An Agent-Based Parking Choice Model

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January 2012
Motivation: Electric and plug-in-hybrid electric vehicles

Hybrid Vehicles

Toyota Prius

Plug-in-Hybrid Electric Vehicles (PHEV)

Chevrolet Volt

Opel Ampera

Bigger batteries and el. plug added

[all figures from wikipedia.org]
Motivation: Modelling electricity demand

Scenario definition (e.g. population information, road network, charging plug available, charging power, charging technology, vehicle fleet composition, etc.)

Vehicle fleet energy consumption model (e.g. CV, EV, PHEV) → Agent-Based Traffic Simulation

Agent-Based Traffic Simulation → Power Network Simulation

Analysis (E.g. CO2 consumption, electricity consumption, etc.)

charging info (time, location) → energy consumption info (time, location) → info on bottlenecks

info on bottlenecks (feedback for policy change)
MATSim

initial demand → simulation → scoring → relaxed demand

replanning
A parking choice model (for MATSim)
Goals of the parking model

- Parking facilities/street parking have limited capacity (simulate occupancy)
- Trade-offs
  - Walking distance
  - Parking cost
  - Extendable to policy/scenario specific criteria, e.g. security aspects
- Modelling different types of parking (private, public, etc.)
- Parking choice vs. parking search
The parking choice model

Parking types
- Public parking
- Private parking
- Reserved parking
- Preferred parking

Utility function

\[ U_{parking} = \sum U_{walking} + U_{parkingCost} + \cdots \] (1)
Parking choice algorithm
Parking choice algorithm
Parking choice algorithm
Parking choice algorithm
Parking choice algorithm

-17
-5
-11
-20
-15
-12

P
P
P
P
P
P
Parking choice algorithm
Feedback to MATSim

Utility score of agent’s plan:

$$U_{plan} = \sum U_{travelTime} + U_{travelCost} + U_{performActivity} \cdots + \sum U_{parking}$$
Simulation scenario - Zurich

- Simulation: all of Zurich, 30km around the city centre
- 180’000 and 18’000 agents (10% resp. 1%)
- Modes: car, public transport, bike and walk
- 50 MATSim iterations
Parking infrastructure supply model

Public Parking

- street parking (49,409)
- garage parking (16,277)

Private Parking

- Indoor (118,531)
- Outdoor (82,781)

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

- Measured counts
- Iteration 50
- Iteration 0
Comparison: Simulation vs. traffic counts
Comparison: Simulation vs. traffic counts (cont.)

![Comparison Graphs](image-url)
Sensitivity analysis of the parking model

- Sensitive to changes in parking capacity/supply
- Sensitive to changes in price
- Walking distance distribution also plausible results
Sample parking policy

- Goal: reduce traffic on links with highest traffic volume during evening peak hours (16:00 to 19:00)
- Approach:
  - Identify high volume links (top 10%)
  - Identify agents traveling on these links
  - Identify activity location of previous and next activities
  - Identify clusters of activities
  - Reduce parking capacity in clusters by 30% resp. 100%
- Alternative goal:
  - Select not highest volume, but most congested links during peak hour
Sample parking policy - experiment

green: 30% reduction
blue: 100% reduction
Conclusions & future work

Conclusions
- Parking choice model
- Simulations with around 180’000 agents
- Can be used to design and test policy changes
- Improved simulation for electric vehicles

Future work
- Overall improvements
- Parking search
Questions?