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Modelling Parking Search Behaviour with an Agent-Based Approach

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Outline

- Motivation
- Example agent-based parking search model
- Challenges
- Proposed parking choice and search framework
- Current status of the work
- Conclusions

Motivation

- Parking supply and price have impact on e.g. mode and destination choice
- Can‘t model parking policy changes without it
- Search traffic can be substantial (average 30%, 16 cities, D. Shoup, 2007)
- Necessary for modelling the parking/charging demand by electric and plug-in hybrid electric vehicles

How is agent-based parking search modelled till now?

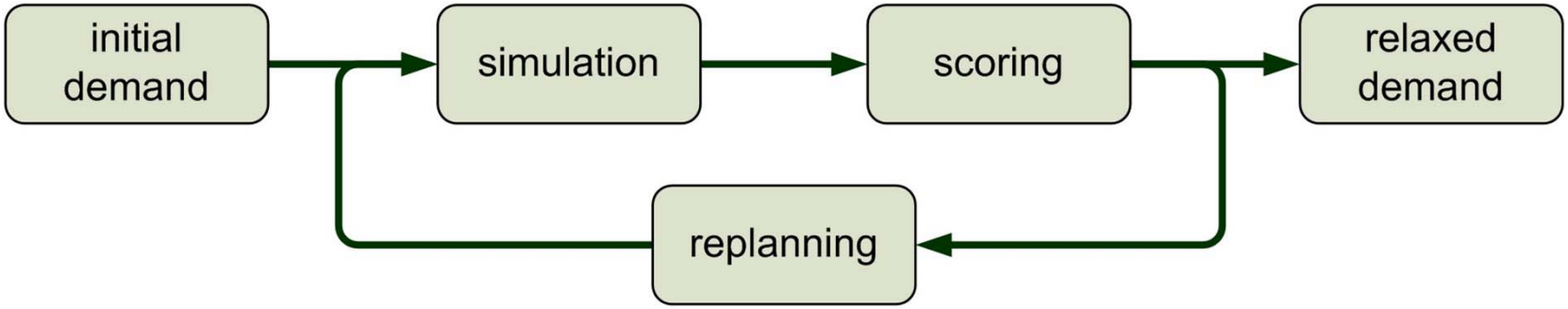
In Benenson *et al.* (2008) PARKAGENT is presented:

- residential parking
- agent’s enter simulation close to destination
- decision in each time step (park or not)
- take any parking, after destination link
- max. search time 10min: drive to closest off-street parking

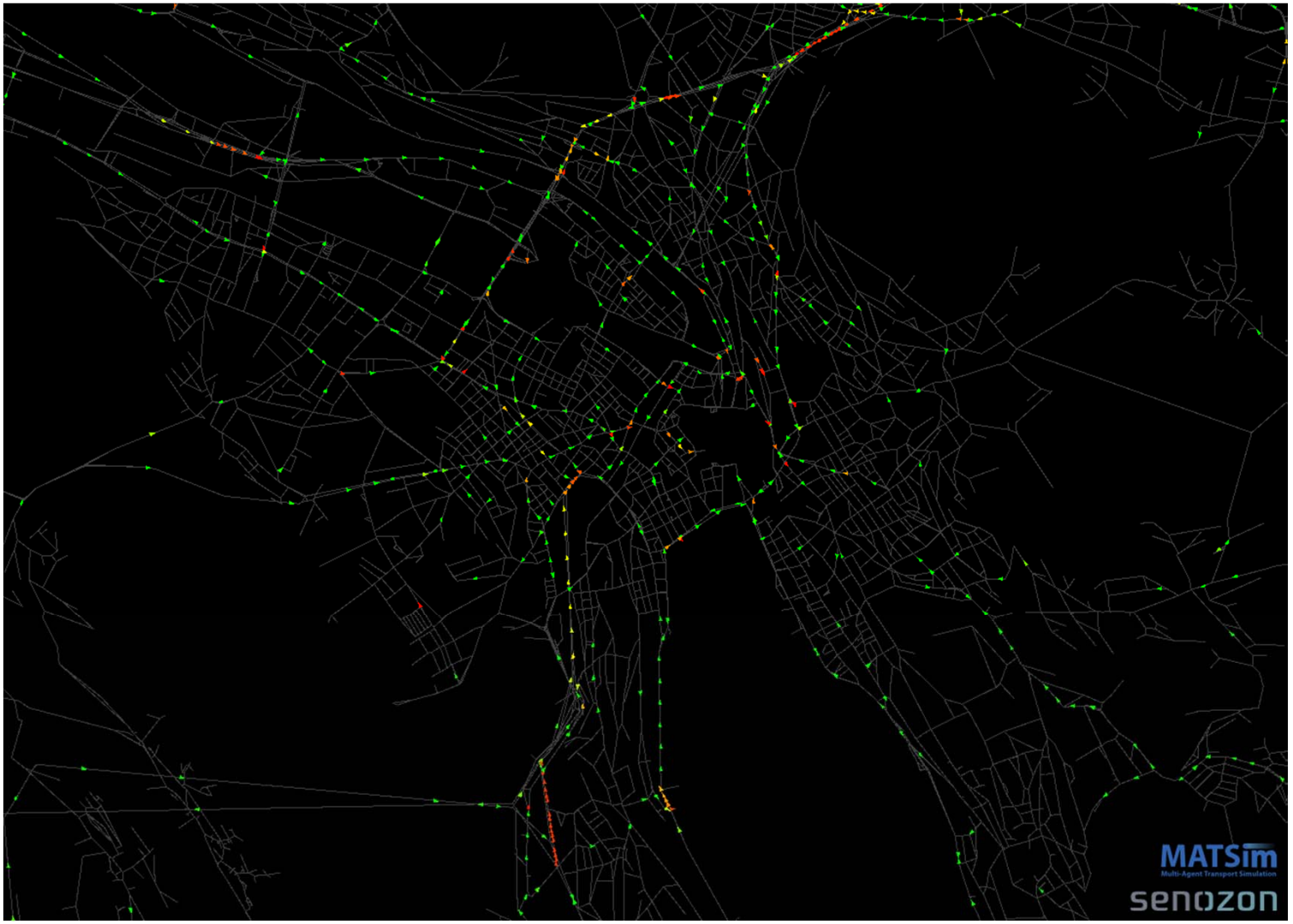
What are the challenges? What is missing?

- Treating off-street parking ALWAYS as a last resort
  - limited notion of agent‘s taste heterogeneity
  - over-estimation of parking search time
- No impact of parking shortage on mode or destination choice

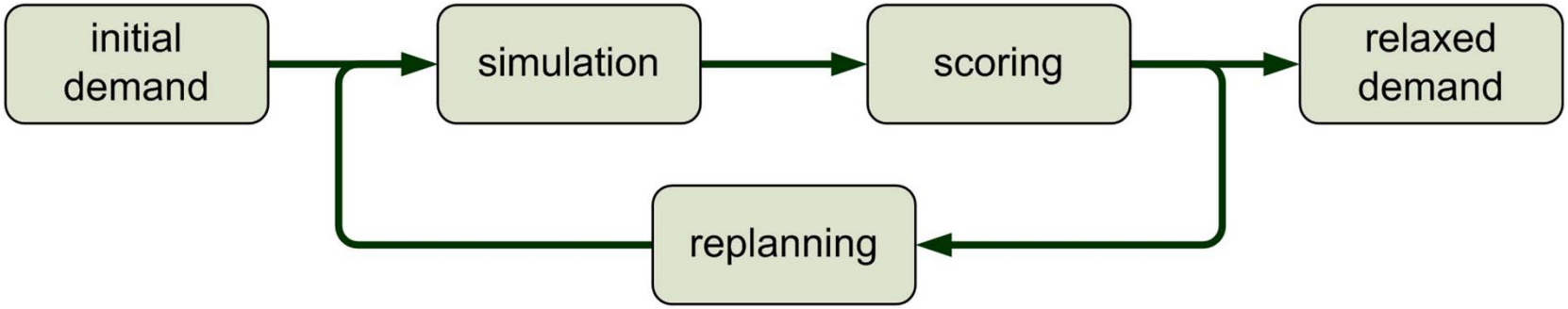
MATSim


initial demand
simulation
scoring
relaxed demand
replanning

Simulation



MATSim


initial demand
simulation
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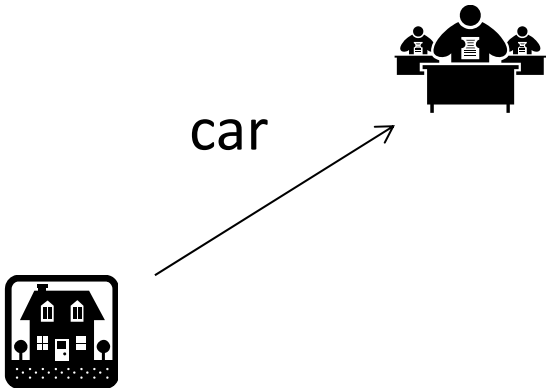
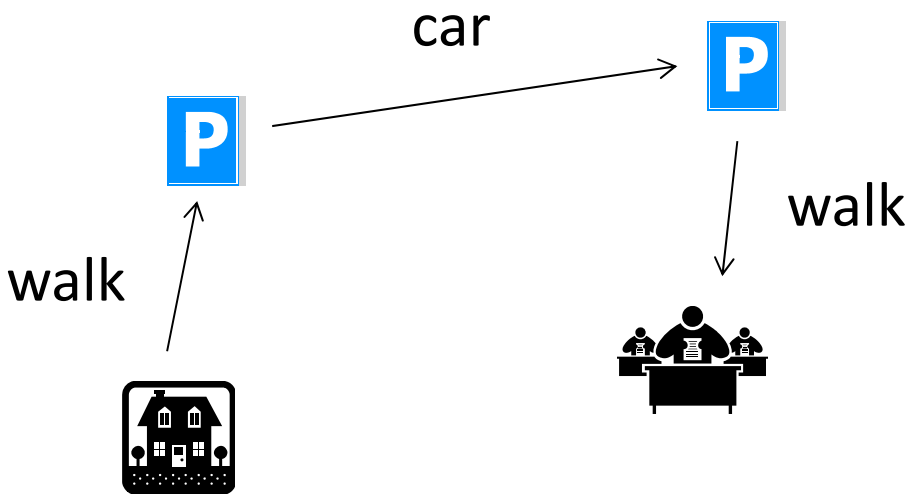
Current MATSim parking model

original MATSim plan



adding parking acts + walk legs



Multiple parking choices/strategies available

User defines, which agent can use which strategies at which activity. Example:

home: search for street parking (non-metered) - as agent has residence parking card for area close to home.

work: drive to parking provided by company - no parking search needed

shop: 4 parking strategies available:

- search for street parking only (free + metered)
- garage parking
- combined street parking search with last resort garage parking
- illegal parking

Utility Function

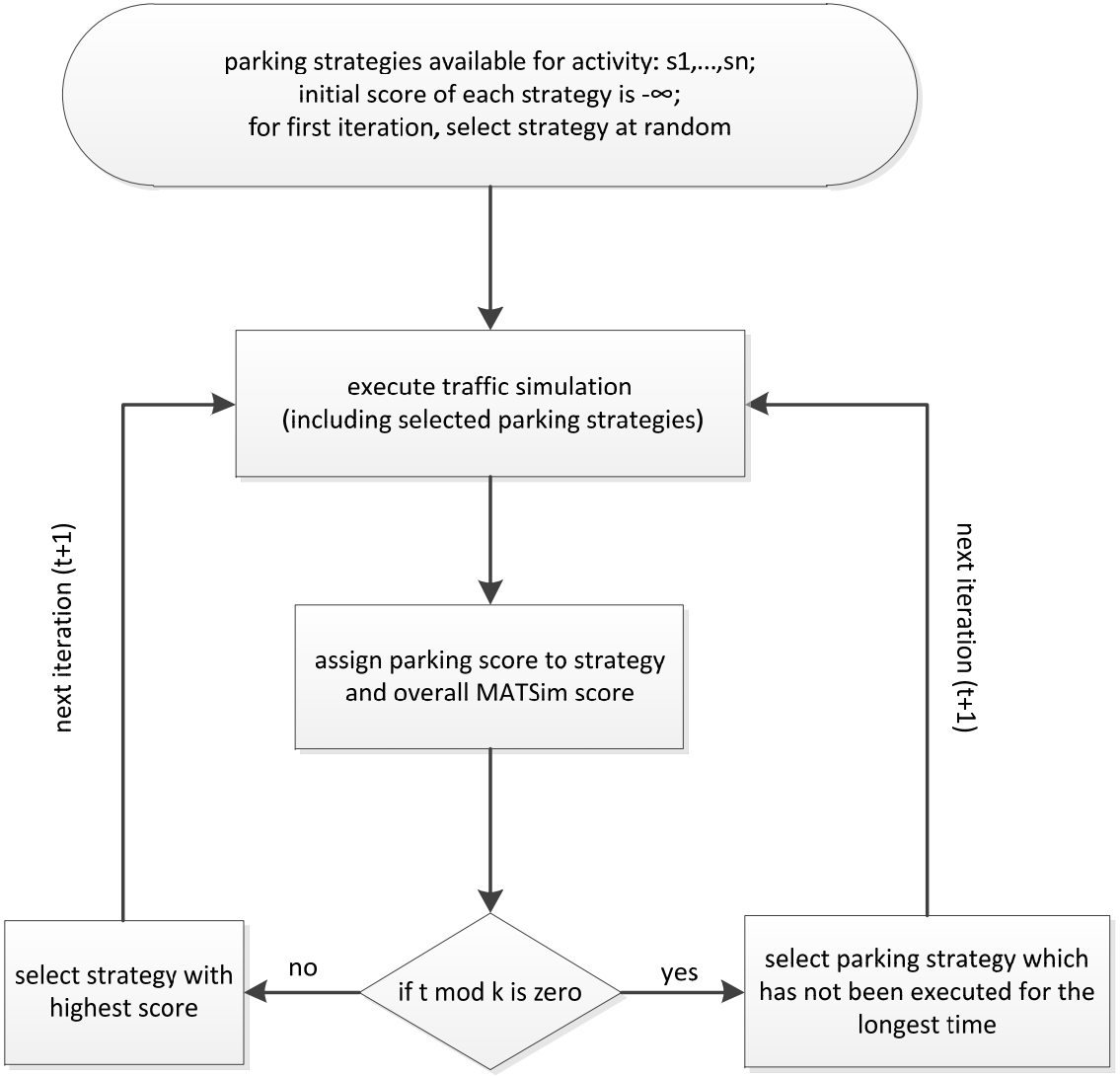
$$U_{parking,i} = U_{P_{cost},i} + U_{P_{searchTime},i} + U_{P_{walk},i} + \epsilon_i \quad (1)$$

$$U_{plan,i} = \sum U_{travelTime,i} + U_{travelCost,i} + U_{performActivity,i} \cdots + \sum \boldsymbol{U_{parking,i}} \qquad (2)$$

Requriements for parking strategy optimizaiton

- At end of simulation with high probability (>90%) optimal parking strategy selected
- Allow system to «relax» (similar condition to MATSim replanning).
- Periodic re-evaluation of parking strategy with «fresh/updated» environment

Parking strategy optimization algorithm



Policy change example

AT WORK

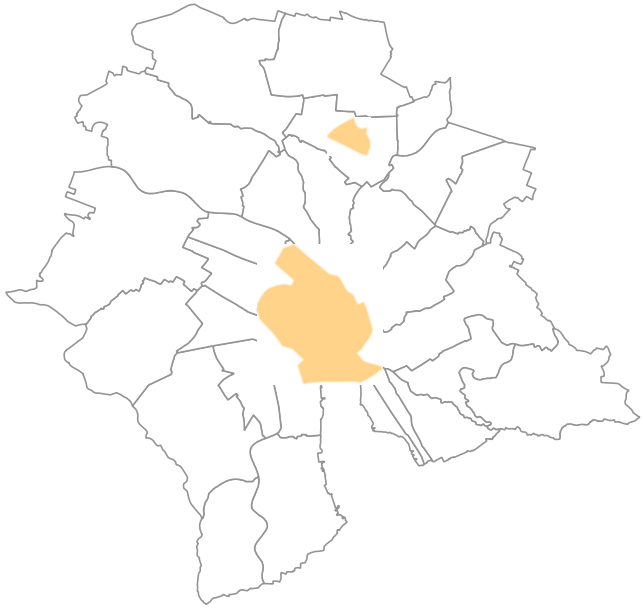
Current implementation status

- Framework implemented
  - optimal parking choice (all parking)
  - (private parking)
  - optimal garage parking
  - random parking search
  - in development: real parking strategies as reported

- Calibrating Zurich scenario

Zurich scenario

- Street parking tariff zones
- Parking garage prices
- Price structure
- Occupancy counts data



[Source: M. Oswald, 2012]

[Source: www.wikipedia.org]

Parking infrastructure supply model

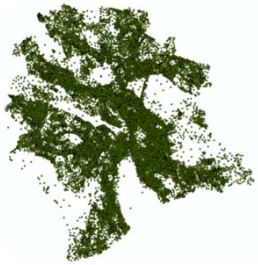
Public Parking

street parking (49’409)

garage parking (16’277)

Private Parking

Indoor (118’531)



Outdoor (82’781)

[Source: Parking counts from «Statistisches Jahrbuch der Stadt Zürich 2011»]

Scoring function

In C. Weiss et al. (2012) a stated choice survey was conducted and a model estimated for the influence of parking on location and mode choice:

Model estimated with following depends on:

- income
- age
- gender
- activity duration

Conclusions

- Optimization of multiple parking choices/strategies
  - avoiding systematic overestimation of parking search time
- Taking taste hetrogentiy into account
- Parking model has impact on mode and destination choice (and other MATSim replanning modules)

Future work:

- Implementing parking strategies
- Running on Zurich scenario

Questions?