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Modelling Parking Choice for MATSim in Zurich

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Simulating EVs/PHEVs in MATSim
Test scenarios

- Immediate Charging upon arrival
- Pricing time of use
- Smart charging
- Test Scenario with 16 agents
Zurich scenario

30km radius
Facilities (work, education, leisure, shops, etc.)
High resolution navigation network (1M links).
First test case

Only Home Charging

Electricity Demand

Time of day
Zurich scenario

Charging everywhere

Electricity Demand

Hub Number
Needed: A parking search model in MATSim

- Lot’s of literature available (Axhausen, Arnott, Polak, etc.)
- Technical problem: Interfaces missing for standardized way of integrating parking search into MATSim
- Christoph Dobler working on within-day replanning
Parking choice: Problem definition

For a given activity destination, select from the set of public parkings in the neighbourhood so that the agent’s utility is maximized?

Parking characteristics
- price
- walking distance
- capacity
- parking access
- parking type
- (Etc.)

Parking Choice (not Parking Search!)
No changes to the micro-simulation needed

till now

with parking

car

car

walk

walk
Parking location choice - implementation overview

- assign closest parking
- gathering parking related statistics during simulation
- add parking score to overall score
- allow agents to select new parking (avoid overcrowding)
Try to find parking with potentially higher score for the selected target activity (based parking statistics/estimates gathered during traffic simulation) in neighbourhood of target activity:

(2)

(5)

(8)

P

P

P

P

P

P

P

(the parking type choice also happens in this step)
Experiments and sensitivity analysis results

- Using small test scenario
- Run with one million agents on the test network tried out
Scenario layout (chess board)
Does system relax? How many iterations?
Relaxation measure 1: capacity violation reduction
Relaxation measure 2: walking distance
Scenario layout – grouping of parkings
Parking price and income

- Two groups: one with very high and one with very low income (50% of people belong to each group)
- Parkings close to home and work are MUCH more expensive than the parkings further away.
Parking supply
Don’t look at single agents!

- System is changing in each iteration (trying to optimize)
- Don’t look individual agents but on aggregate values!

- This means, that it may happen that isolated agents may have wrong parking behavior, but average behavior should be right

- Experiment
  - Enumerate agents from 1 to 99 and each agent departs one minute ahead of time than the next agent
  - This means that there is a clear temporal advantage towards the parking for agents departing earlier
  - Even though this advantage can get lost (e.g. agent 32 may get a worse parking than agent 33)
  - Aggregated statistics should be right!
Temporal aggregated advantage

Extending and rethinking the model

- Private parking model missing
- Reserved parkings, e.g. for disabled people/ EVs/car sharing
- Requires changes to the plan structure (integration more difficult/combination with other replanning modes needed)
  - A more generic model needed.
The new parking model

- Available free parkings
- Distance (walking time)
- Price
- Access time
- Search time

Also have to define a format for the different attributes for the different attributes for the parkings.
Parking location choice - implementation overview

Select best parking according to utility function and simulate parking selection

Score the selected parking

Add foot legs and parking acts to events file.

No replanning needed (as this is performed during the simulation and no overcrowding possible)
Adding foot legs and correct activity durations

Peforming activity (e.g. home, work, shop, etc.)

Adding foot legs (in post processing)

travel by car

Peforming activity (e.g. home, work, shop, etc.)

travel by car

car access + parking search time

car access time

travel between parking and activity location by foot
Updated scoring function

- Consider all parkings, in range $\max \text{SearchDistanceInMeters}$ from the destination.
- Score as follows and rank them:

$$
\phi_{act\,Perf\,Earning\,Rate} = \frac{\sum_i U_{act,i} \left[\frac{\text{util}}{s}\right]}{\sum_i \text{dur}_{act,i}} , \forall i \in \text{act}
$$

$$
cost_{\text{parking}} = \int_{\text{parkArr}}^{\text{parkDep}} f_{\text{parking\,Price}}(t) \left[\text{util}\right]
$$

$$
U_{\text{parking}} = -\phi \times (t_{\text{walkToPark}} + t_{\text{parkAccess}}) + t_{\text{parkSearchTime}}) \times \phi_{act\,Perf\,Earning\,Rate} - U_{\text{cost\,Parking}} \left[\text{util}\right]
$$

$\phi$: $\text{walkingScoreUtilityFactor}$ (for calibration)
Private parkings

- Assign private parkings not only to specific facilities but assign them to specific activities (inside facilities), as typically there are several activities possible in the same building like home, work, shop, etc.
Parking data for Zurich

Public Parkings

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

Private Parkings

- indoor (118,531)
- outdoor (82,781)

(Parking counts from «Statistisches Jahrbuch der Stadt Zürich 2011»)
Private Parking Initial Demand City ZH

**actTypes**

- home
- work_sector3
- work_sector2
- Shop
- Leisure (from general distribution)

**Main Usage of Building (to which the parking belongs to):**

- Wohnen
- Büro
- Lager
- Produktion
- Verkauf

**Ignore (assign no private parkings)**

- education_secondary
- education_kindergarten
- education_primary
- education_higher
- education_other

**General distribution (proportionally to facility capacity):**

- Zu bestimmen
- Gemischte Nutzung
- Parkierung
- Sondernutzung
- Nicht nutzbar
Garage parkings occupancy data

-Detailed occupancy data counts for 68 parkings

Integrating the Parking Module

- New Zurich Scenario (pt simulation, freight, etc.)
- Capacity constraints (trying to minimize walking distance – alternatives: mode choice, time mutator, route choice).
- Income + price
Conclusions

- Some progress at the parking modelling front in MATSim
- But, still work to do...

Future work:
- Performance?
Questions?