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Computational Algorithms and Procedures for Integrated Micro-Simulation Models

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December 2009

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Computational Challenges for Integrated Micro-Simulation Models

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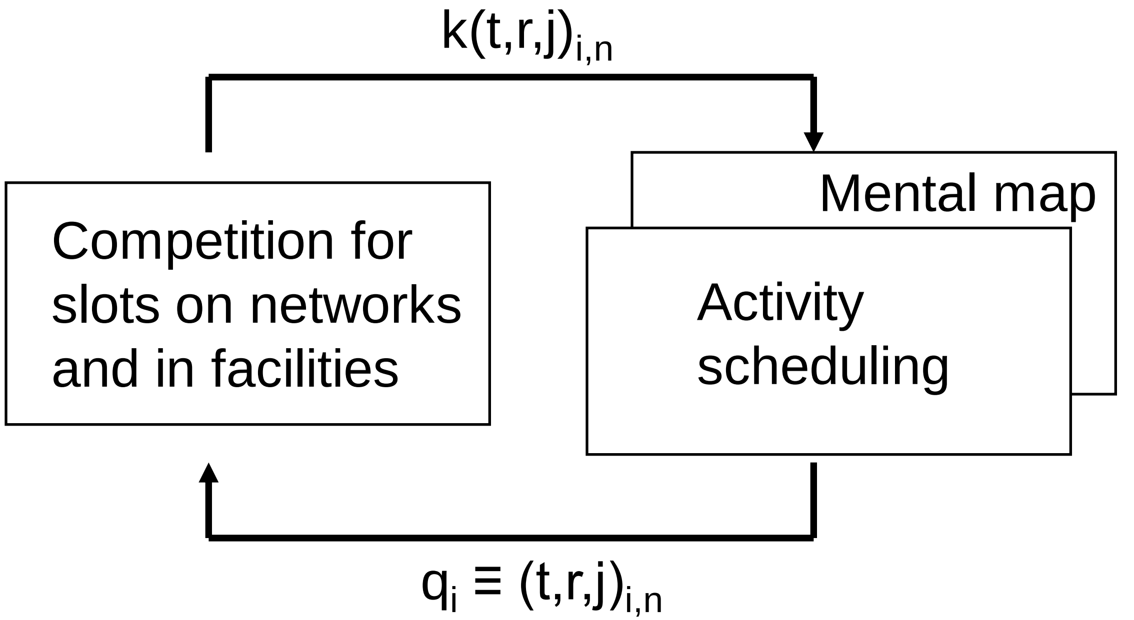
Overall learning approach



Traffic flow simulation requirements

- Disaggregate simulation of car traffic
  - Detailed parking facilities
  - Detailed recharging facilities for electric vehicles
- Disaggregate simulation of public transport
- Disaggregate simulation of cyclists
- Disaggregate simulation of pedestrians

Activity scheduling

- Number and type of activities
- Sequence of activities
  - Start and duration of activity
  - Composition of the group undertaking the activity
  - Expenditure division
  - Location of the activity
    - Connection between sequential locations
      - Location of access and egress from the mean of transport
        - Parking type
      - Vehicle/means of transport
      - Route/service
      - Group travelling together
      - Expenditure division

Long(er) term choices

- Social network geography
- Social commitments
- Occupation

  - Work location
  - School location
  - Home location

    - Mobility tools
    - Discount cards
    - Season tickets
    - Vehicles (by body type, fuel, energy efficiency)

Challenges 1

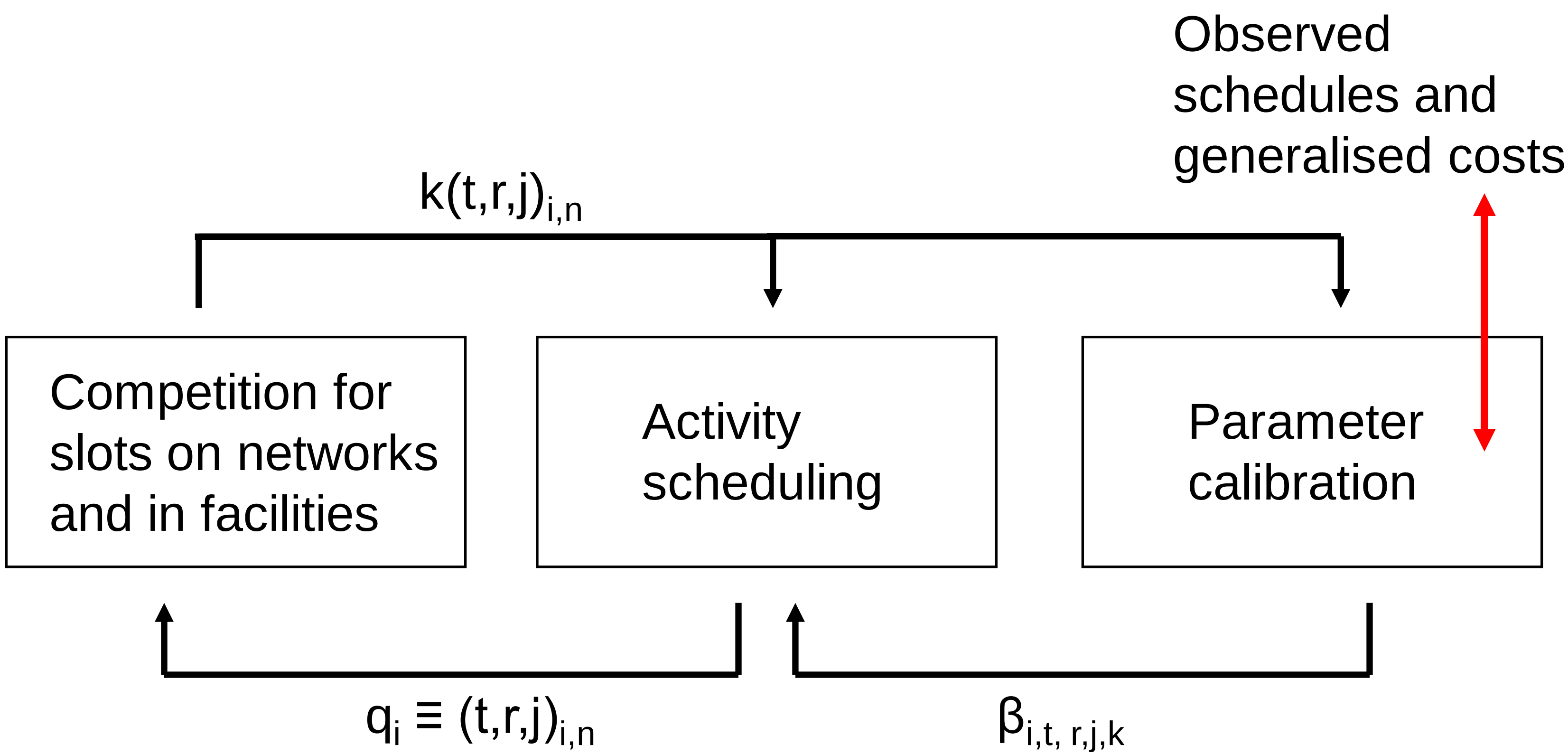
How to find the equilibrium ?

The point in the joint search space, when no agent can unilaterally improve its situation by changing its behaviour

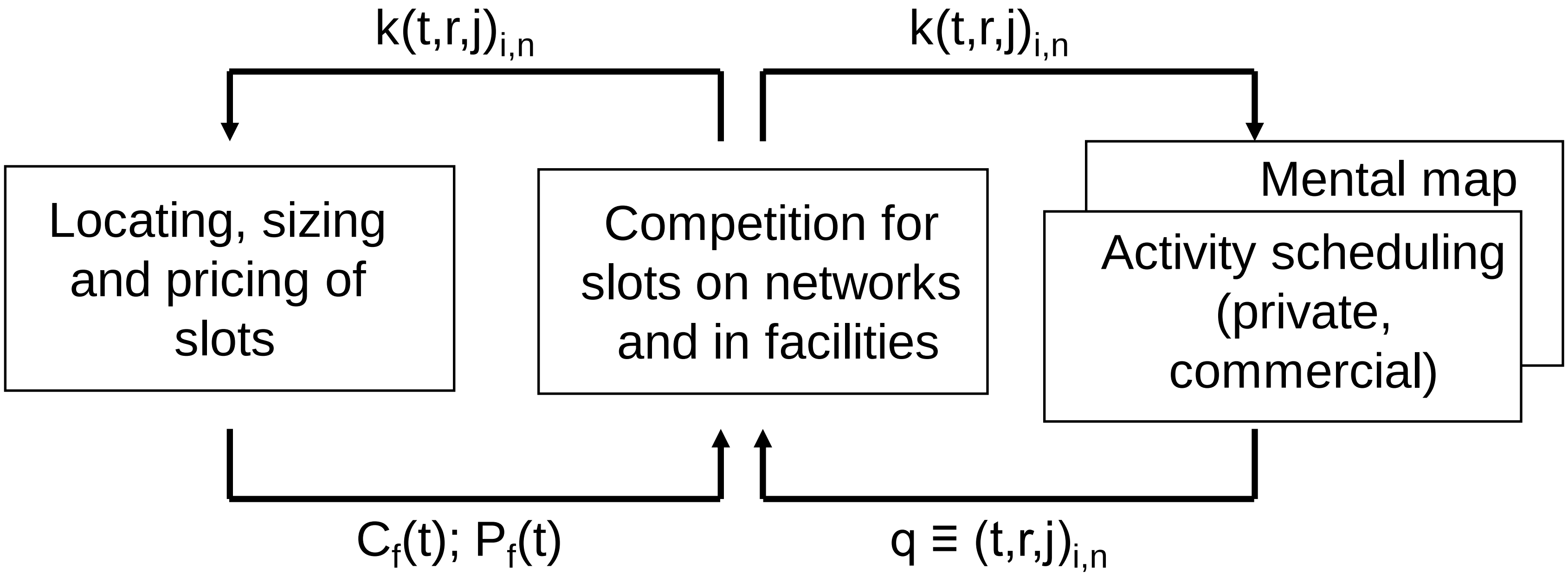
How to find it fast enough to be useful ?

Claim: The overnight policy run is fast enough (for now)

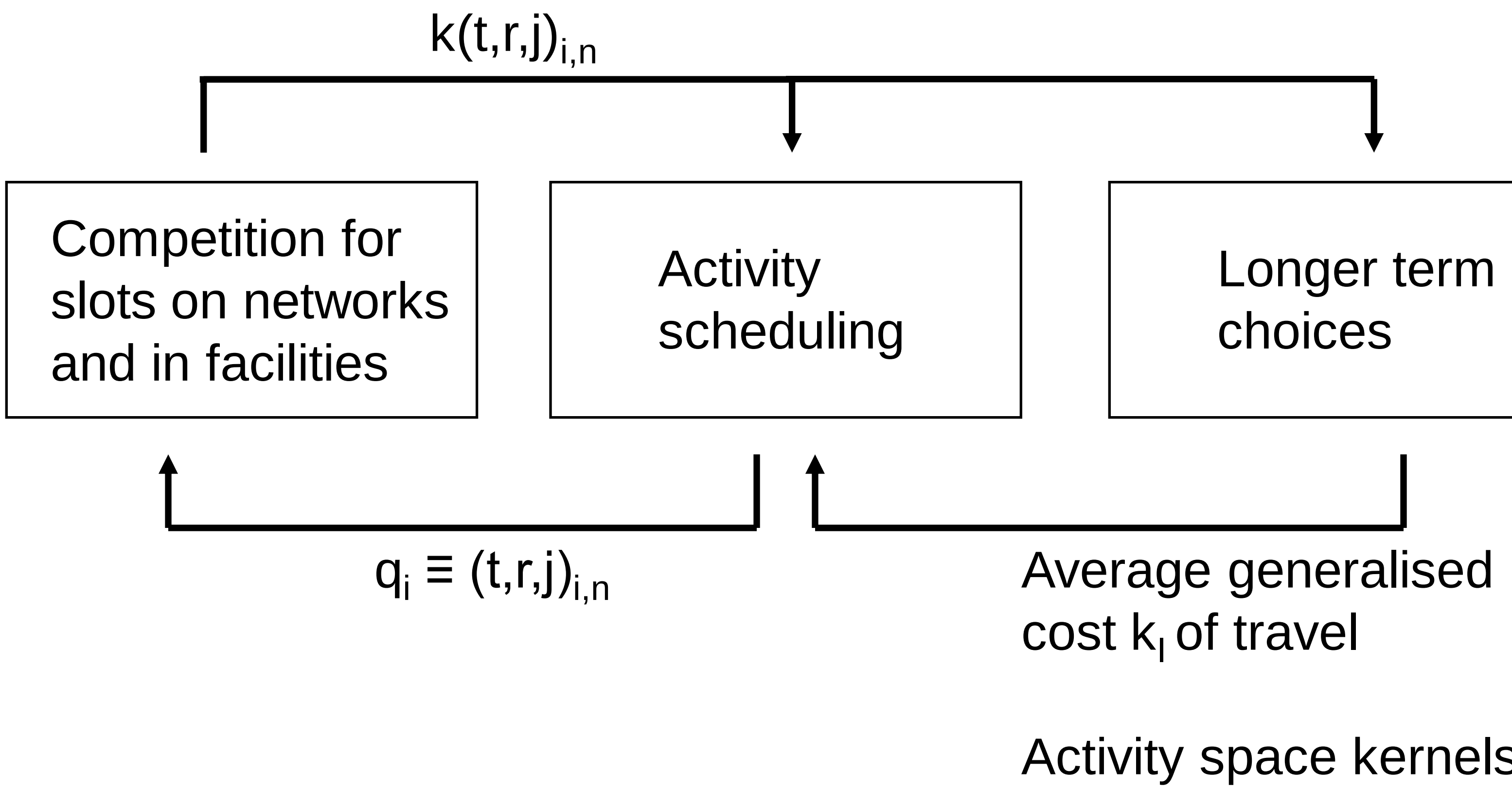
Which equilibrium ? With parameters ?



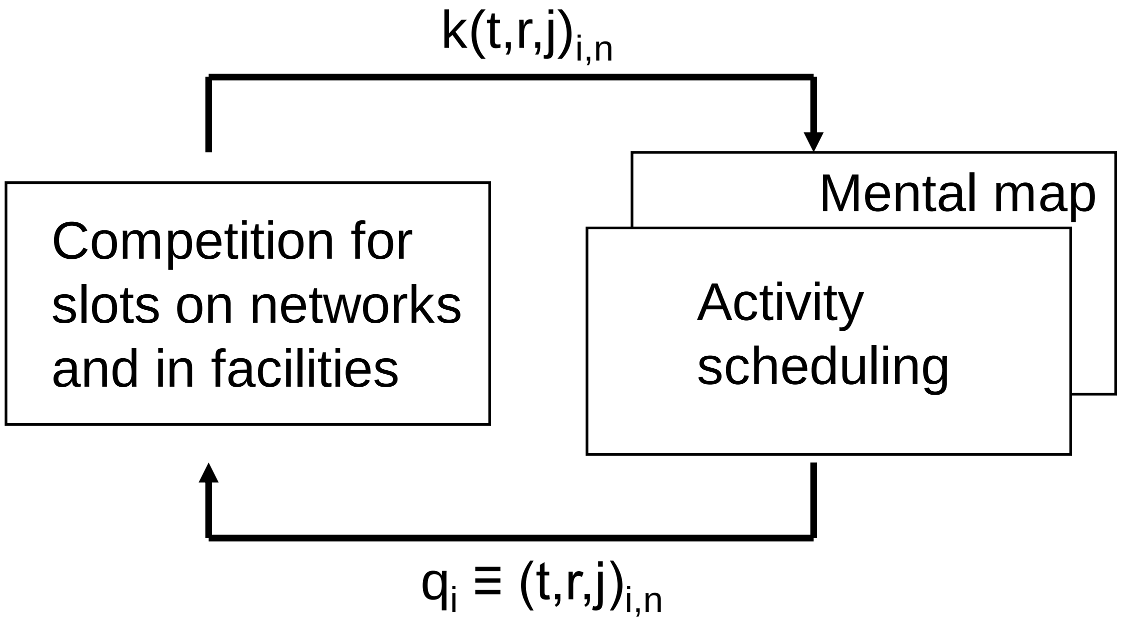
Which equilibrium ? With prices and capacities ?



Which equilibrium ? With longer term choices ?



or better: a simple, if extended „Wardrop“ equlibrium



2009 MATSim Switzerland: Configuration

During the iterations:

- **Optimal start and duration of activity**
- **Location of the activity (with capacity restraint)**

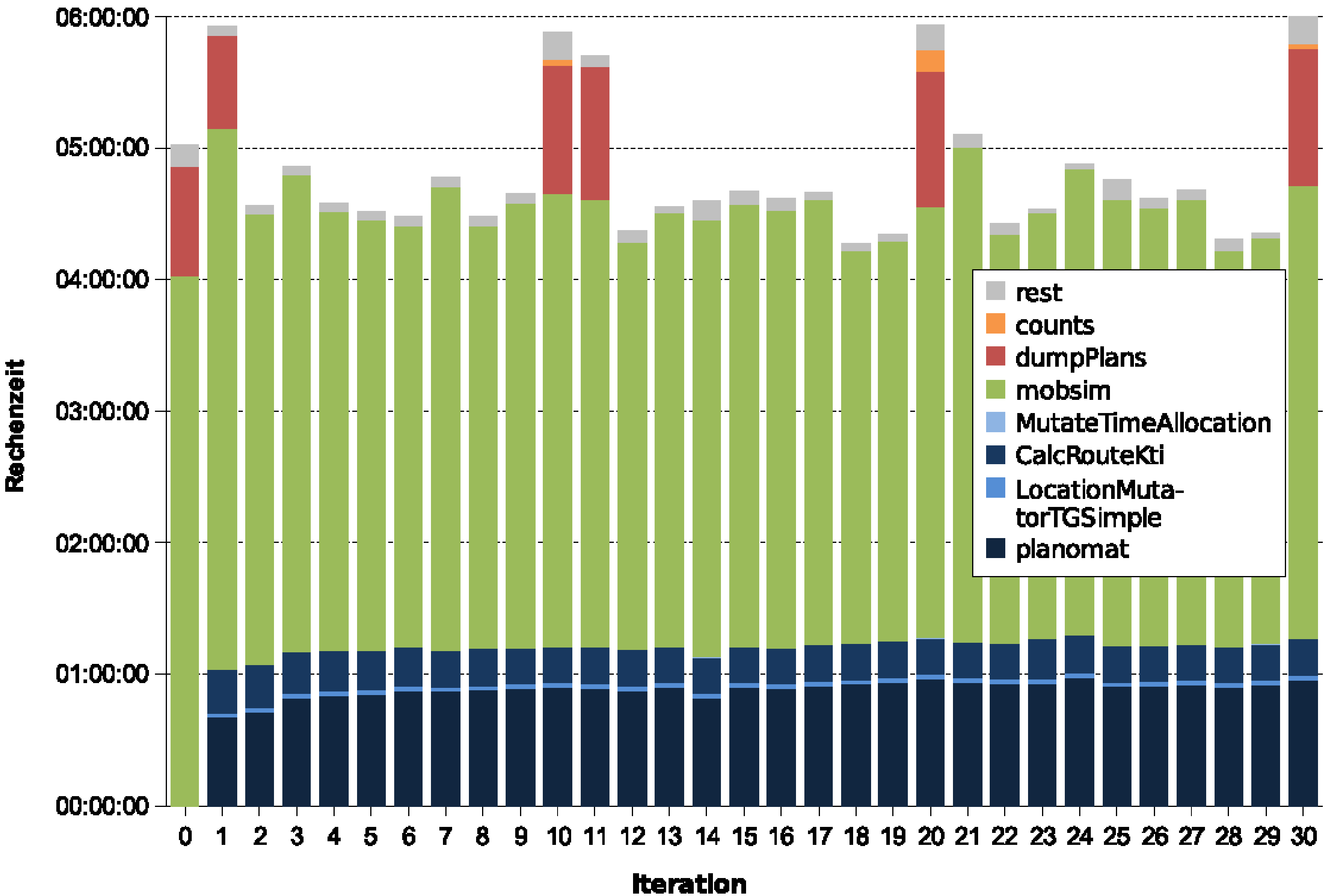
  - Connection between sequential locations

    - Location of access and egress from the mean of transport
    - **Vehicle/means of transport at sub-tour level**
    - **Optimal route/service**

For a search space of:

- $6.0 * 10^6$ agents with 11 activity types
- $1.6 * 10^6$ facilities
- $1.0 * 10^6$ links
- 24 * 60 * 60 seconds

2009 MATSim Switzerland: Computing time



Balmer, 2009

2010 MATSim configuration of traffic flow simulation

- (Parallel) **queue based simulation of car traffic**
  - Detailed parking facilities
  - Detailed recharging facilities
- **Vehicle – timetabled based simulation of public transport**
- Disaggregate simulation of cyclists
- Disaggregate simulation of pedestrians

2010 MATSim configuration of activity scheduling

- **Number and type of activities**
- **Sequence of activities**

  - **Start and duration of activity**
  - Composition of the group undertaking the activity
  - Expenditure division
  - **Location of the activity**

    - Connection between sequential locations

      - **Location of access and egress from the mean of transport**
        - Parking type
      - **Vehicle/means of transport**
      - **Route/service**
      - **Group travelling together**
      - Expenditure division

2010 MATSim configuration of long(er) term choices

- Social network geography
- Social commitments
- Occupation
  - Work location
  - School location
  - Home location
    - Mobility tools
    - Discount cards
    - Season tickets
    - Vehicles (by body type, fuel, energy efficiency)

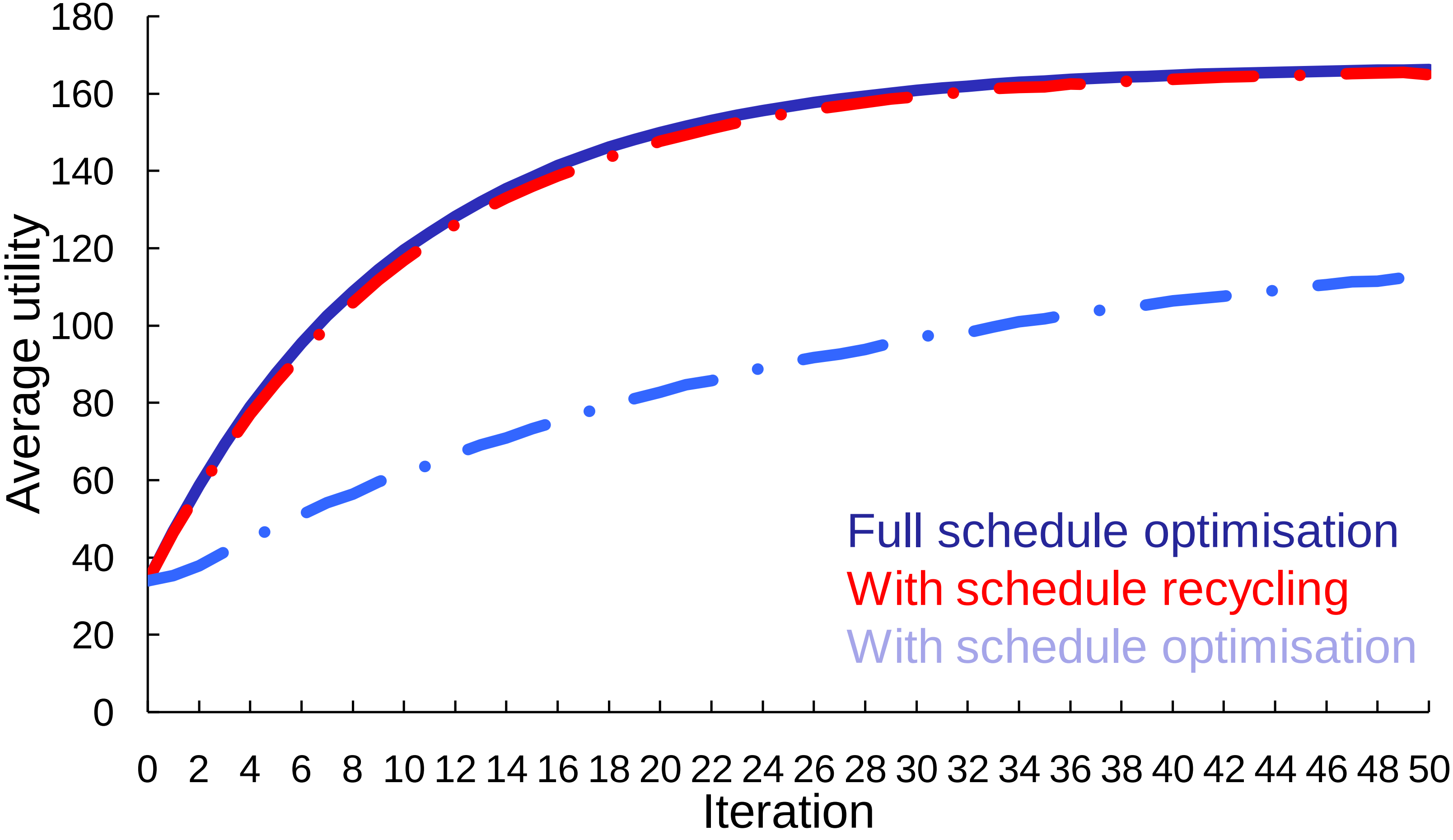
Challenges 2

- Better initial schedules for iteration 0
- Regret-based identification of agents for replanning
- Reduce search spaces (extend time-space prisms)
- Recycling scheduling “solutions”
- Parallel traffic flow simulation
- [Warm start capabilities]

Recycling strategy: Overall approach

- Optimise schedules (using a tabu-search approach) for a sample of agents
- Find the optimal metric to match further agents to optimised sample (maximum utility gain)
- Attach optimised schedules with optimally matched agents
- Adjust remaining degrees of freedom

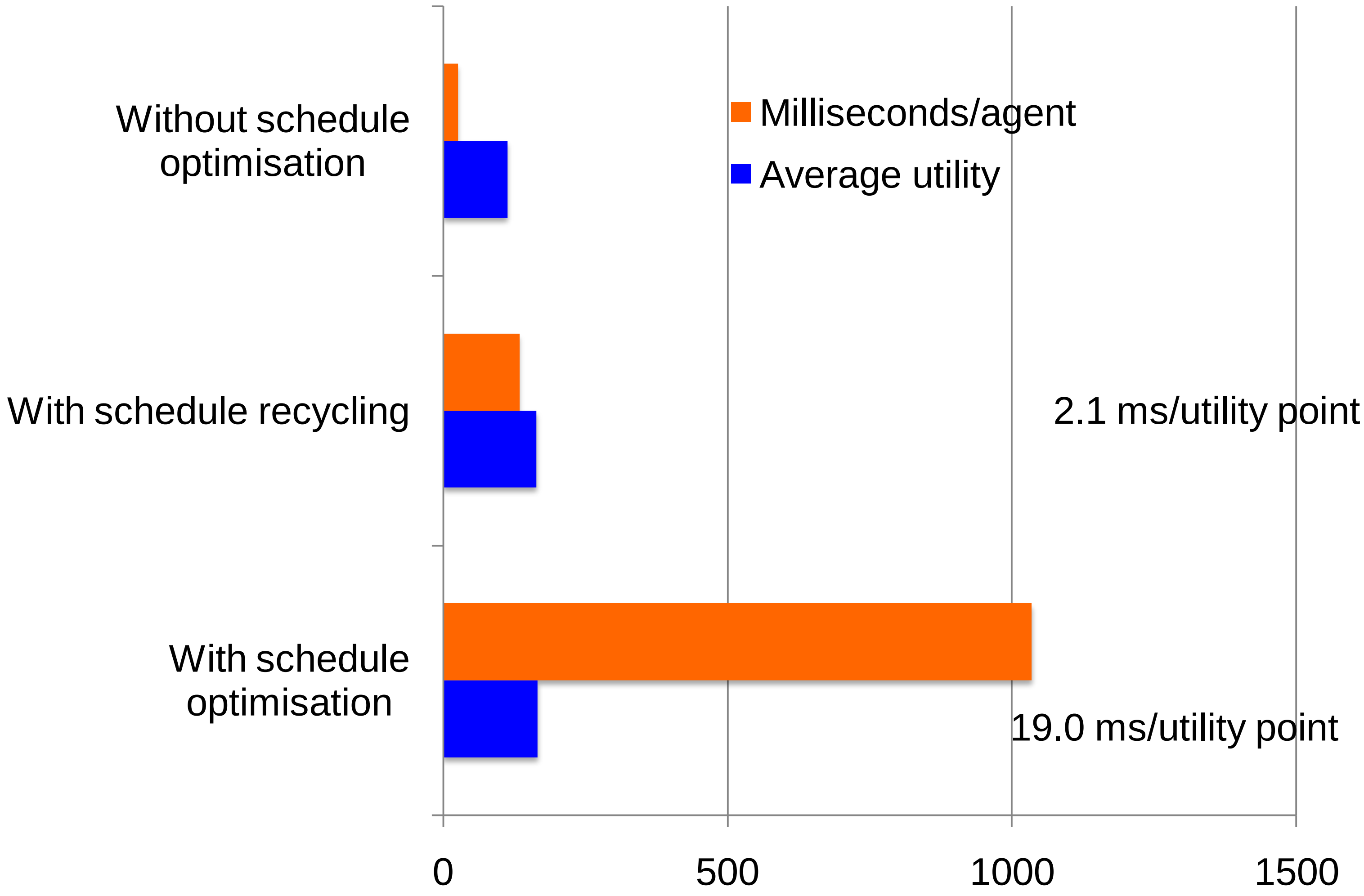
Recycling strategy: Average utility



Feil, Balmer and Axhausen, 2009

Diluted Zürich scenario;
 170’000 agents;
navigation network for 35km around Zurich

Recycling strategy: Computational experience



Feil, Balmer and Axhausen, 2009

Challenges 3

What is faster ?

- (Random) choice set generation and "choosing"
- (Incrementally) optimised schedules for heterogenous users
- Rule-based scheduling systems

Where is the optimal point ?

- Number of iterations (search space coverage) versus
- smart share of agents to replan

www.matsim.org @ ETH Zürich

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- David Charypar
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- Christoph Dobler
- Jeremy K. Hackney
- Andreas Horni
- Konrad Meister
- Nicolas Lefebvre
- Rashid Waraich