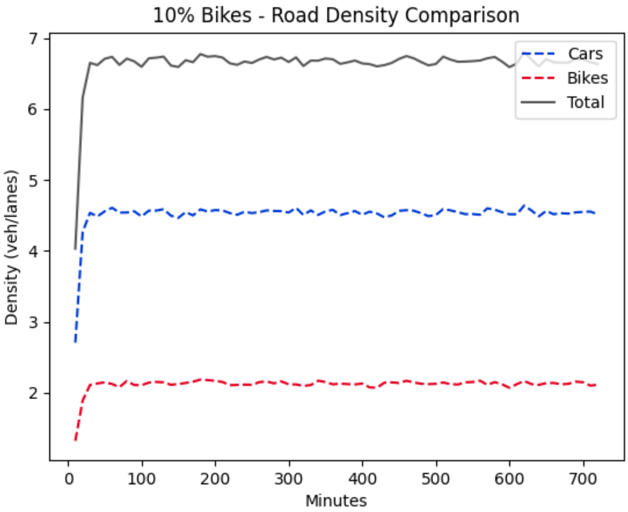
[3] European Commission et al. Handbook on the external costs of transport : version 2019 – 1.1. Publications Office, 2020.

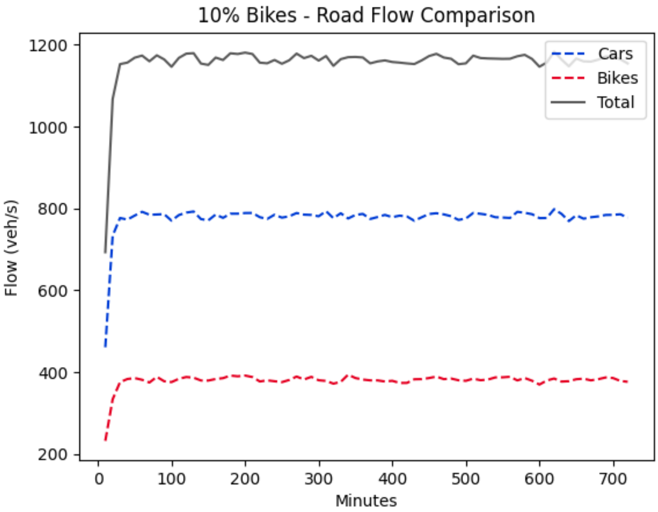
[4] Federal Office for the Environement FOEN. NO2 Ambient Concentrations in Switzerland. (accessed: 15.12.2022).

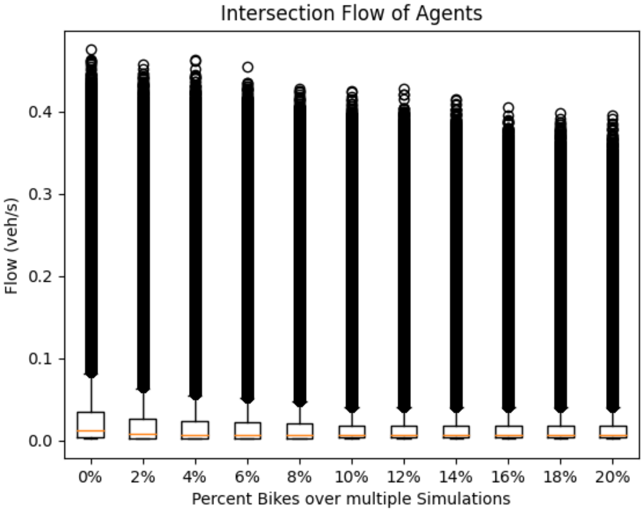
[5] Stadt Zürich. Stadtverkehr 2025 - Bericht 2021. (accessed: 15.12.2022).

[6] Stadt Zürich. Velostrategie 2030. (accessed: 15.12.2022).


10% Bikes - Intersection Agent Flow
Flow (veh/s)
Minutes
95% Percentile
Mean + Variance
Arithmetic Mean
Mean - Variance
5% Percentile
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
100
200
300
400
500
600
700


10% Bikes - Road Density Comparison
Cars
Bikes
Total
Density (veh/lanes)
Minutes
0
100
200
300
400
500
600
700
2
3
4
5
6
7


10% Bikes - Road Flow Comparison
Cars
Bikes
Total
Flow (veh/s)
1200
1000
800
600
400
200
0
100
200
300
400
500
600
700
Minutes


Intersection Flow of Agents
Flow (veh/s)
0.0
0.1
0.2
0.3
0.4
0%
2%
4%
6%
8%
10%
12%
14%
16%
18%
20%
Percent Bikes over multiple Simulations