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Demand and user behaviour: Suggestions for a research agenda

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Starting point
A peak hour in Zürich (modelled with MATSim)
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
- Movement between sequential locations
  - Location of access and egress from the mean of transport
    - Parking type and location
  - Vehicle/means of transport
  - Route/service
  - Group travelling together
  - Expenditure division
Learning approach of the generic one-day transport model

\[ k(t,r,j)_{i,n} \]

- Competition for slots on networks and in facilities
- Mental map
- Activity scheduling

\[ q_i \equiv (t,r,j)_{i,n} \]
Relevant individual long(er) term choices

- Social network geography
- Social commitments
- Amount and type(s) of occupation
  - Work location(s)
  - School location
  - Home location
- Mobility tools
- Discount cards
- Season tickets
- Vehicles (by body type, fuel, energy efficiency)
Makkah: External cordon – Accumulated balance
Ramadan
Challenge 1: the medium term “project”

• Meaningful sets of coherent activities over multiple days:
  • Pilgrimage, e.g. Hajj, but others as well
  • Vacation
  • Conference

• Work assignment abroad

• Courses, like learning to sail, fly, etc.
• Renovating a house or apartment
Challenge 2: Dynamics of the year

The combination of

- Weekly rhythms
- Annual rhythms

Overlaid with

- Recurring, but moving events
- One – off events
An example weekly rhythms: Swiss inter-urban traffic
Challenge 3: Scheduling the year(s)

Understanding the

- Trade-offs across medium-term time-horizons
- Coordination within the social networks

And their integration with

- Expected and planned income streams (and therefore saving and investment behaviour)
- Time use expectation over the longer term
New questions: Measurement

- How to observe “projects”? 
- How to observe longer term ambitions? 
- How to observe social networks?
Asking for projects: Univox 2009 in Switzerland
New questions: Choice modelling

Understanding the

- Choice sets
  - Medium term at high resolution
  - Longer term: Permissible options;

- Strategic behaviour (to open up alternatives)

- Household interactions
- Social network dynamics
New questions: Which simulation?

- Path-dependent or equilibrium?
  - Open ended simulation of the system

- Social learning mechanisms?

- Creation of alternatives?
  - Services
  - Infrastructure

- Link with real time control
A possible focus?

- Research on medium – term projects
- Research on open-ended simulations
- Research on dynamic equilibria
www.ivt.ethz.ch

www.matsim.org
Makkah Western Gateway Transport and Traffic Study (Without date) Task 2.6 – 2.7: Makkah Transport Modeling Study – Results, IBI Group, DMJM Harris
Annex: MATSim today - A brief summary
MATSim: A GNU public licence software project

Main partners
- TU Berlin (Prof. Nagel)
- ETH Zürich
- Axon Active (Dr. Balmer, Rieser)

Coordination via:
- User meeting
- Developer meeting

Help for new users
- Tutorial (e.g. Mai 2010)
- www.matsim.org
MATSim evolutionary process

Read scenario
Generate initial demand (schedules)

Do until convergence

Select schedule to execute with a biased random approach
Execute schedules (traffic flow simulation)
Score all schedules
Add a new schedule to a random subset of the agents
Delete worst schedule, if necessary
Current Vickrey-type utility function

\[ U_{plan} = \sum_{i=1}^{n} U_{act,i} + \sum_{i=2}^{n} U_{trav,i-1,i} \]

\[ U_{act,i} = U_{dur,i} + U_{late.ar,i} \]
2009 MATSim: Initial demand

Population: Census-based (sample); Through traffic from surveys

- Number, type, sequence and duration of activities:
  - Conditional random draw from observed categorised MZ 2000-2005 distributions by person type

- Location of work/school activity:
  - Census commuter matrix

- Location of secondary activities:
  - Random constrained selection or
  - Capacity-constrained MNL within a time-space prism

- Mode choice:
  - MZ-based subtour MNL

- Route choice:
  - Improved A* shortest path
Capacity constrained MNL with time-space prism

Based on PPA-Algorithm Scott, 2006

„Implicit choice sets“
E.g.: Chains of consecutive shopping activities → recursion

\[ r = \frac{t_{budget}}{2} \times v \]

Random choice

Check \( \sum t_{travel} \leq t_{budget} \)
Capacity constrained MNL with time-space prism

Config 2/3 without/with capacity restraint
Mode choice: Subtour

- Subtour 1
- Subtour 2
- Subtour 3
2009 MATSim configuration: Iteration

- Number and type of activities
- Sequence of activities

  - Start and duration of activity
    - Random mutation
    - Planomat: GA optimiser
  - Composition of the group undertaking the activity
  - Expenditure division
  - Location of the activity

  - Location of access and egress from the mean of transport
    - Parking type
  - Vehicle/means of transport
  - Route/service
  - Group travelling together
  - Expenditure division
2009 MATSim: Traffic flow simulation

- Disaggregate simulation of car traffic
  - Detailed signal control
  - Detailed parking facilities
  - Detailed recharging facilities for electric vehicles
- Disaggregate simulation of public transport
- Disaggregate simulation of cyclists
- Disaggregate simulation of pedestrians
## Java - queue-based traffic flow simulations

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<tr>
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During the iterations:

- Optimisation of start time and duration of the activities
- Random location of the activity (with capacity constraint)
- Vehicle/means of transport at sub-tour level
- Optimal routes
- Event-oriented queue-based traffic flow simulation

For a search space of:

- $6.0 \times 10^6$ agents with 11 activity types
- $1.6 \times 10^6$ facilities
- $0.8 \times 10^6$ links
- $24 \times 60 \times 60$ seconds
Quality of the results: Overall counts
Quality of the results: A1 at Winterthur (no transit traffic)
Quality of the results: 2 of 5 modes
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