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Modelling Parking Choice for MATSim in Zurich

Rashid A. Waraich

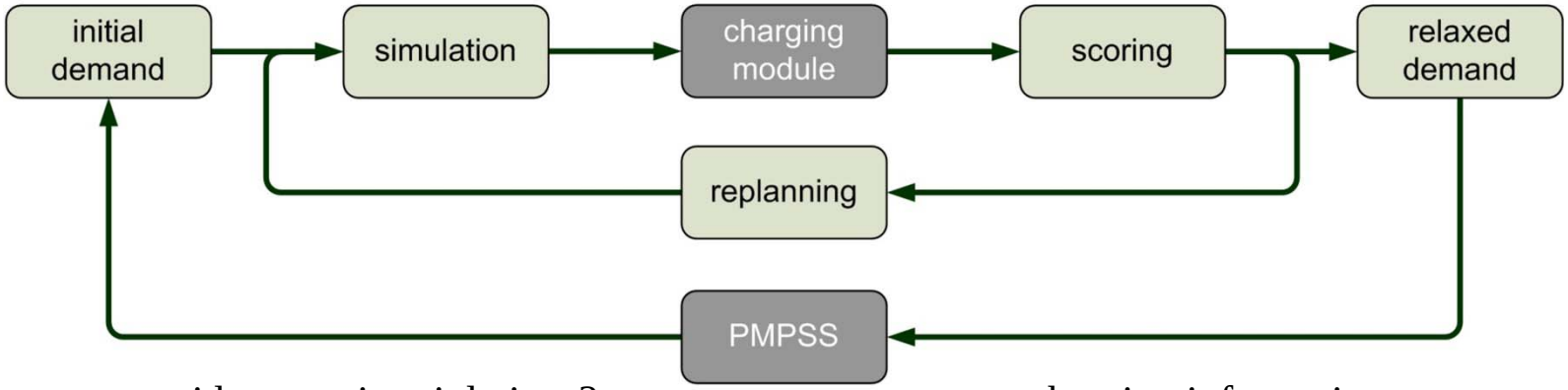
IVT
ETH
Zurich

July 2011

Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

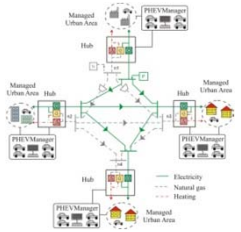
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Simulating EVs/PHEVs in MATSim



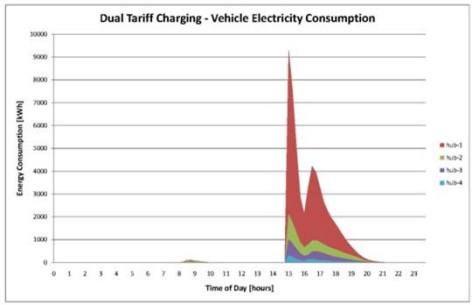
grid constraint violations?

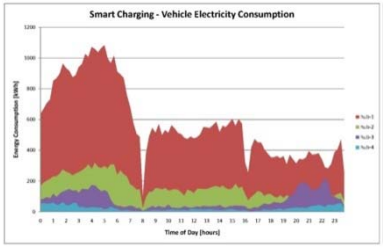
charging information

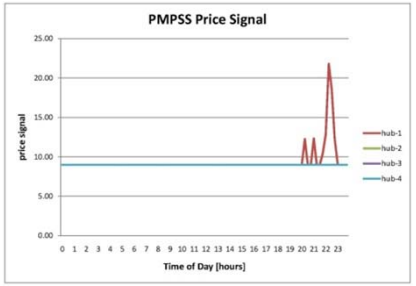


Test scenarios

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







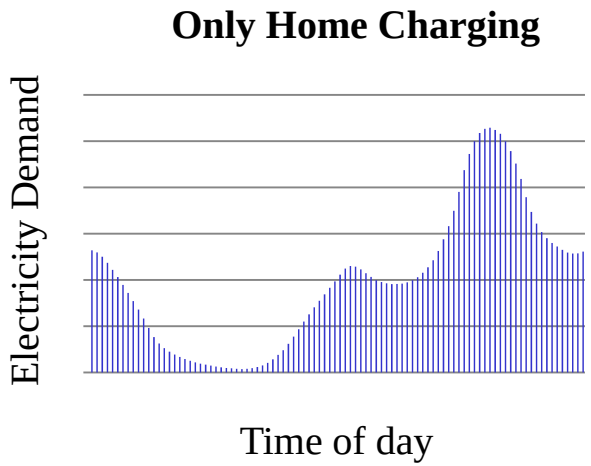
Zurich scenario

30km radius

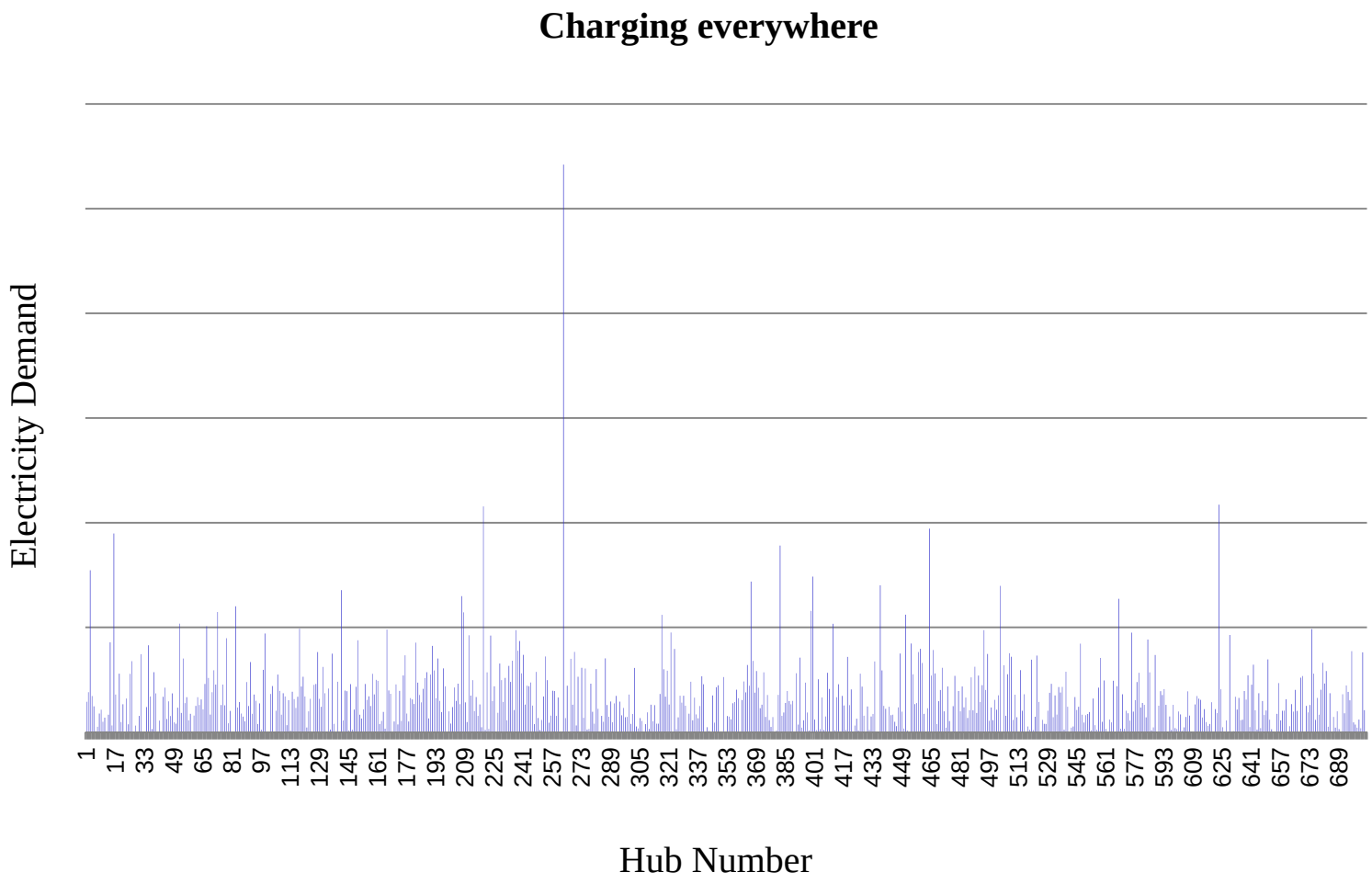
Facilities (work, education, leisure, shops, etc.)

High resolution navigation network (1M links).

First test case



Zurich scenario



Needed: A parking search model in MATSim

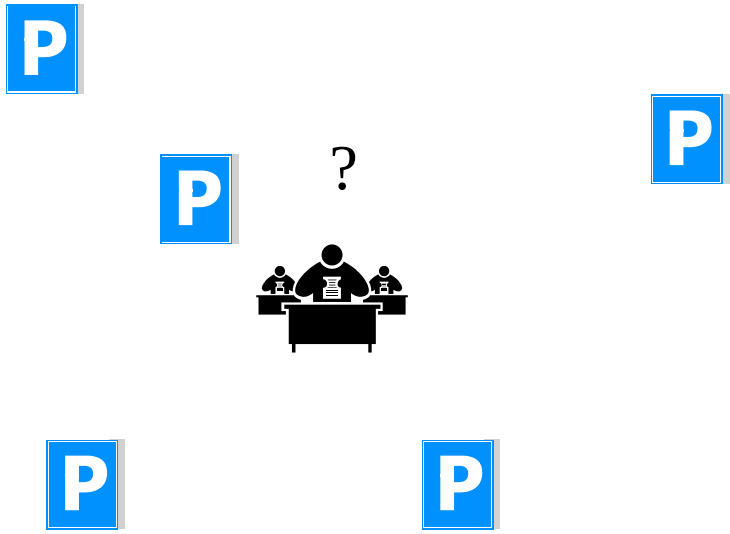
- Lot’s of literature available (Axhausen, Arnott, Polak, etc.)
- Technical problem: Interfaces missing for standardized way of integrating parking search into MATSim
- Christoph Dobler working on within-day replanning

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

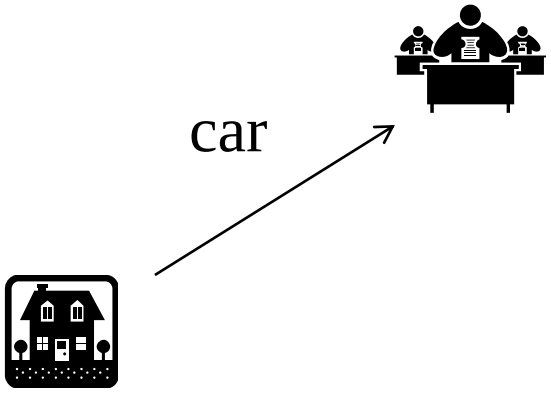
- price
- walking distance
- capacity
- parking access
- parking type
- (Etc.)



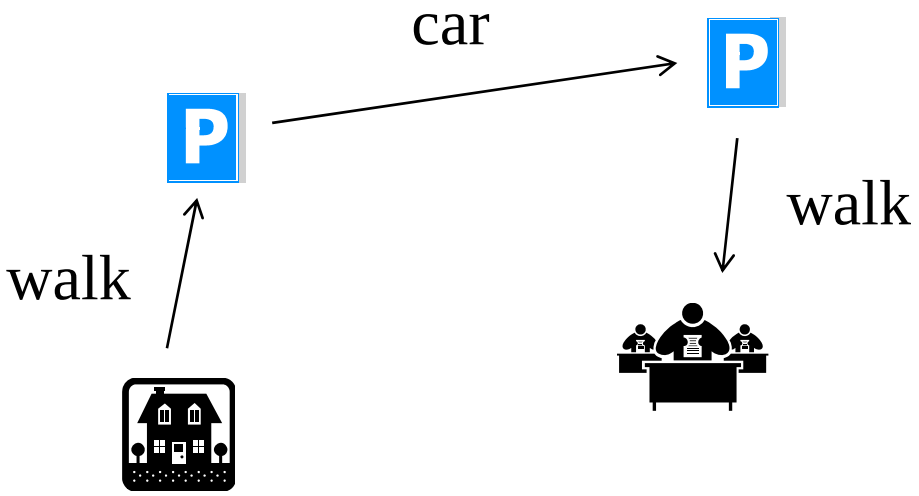
Parking Choice (not Parking Search!)

No changes to the micro-simulation needed

till now



with parking

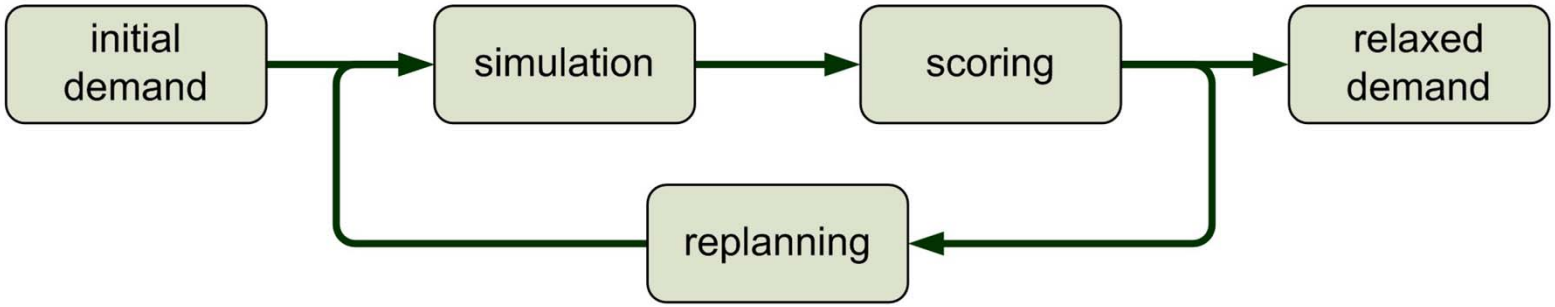


Parking location choice - implementation overview

assign closest parking

gathering parking related statistics during simulation

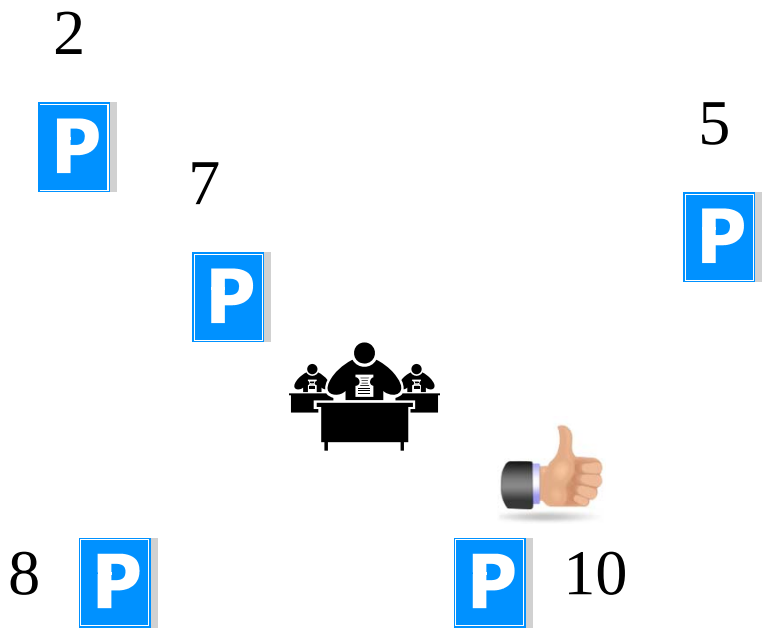
add parking score to overall score



allow agents to select new parking (avoid overcrowding)

Parking location choice – replanning (cont.)

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:

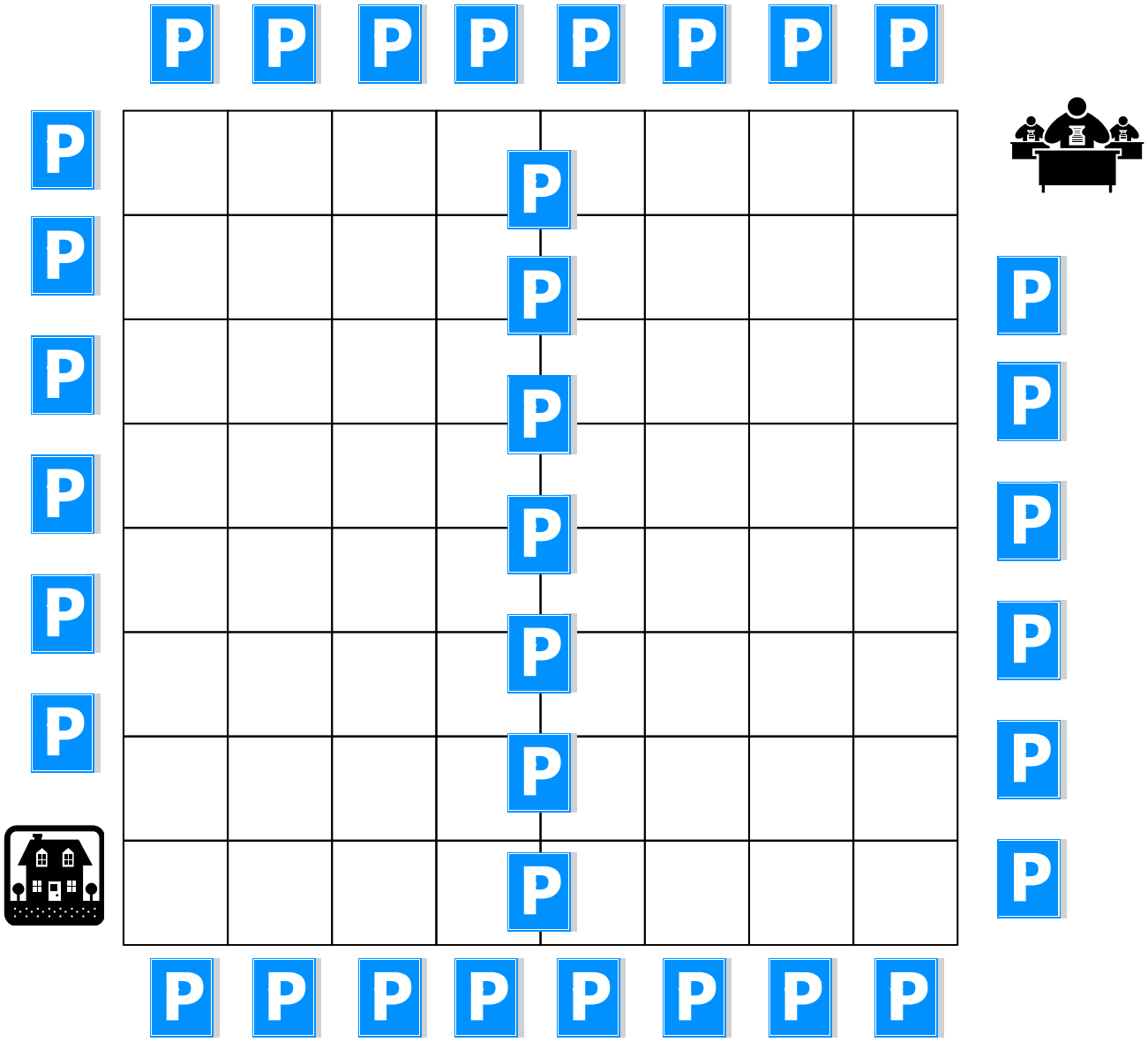


(the parking type choice also happens in this step)

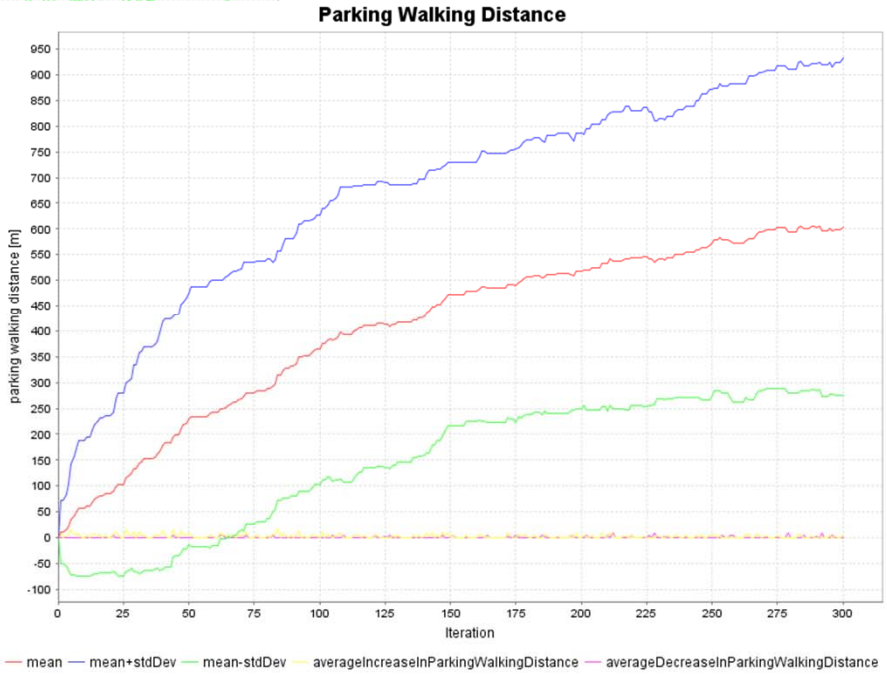
Experiments and sensitivity analysis results

- Using small test scenario
- Run with one million agents on the test network tried out

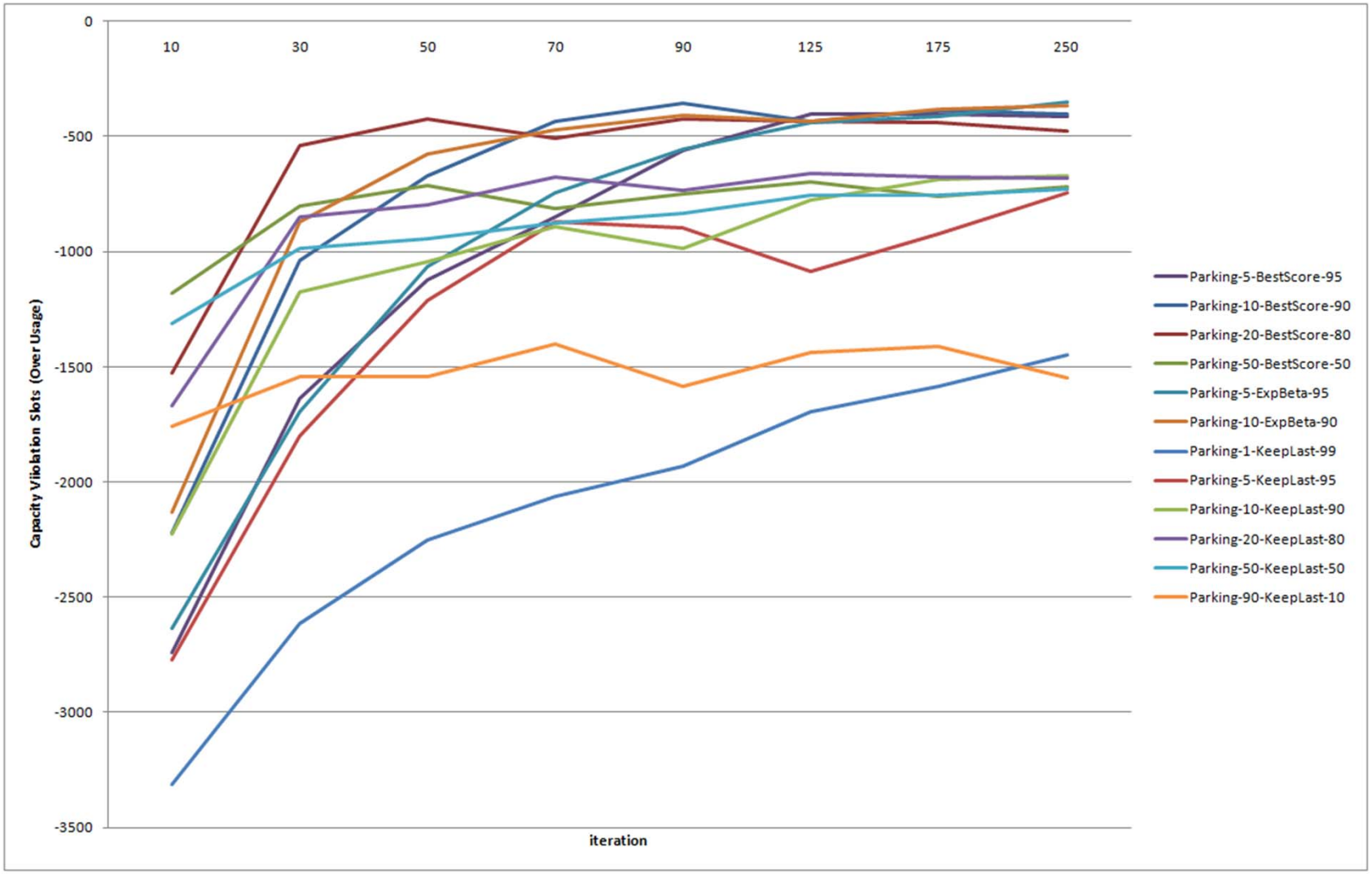
Scenario layout (chess board)



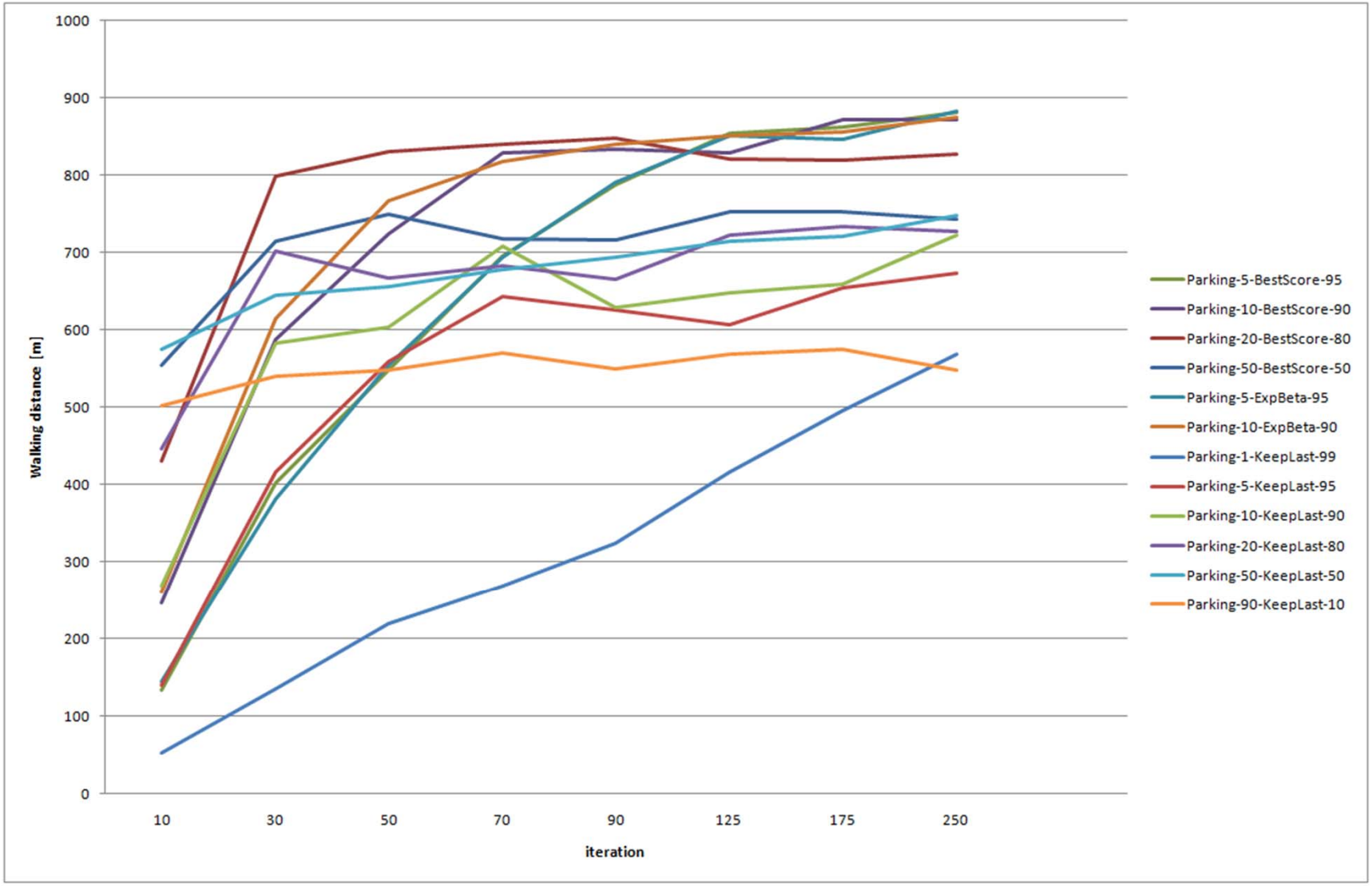
Does system relax? How many iterations?



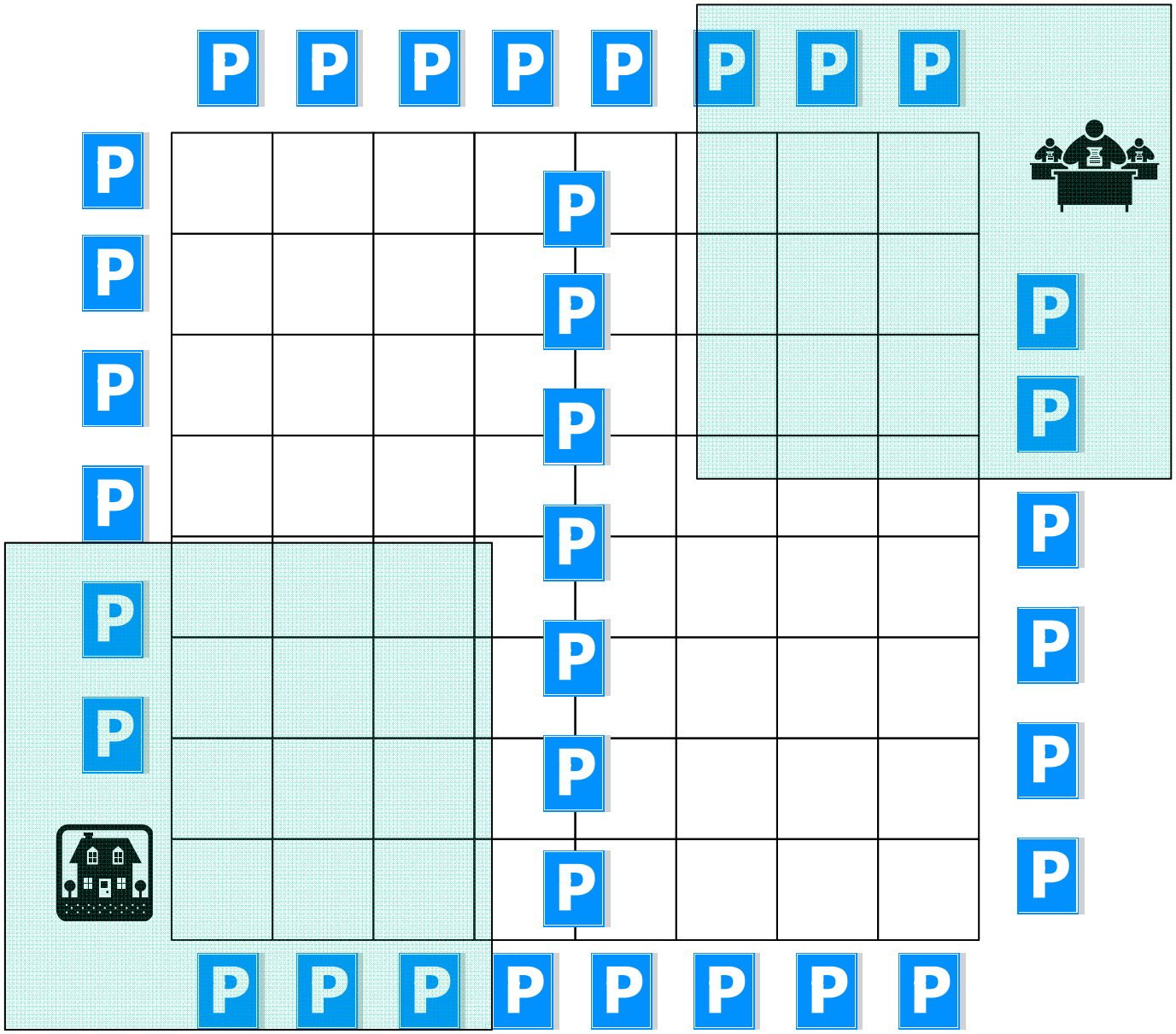
Relaxation measure 1: capacity violation reduction



Relaxation measure 2: walking distance

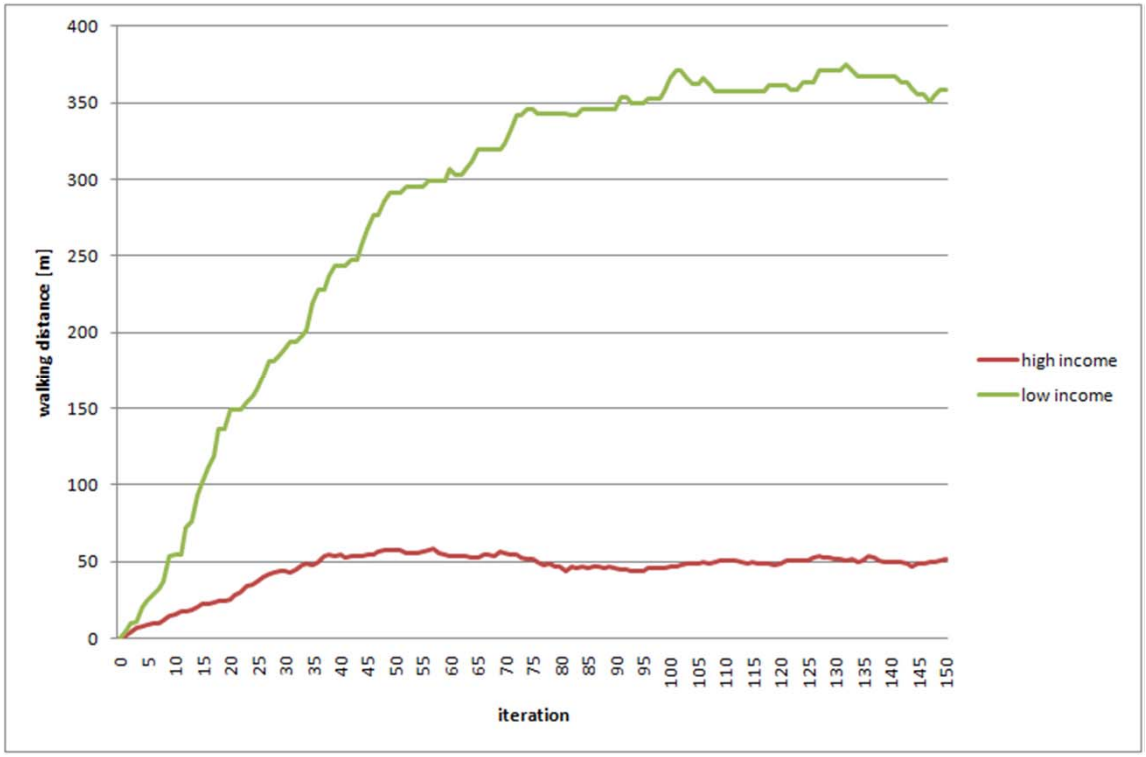


Scenario layout – grouping of parkings

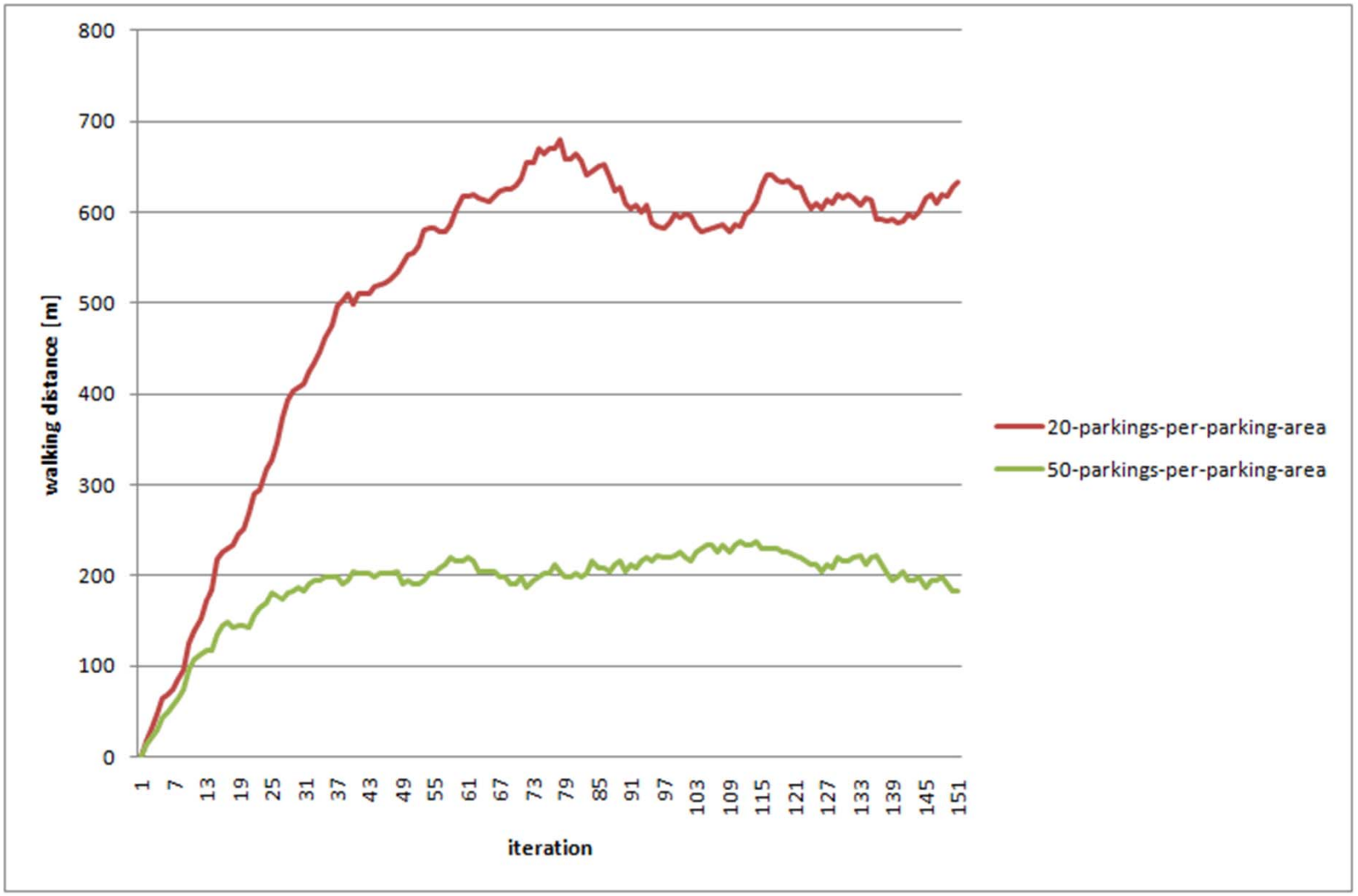


Parking price and income

- 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!

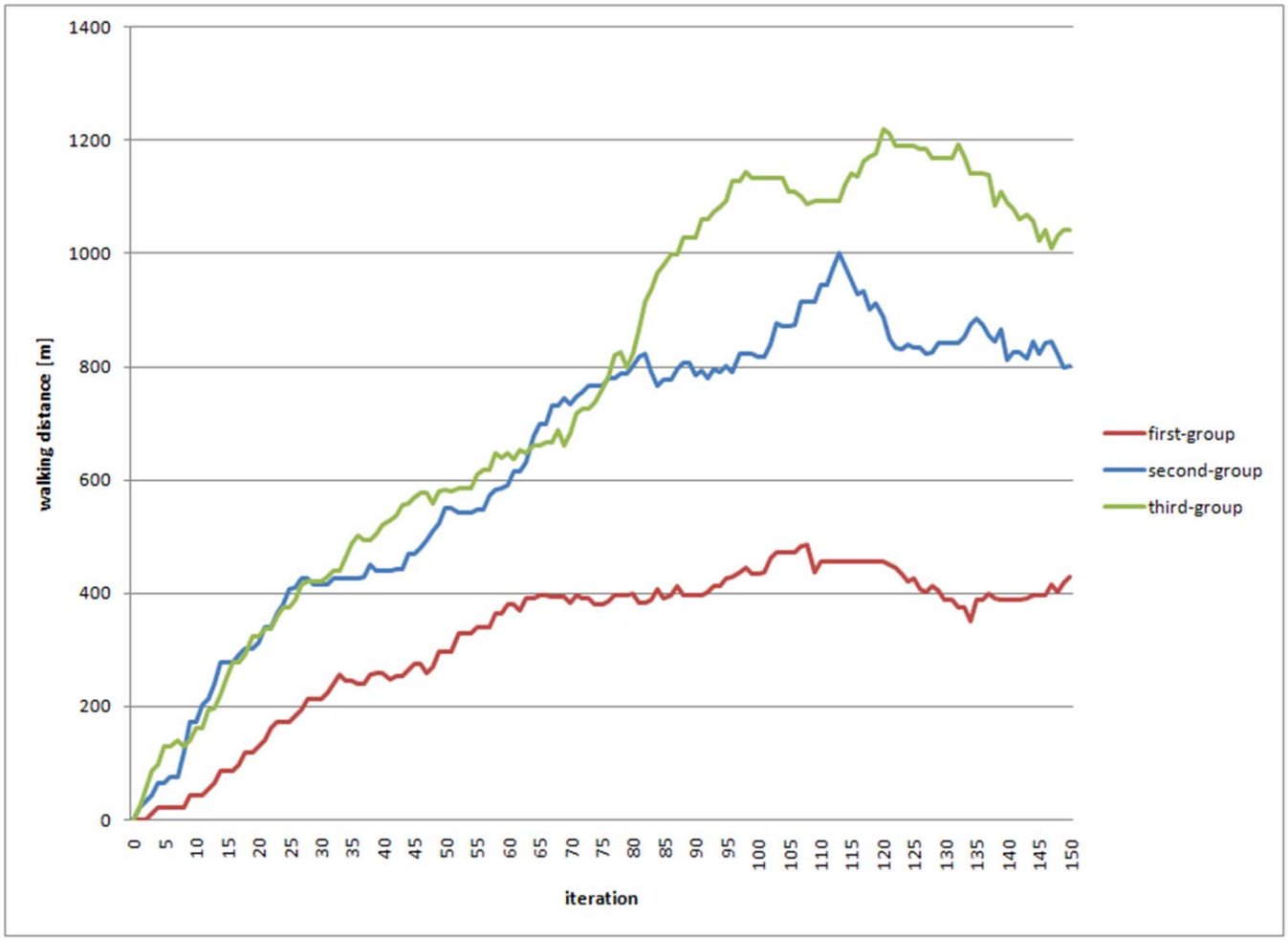
- System is changing in each iteration (trying to optimize)
- Don’t look individual agents but on aggregate values!

- 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

First-group: 1-33, second-group: 34-66, third-group: 67-99

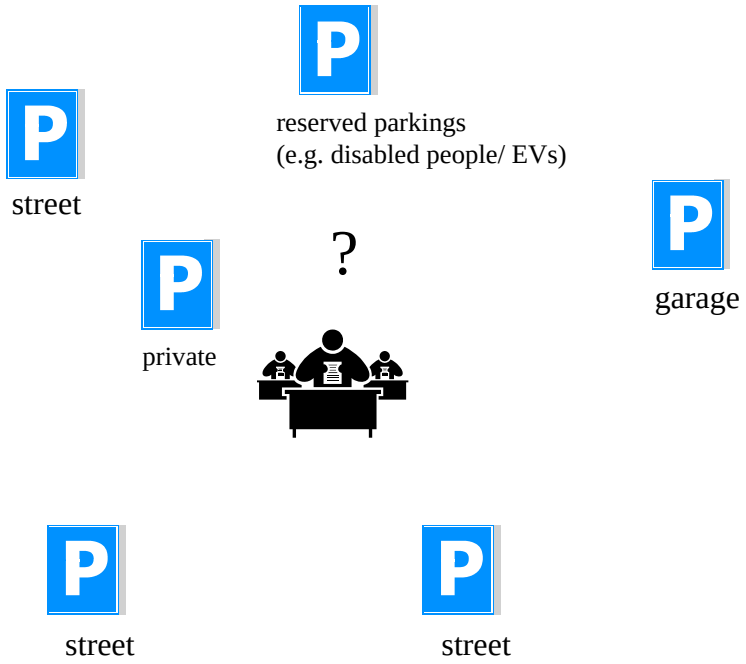


Extending and rethinking the model

- 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.

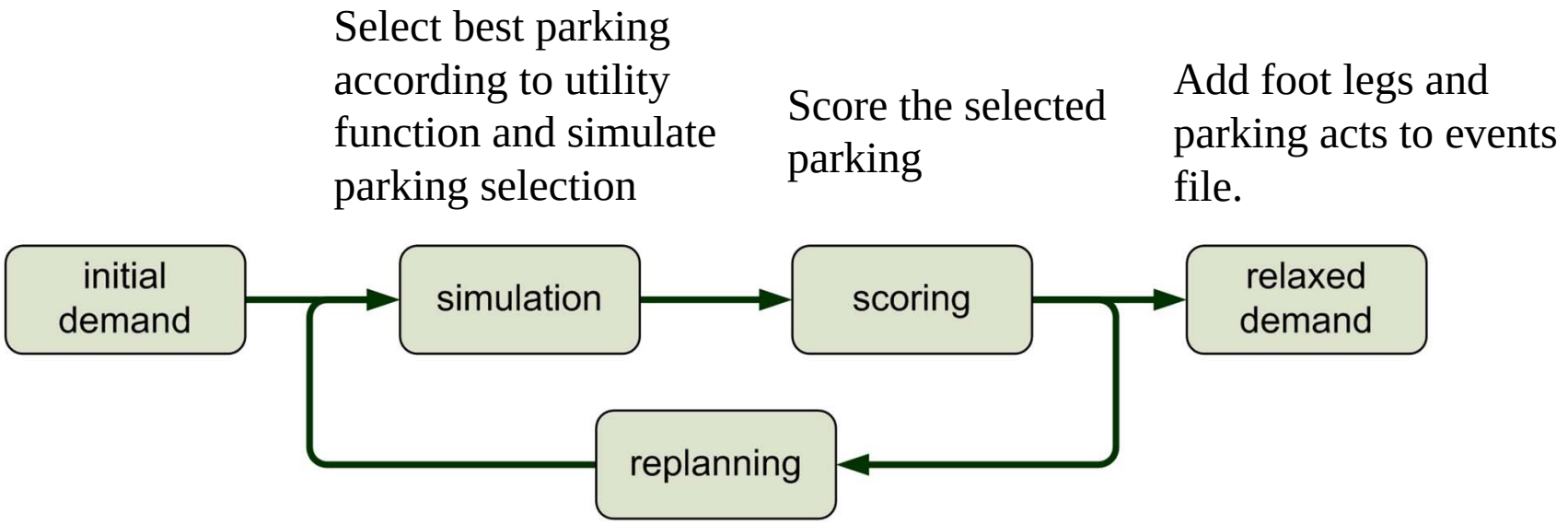
The new parking model

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



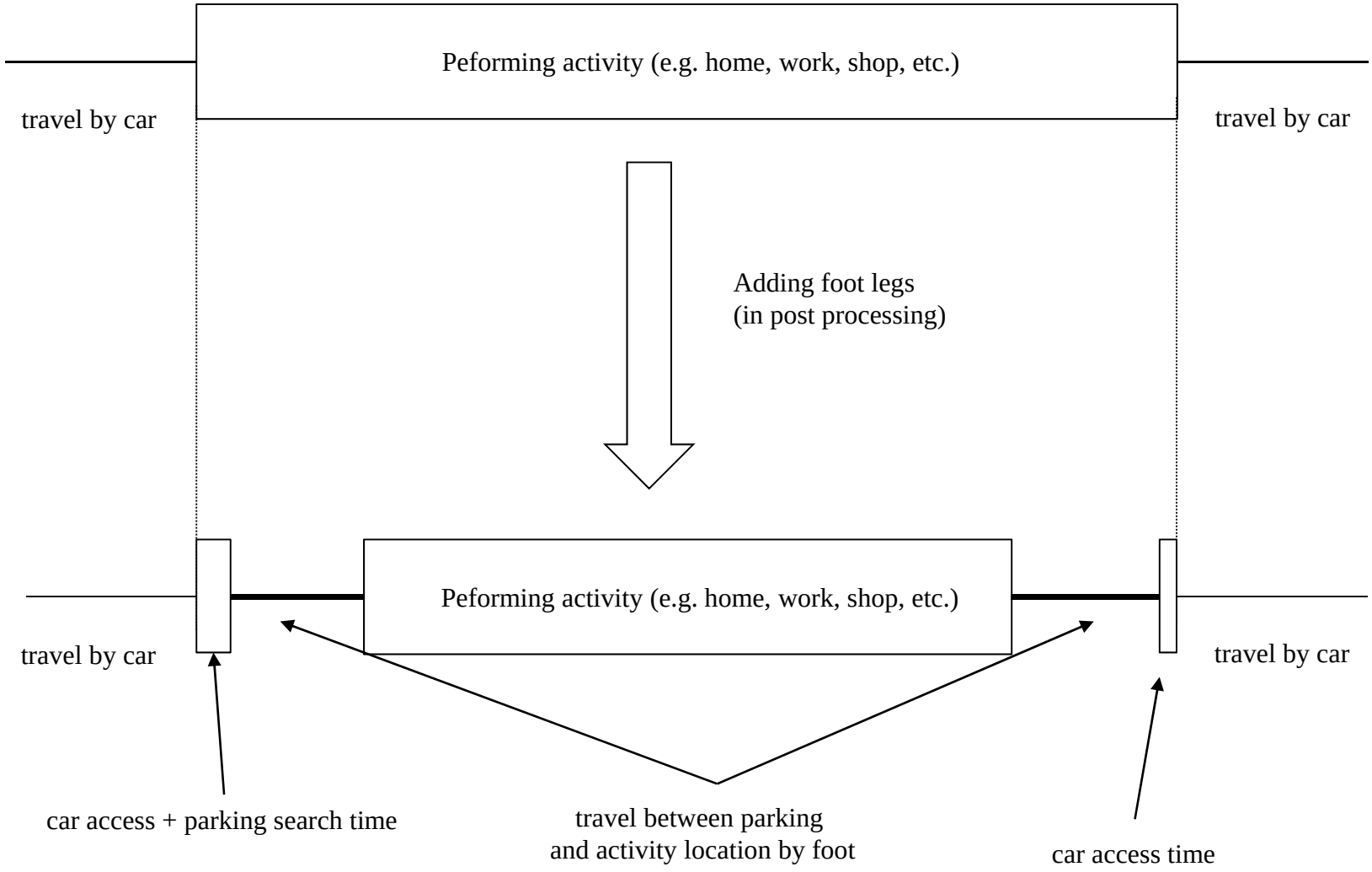
Also have to define a format for the different attributes for the different attributes for the parkings.

Parking location choice - implementation overview



No replanning needed (as this is performed during the simulation and no overcrowding possible)

Adding foot legs and correct activity durations



Updated scoring function

- Consider all parkings, in range *max*SearchDistanceInMeters from the destination.
- Score as follows and rank them:

$$\emptyset_{actPerfEarningRate} = \frac{\sum_i U_{act,i}}{\sum_i dur_{act,i}} \left[\frac{util}{s}\right], \forall i \in act$$

$$cost_{parking} = \int_{parkArr}^{parkDep} f_{parkingPrice}(t)\,[util]$$

$$\boldsymbol{U_{parking} = -\left(\varphi \times \left(t_{walkToPark} + t_{parkAccess}\right) + t_{parkSearchTime}\right) \times \emptyset_{actPerfEarningRate} - U_{costParking}\,[util]}$$

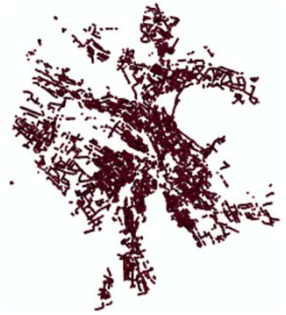
φ: *walkingScoreUtilityFactor (for calibration)*

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

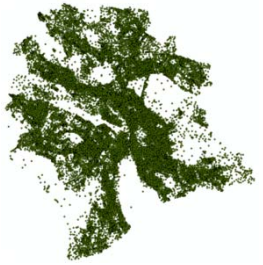


street parkings (49’409)

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)

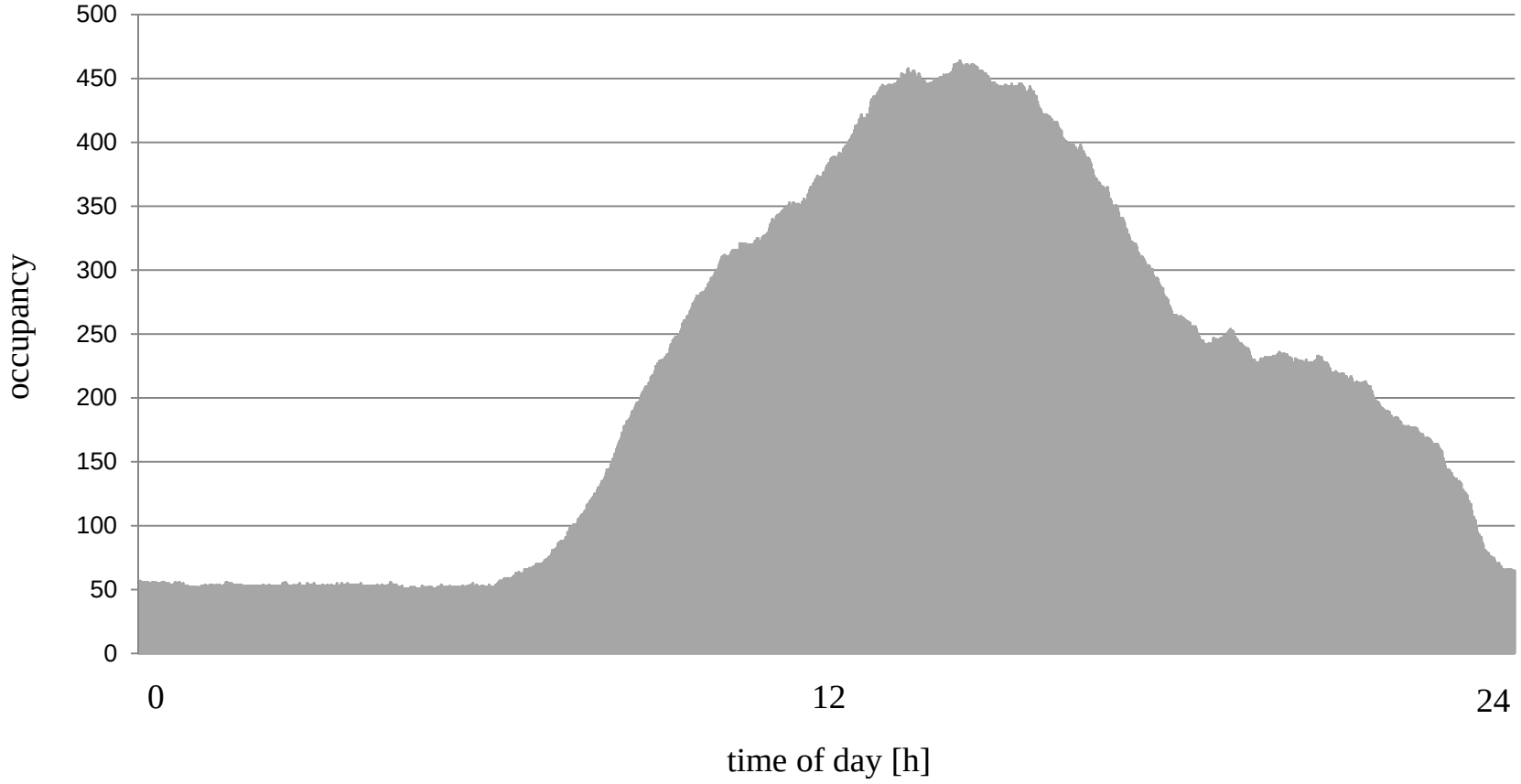
Ignore (assign no private parkings)
education_secondary
education_kindergarten
education_primary
education_higher
education_other

Main Usage of Building (to which the parking belongs to):
Wohnen
Büro
Lager
Produktion
Verkauf

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



Occupancy on Wednesday, 9th March 2011, City Parking / Gessnerallee 14, Zürich). Max. Occupancy: 620. From www.pls-zh.ch

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?