Incorporating Infrastructure Characteristics and Vehicular Interactions into an Agent-Based Transport Simulation Framework for a Realistic Simulation of Bicycle Traffic

Dominik Ziemke and Amit Agarwal | Technische Universität Berlin
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Cycling

- Inexpensive
- Fast
- Healthy
- Quiet
- Energy-efficient
- Less land-consuming
- Enjoyable

- Societal, environmental, economic, and public health problems of motorized vehicle traffic

- ➢ Cities promote cycling for everyday use
- ➢ Increasingly included into plans for travel behavior change

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Need for appropriate infrastructures

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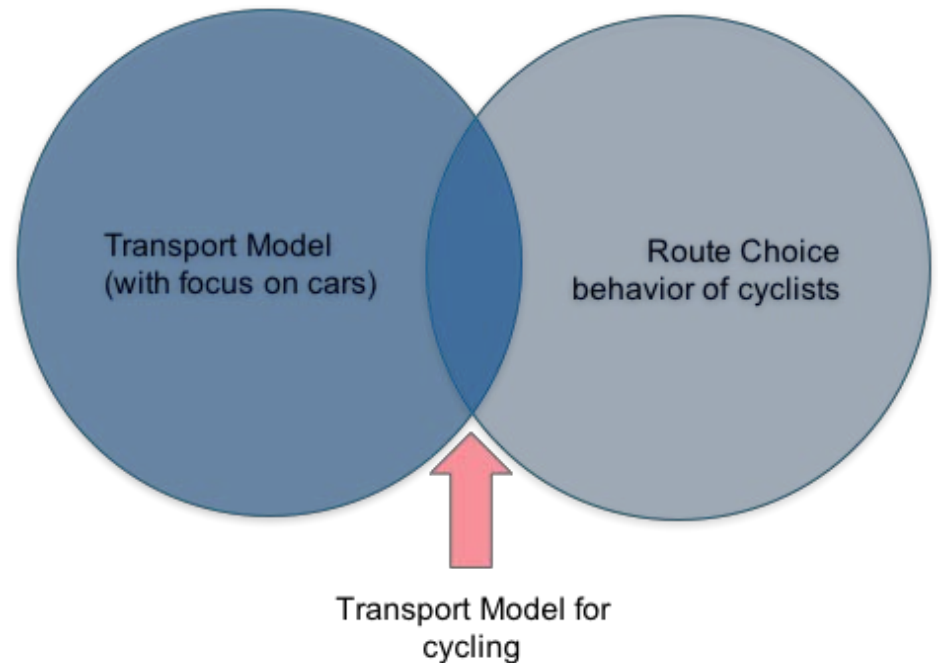
Cycling

- Benefits of cycling as a mode of transport

- Need for appropriate conditions for cycling

Transport (Planning) Models

- Important tool for effective planning of transport systems

- A means to evaluate proposed policies in a structured and systematic fashion

- State-of-the-practice for motorized individual transport and public transport

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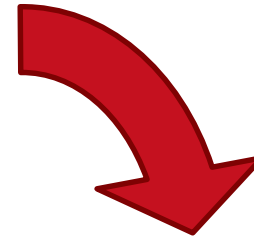- State-of-the-practice for motorized individual transport and public transport

Transport Model (with focus on cars)

Route Choice behavior of cyclists

Transport Model for cycling

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Modeling cyclists' behavior and choices realistically

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People are different

People are different

- … but less so when traveling by car

➢ Minimize travel time

How do cyclists choose their routes?

- Travel time
- Route length
- Slopes
- Comfort
    - Smoothness / Surfaces
- Infrastructure
    - Bicycle lanes
    - Intersections
- Volumes of motorized traffic
- ...

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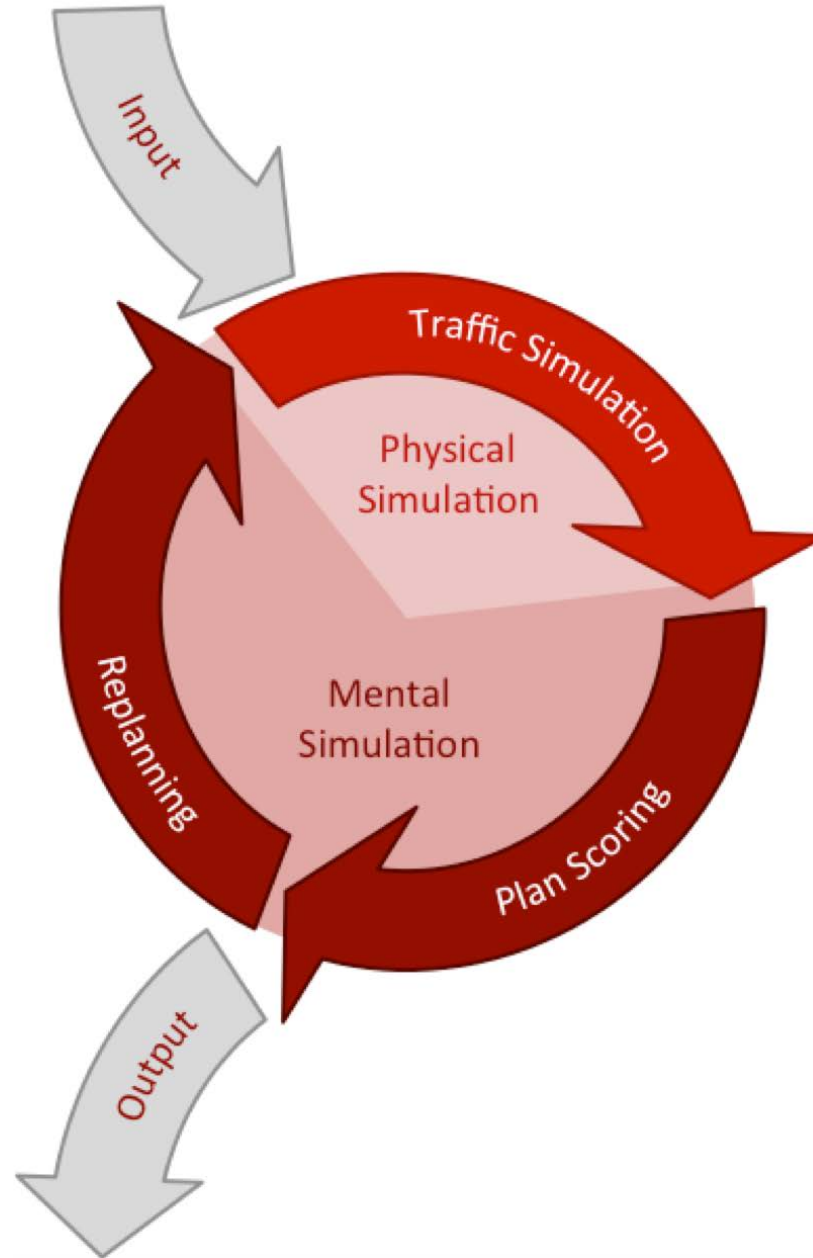Berlin

MATSim Basics
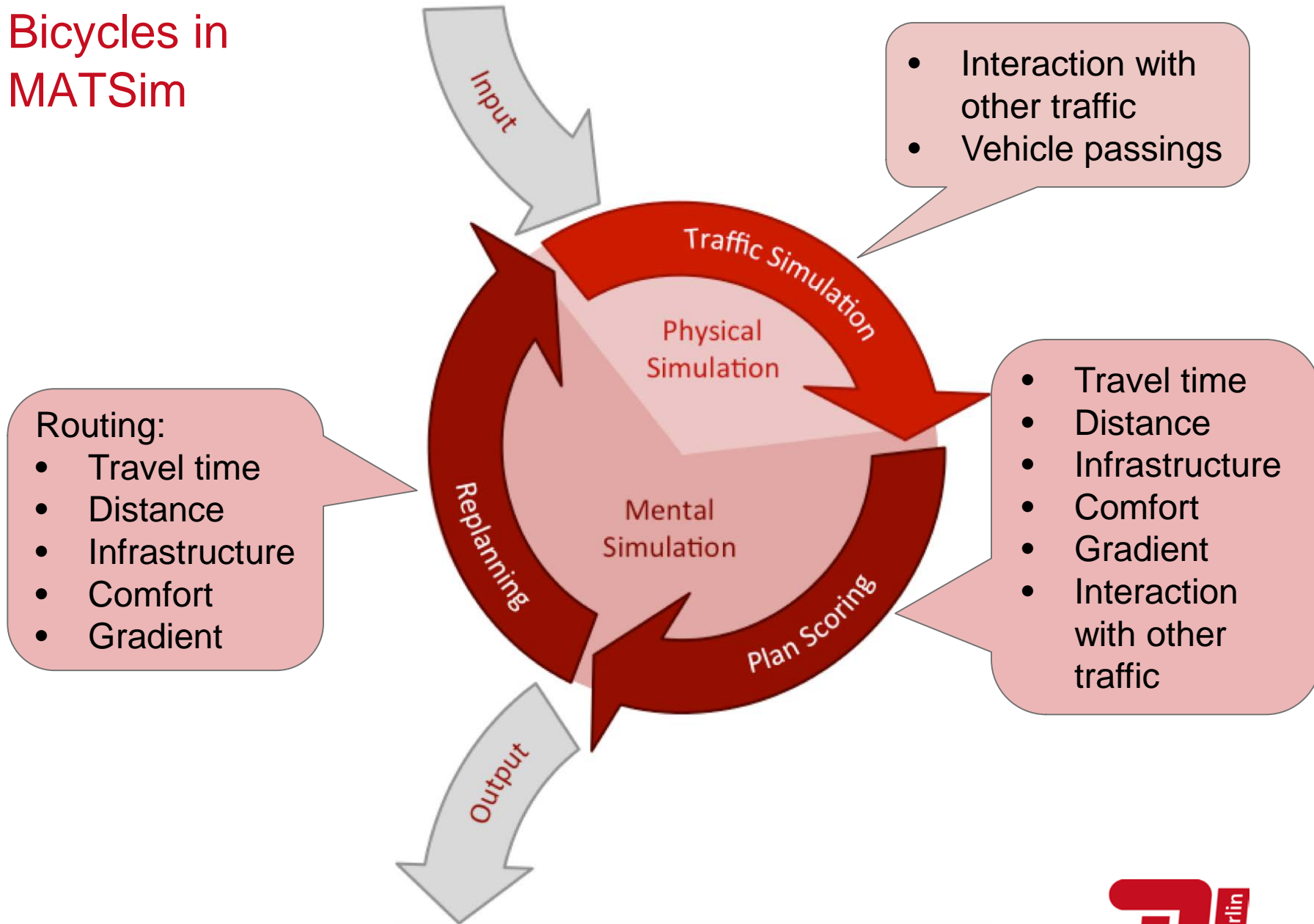
Traffic Simulation

- Agents travel on the network

Plan Scoring

- Agents score their activities and trips

Replanning

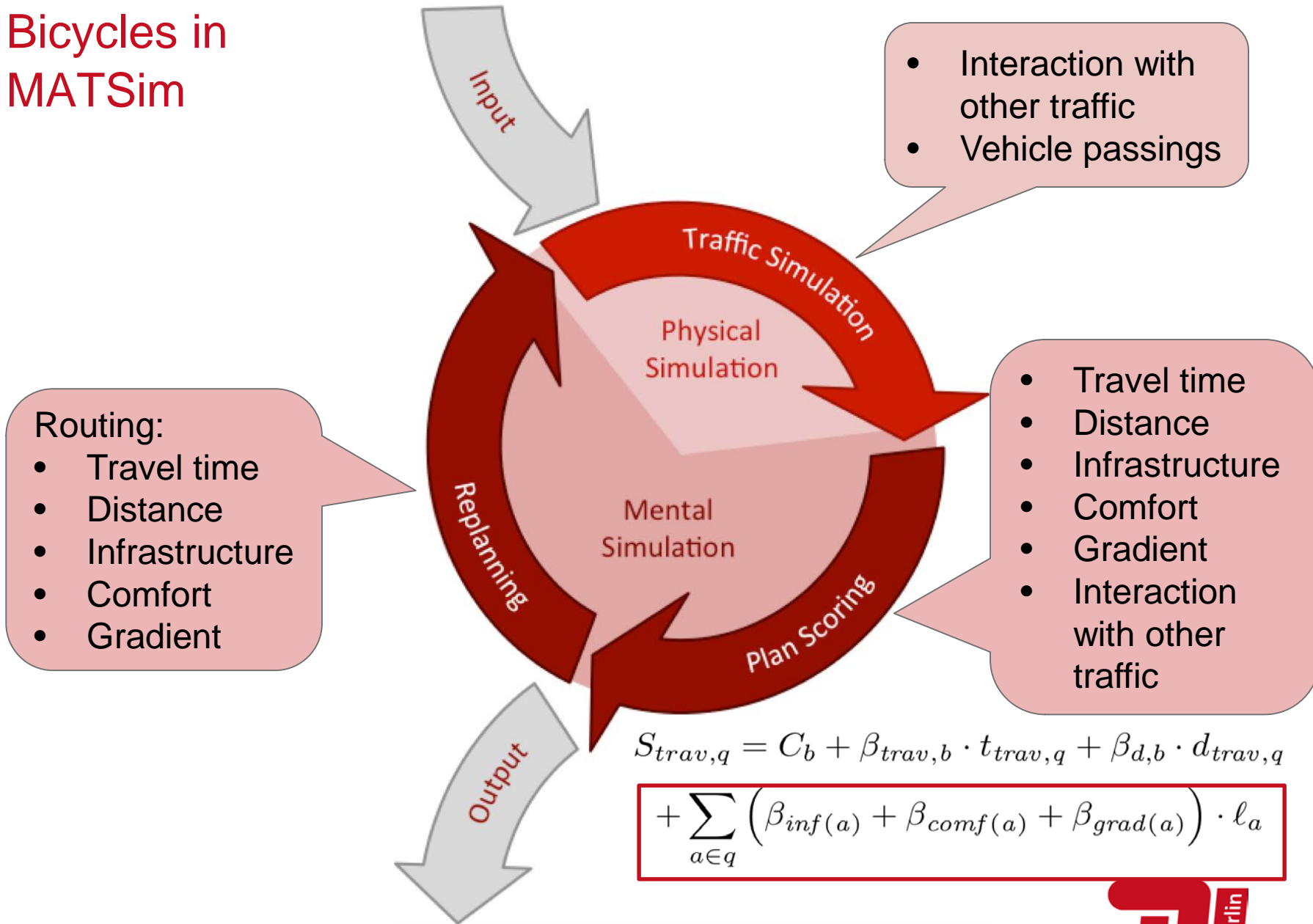- Agents modify plans
- Agents select a plan

Bicycles in MATSim

- Interaction with other traffic
- Vehicle passings

Input

Traffic Simulation

Physical Simulation

Mental Simulation

Replanning

Plan Scoring

Output

Routing:
- Travel time
- Distance
- Infrastructure
- Comfort
- Gradient

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Bicycles in MATSim

Interaction with other traffic
- Vehicle passings

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- Travel time
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Traffic Simulation

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Plan Scoring

Output

- Travel time
- Distance
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- Gradient
- Interaction with other traffic

$$S_{trav,q} = C_b + \beta_{trav,b} \cdot t_{trav,q} + \beta_{d,b} \cdot d_{trav,q}$$

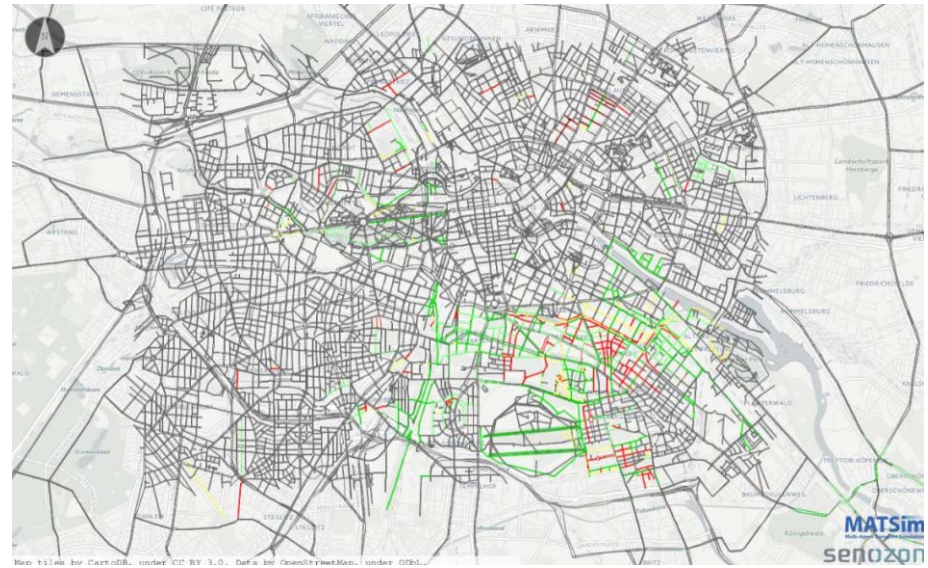$$+ \sum_{a \in q} \Big(\beta_{inf(a)} + \beta_{comf(a)} + \beta_{grad(a)} \Big) \cdot \ell_a$$

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„Smoothness"

- Evaluation of the surface
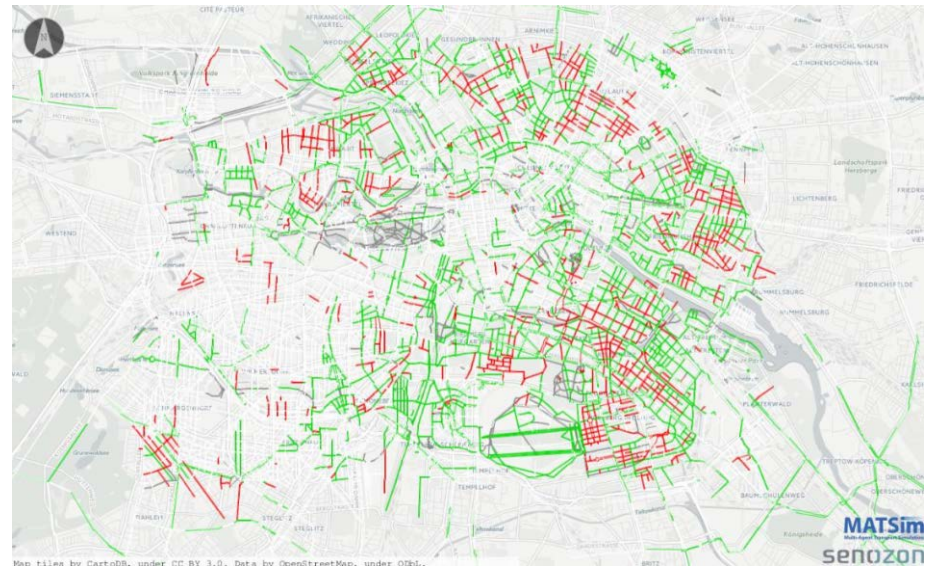- "Impassable" … "excellent"
- Only 12% of all links in Berlin
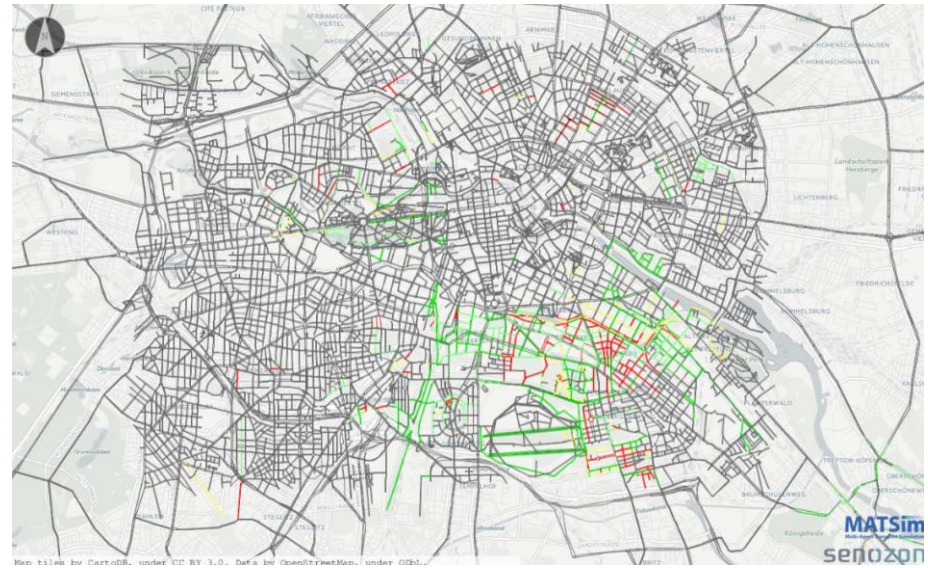
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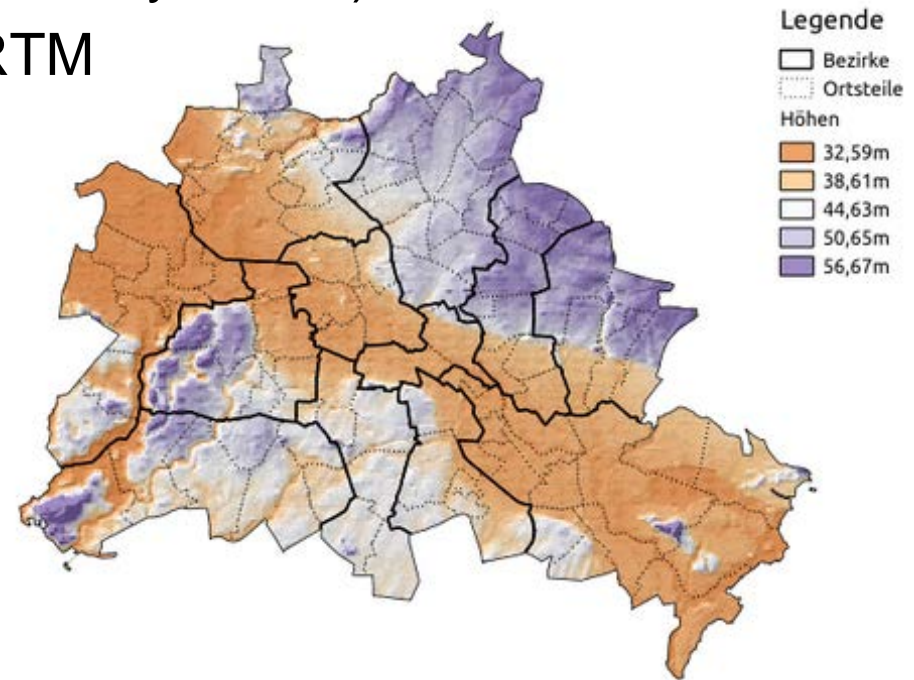- Only 12% of all links in Berlin

"Surface"

- Type of surface
- "Asphalt", "cobblestone", …
- Use as proxy for "smoothness"
- 58% of all links in Berlin
- Additionally, some highway types are assigned with defaults (e.g. primary highways are by default asphalt roads).
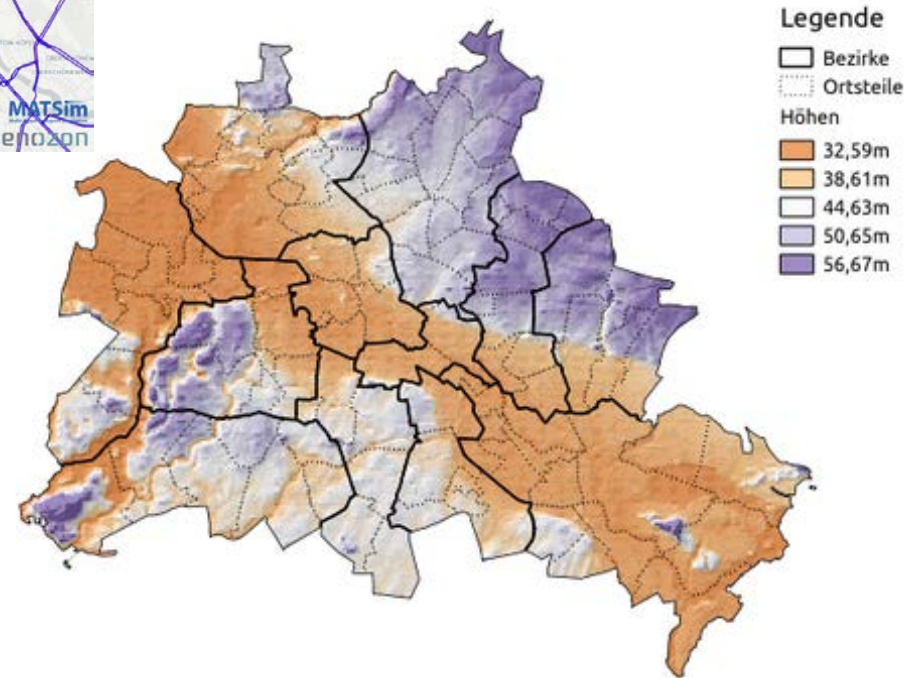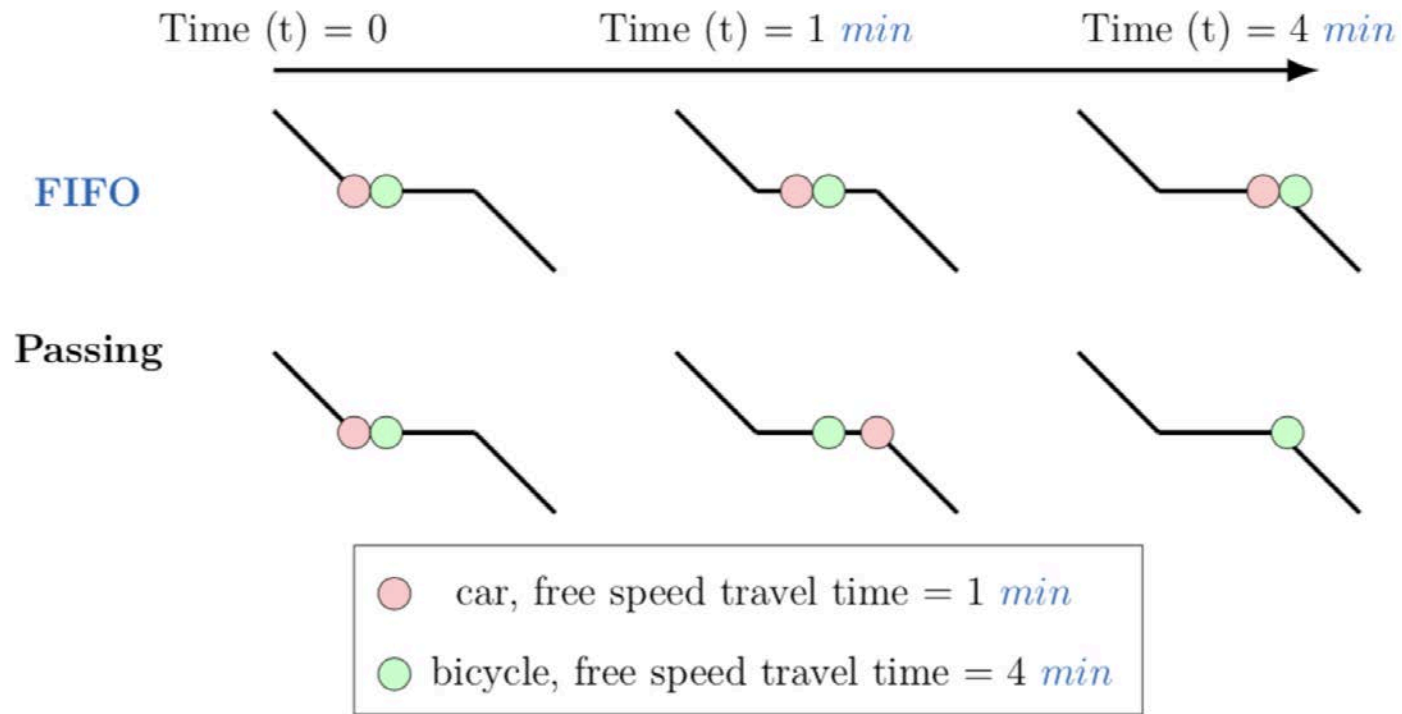
Slopes from EU-DEM

- European Digital Elevation Model
- Hybrid of
    - SRTM (Shuttle Radar Topography Mission, by NASA) and
    - ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer, also by NASA)
- Less artifacts than "pure" SRTM
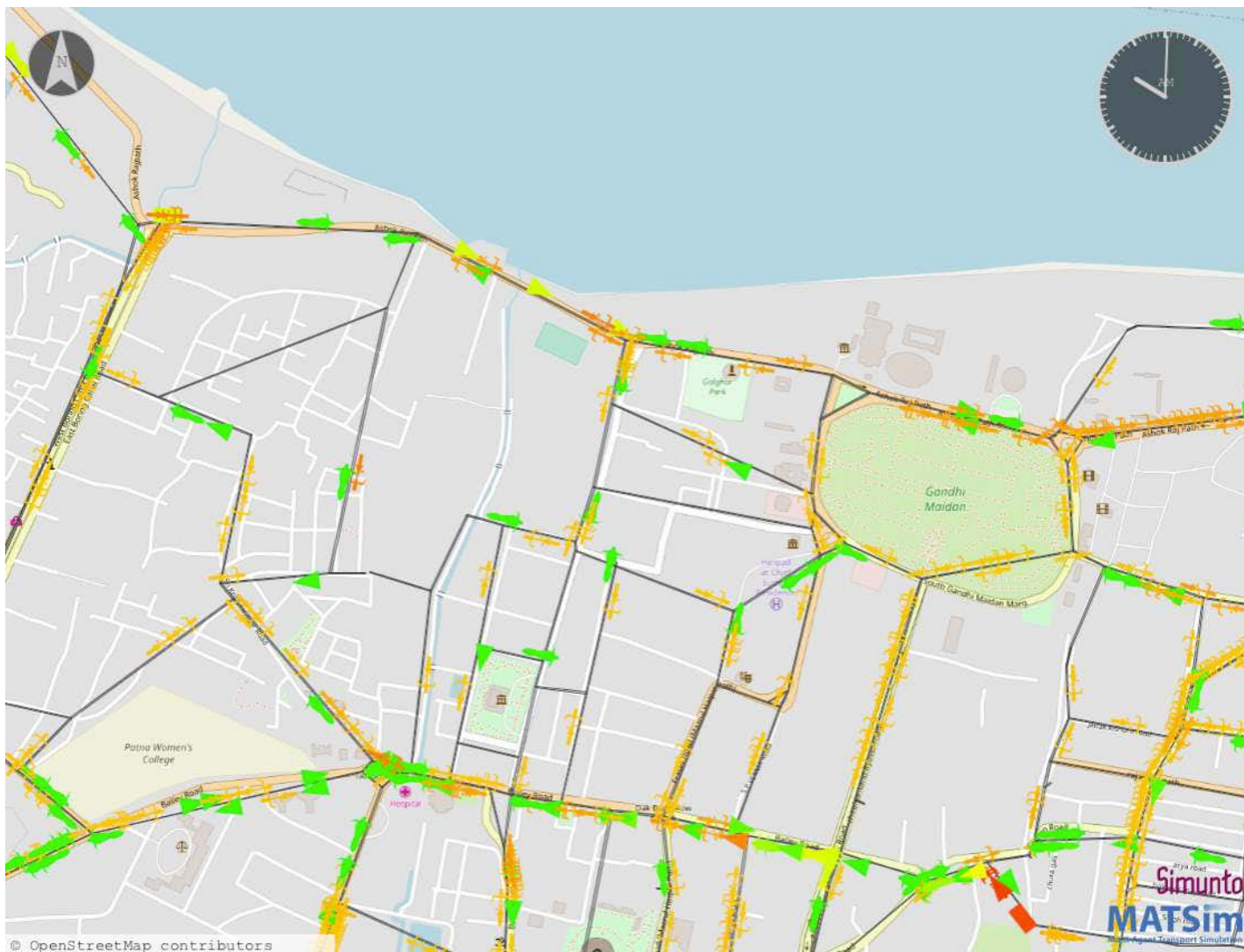- Free to download
- Resolution of 25m

Legende

☐ Bezirke
┌┄┐ Ortsteile
Höhen
- 32,59m
- 38,61m
- 44,63m
- 50,65m
- 56,67m

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Slopes from EU-DEM

Legende
- □ Bezirke
- ⋯ Ortsteile
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Passing

- PCU equivalent assigned to each vehicle type → Consume right flow and storage capacities
- Link queue data structure sorted based on the earliest link exit time → Allows passing

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www.matsim.org

Bicycle traffic in an agent-based transport simulation | D. Ziemke, A. Agarwal | ITM | Atlanta | 26 June 2018
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