Case Studies and Analysis with MATSim
Content

• Target definition & data needs
• Scenario setup (actual state and case studies)
• Calculation of the actual state with MATSim
• Calculation of the case study with MATSim
• Analysis and comparisons (with and without MATSim)
• Discussion

• ➔ [EXAMPLE EQUILNET]
Target Definition & Data Needs
Target Definition & Data Needs
Specify the Region

Source: westumfahrung.ch (2008)

AM: Street restructuring
Uetliberg tunnel
TL: Wollishofen
Target Definition & Data Needs
Specify the System Constraints

• Region of Interest (infrastructure)
  ○ Special constraints: Light signals in Zurich city

• Agents of Interest (demand, 24h, typical workday)
Target Definition & Data Needs
Specify the Analysis

- Actual state
  - System relaxation
  - Count comparisons (hours, day)

- Actual state & case study
  - Volumes (hours, day, peak hour)
  - „Dynamic spider analysis“ (hours, day)
  - Winner / looser statistics
    - Total utility, trip travel times, trip distances
    - Swiss population set, abroad population set, „route switchers“ & population „Westtangente“

- Comparisons: Actual state vs. case study
Target Definition & Data Needs
Specify the Processes (Init. Demand Modeling)

• Creating initial individual time-dynamic demand based on:
  ○ Census 2000
  ○ Micro census 2005
  ○ Commuter matrices 2000
  ○ Transit matrices (border crossing traffic)
  ○ Enterprise census 2000
  ○ National network model

⇒ Agents (demographics) with initial plans
Target Definition & Data Needs
Specify the Processes (Relaxation)

**Input**
- CH Network
- Traffic counts
- Traffic lights (dynamic green times fractions)

**SynPop (init demand)**
- Person att., license
- Mobility tools
- All act.location (Facility)
- act chains
- act durations
- mode
- initial routes

**MATSim run**
- Dynamic in time
- link resolution
- activity based
- complete day plan optimization

**MATSim-EA**

**Output per Iteration / every 10th iteration**
- SynPop (relaxed demand)
  - Person atts., license
  - Mobility tools
  - All act. location (Facility)
  - act chains
  - relaxed act durations
  - mode
  - relaxed routes

- events
- score evolution (png, txt)
- Dep.-, arr.-histogram (png, txt)
- Travel time evolution (txt)
- Counts compare (kmz, txt, html)
- link statistiks (txt)
- Trip durations (txt)
Target Definition & Data Needs
Specify the Processes (Comparisons)

SynPop (init demand)
Network
Traffic lights

MATSim-EA

Actual State

COMPARE

Real World:
- Counts data
- Mob. Statistics

SynPop (Actual State)
Network (WU&AM)
Traffic lights (TL)

MATSim-EA

Case Study:
WU & AM & TL
Target Definition & Data Needs
Specify the Processes (Post Process Steps)

- Tables
- Figures
- Slides
- Movies
Scenario setup (actual state and case studies)
Scenario setup (actual state and case studies)
Network (actual state)

Colors: free speed, thickness: # lanes
Scenario setup (actual state and case studies)

Network (case study)

colors: free speed, thickness: # lanes
Scenario setup (actual state and case studies)
Initial Demand (plans.xml file)

```xml
<plans name="example plans">
...
<person id="393241" sex="f" age="27" license="yes" car_avail="always"
    employer="yes">
    <travelcard type="ch-HT">
    <plan>
        <act type="home" link="101" facility="712" start_time="00:00"
            dur="07:00" end_time="07:00" />
        <leg mode="car" dept_time="07:00" trav_time="00:25" arr_time="07:25">
            <route>1932 1933 1934 1947</route>
        </leg>
        <act type="work" link="844" facility="123" start_time="07:21"
            dur="09:00" end_time="16:25" />
        <leg mode="car" dept_time="16:25" trav_time="00:14" arr_time="17:39">
            <route>1934 1933</route>
        </leg>
        <act type="home" link="101" facility="712" start_time="16:00"
            dur="07:21" end_time="24:00" />
    </plan>
    <plan ...>
    </person>
...
</plans>
```
Calculation of the actual state with MATSim
Calculation of the actual state with MATSim

Monitor the run

• score evolution file; Departure and arrival histograms; Trip travel distances; Trip travel times

• ➔ If it does not fit yet, play around with the config parameters
Calculation of the actual state with MATSim

Decide when you are done

• Scores do not change much anymore
• Travel times are feasible do not change much anymore
• Travel distances are feasible do not change much anymore
• Histograms are feasible do not change much anymore
• Compare with count stations

• ➔ [EXAMPLE OUTPUT] [HISTO EVOLUTION]

• ➔ A lot of data will be produced. KEEP them as long as you do not know if they are needed, but DELETE everything that is not necessary.

• ➔ Hint: define a large number of Iterations. You can stop the process whenever you want.
Calculation of the actual state with MATSim

Decide when you are done (2)

- Keep the final iteration. That’s the solution!!!

- Intermediate iterations do NOT give you additional information. Use only for monitoring the optimization process

[EXAMPLE OUTPUT]

- Plans.xml
- Events.txt
- Some Analysis

Real World:
- Counts data
- Mob. Statistics
Calculation of the case study with MATSim
Calculation of the case study with MATSim

Monitor the run (again)

• score evolution file; Departure and arrival histograms; Trip travel distances; Trip travel times

USE THE SAME CONFIGURATION AS BEFORE
Calculation of the case study with MATSim

Decide when you are done

• Scores do not change much anymore
• Travel times do not change much anymore
• Etc...
Calculation of the case study with MATSim

Decide when you are done (2)

- Keep the final iteration. That’s the solution!!!

- Intermediate iterations do NOT give you additional information. Use only for monitoring the optimization process.

![Diagram of MATSim-EA process]

- Plans.xml
- Events.txt
- Some Analysis
Analysis and comparisons (with and without MATSim)
Analysis and comparisons
What do we have now?

• Actual state:
  ○ Relaxed demand (150.plans.xml.gz)
  ○ Events (150.events.txt.gz)
  ○ (current) network.xml.gz

• Case Study:
  ○ Relaxed demand (240.plans.xml.gz)
  ○ Events (240.events.txt.gz)
  ○ (future) network.xml.gz
Analysis and comparisons
Events (big but cool)

• Complete, detailed, dynamic agent tracking

  ActEnd
  AgentDeparture
  Wait2Link
  LeaveLink
  EnterLink
  AgentArrival
  ActStart

  ➔ [EXCEL EXAMPLE]

Source: Rieser (2008)
Analysis and comparisons
Plans (What kind of synthetic Person is it?)

<plans name="example plans">
  ...
  <person id="393241" sex="f" age="27" license="yes" car_avail="always"
    employed="yes">
    <travelcard type="ch-HT">
      <plan>
        <act type="home" link="101" facility="712" start_time="00:00"
          dur="07:00" end_time="07:00" />
        <leg mode="car" dept_time="07:00" trav_time="00:25" arr_time="07:25">
          <route>1932 1933 1934 1947</route>
        </leg>
        <act type="work" link="844" facility="123" start_time="07:25"
          dur="09:00" end_time="16:25" />
        <leg mode="car" dept_time="16:25" trav_time="00:14" arr_time="16:39">
          <route>1934 1933</route>
        </leg>
        <act type="home" link="101" facility="712" start_time="16:39"
          dur="07:21" end_time="24:00" />
      </plan>
    </travelcard>
  </person>
  ...
</plans>
Analysis and comparisons
How is the data connected?

Actual state network
⇒ Link ids

Actual state event
⇒ Person id, Link id

Actual state population (plans)
⇒ Person ids
⇒ Link ids

Case study network
⇒ Link ids

Case study event
⇒ Person id, Link id

Case study population (plans)
⇒ Person ids
⇒ Link ids
Analysis and comparisons
Network.xml → GIS Shape file

• Version 1 (Write Shapefile directly from MATSim):

```java
FeatureGeneratorBuilder builder = new FeatureGeneratorBuilder(network);
builder.setFeatureGeneratorPrototype(LineStringBasedFeatureGenerator.class);
builder.setWidthCalculatorPrototype(LanesBasedWidthCalculator.class);
new Network2ESRIShape(network, outputDir + "/output_links.shp", builder).write();
```

• Version 2 (Write Table for ETGeoWizard):

```java
NetworkWriteAsTable nwat = new NetworkWriteAsTable(outputDir);
nwat.run(network);
nwat.close();
```

• ➔ Visualization in ArcGIS

• ➔ [ARCGIS EXAMPLE]
Analysis and comparisons
Events ➔ write “Join Tables”

- MATSim events parser and MATSim events handler (in "playground.toronto.example" MATSim JAVA package)

Events events = new Events();

DailyLinkVolumeCalc dlvc = new DailyLinkVolumeCalc();

events.addHandler(dlvc);

EventsReaderTXTv1 reader = new EventsReaderTXTv1(events);

reader.readFile("events.txt.gz");

dlvc.writeTable();

- ➔ [EXAMPLE]
Analysis and comparisons
Network Join Tables Examples

Link volumes
„Spiders“
Link volume comparison

Traffic counts comparison
Analysis and comparisons
Person Analysis ➔ Write $x,y,\text{attributes-tables}$

<table>
<thead>
<tr>
<th>Grenzquerende Reisende ($\sim$57 000 Personen)</th>
<th>Ist-Zustand</th>
<th>WU/WT</th>
<th>Veränderung</th>
</tr>
</thead>
</table>
durchschn. Tagesnutzen                         | 64.84       | 67.78 | 104.53 %    |
durchschn. Wegreisezeit                        | 02:13:14    | 02:10:04 | 97.62 % |
durchschn. Wegdistanz [km]                    | 189.77      | 189.66 | 99.94 %    |

<table>
<thead>
<tr>
<th>Census Bevölkerung ($\sim$614'800 Personen)</th>
<th>Ist-Zustand</th>
<th>WU/WT</th>
<th>Veränderung</th>
</tr>
</thead>
</table>
durchschn. Tagesnutzen                         | 183.72      | 184.91 | 100.65 %    |
durchschn. Wegreisezeit                        | 00:16:22    | 00:14:41 | 89.71 % |
durchschn. Wegdistanz [km]                    | 12.35       | 12.34  | 99.90 %    |

<table>
<thead>
<tr>
<th>Wechsler WT → WU ($\sim$21 300 Personen)</th>
<th>Ist-Zustand</th>
<th>WU/WT</th>
<th>Veränderung</th>
</tr>
</thead>
</table>
durchschn. Tagesnutzen                         | 162.86      | 168.20 | 103.28 %    |
durchschn. Wegreisezeit                        | 00:46:18    | 00:37:56 | 81.93 % |
durchschn. Wegdistanz [km]                    | 41.13       | 42.59  | 103.55 %   |

<table>
<thead>
<tr>
<th>Anlieger WT ($\sim$1 500 Personen)</th>
<th>Ist-Zustand</th>
<th>WU/WT</th>
<th>Veränderung</th>
</tr>
</thead>
</table>
durchschn. Tagesnutzen                         | 164.68      | 164.02 | 99.61 %    |
durchschn. Wegreisezeit                        | 00:21:54    | 00:18:38 | 85.08 % |
durchschn. Wegdistanz [km]                    | 8.57        | 8.45   | 98.57 %    |

▲ Gewinn von Nutzen; Reduktion von Reisezeit, resp. Reisedistanz
▼ Verlust von Nutzen; Erhöhung von Reisezeit, resp. Reisedistanz
■ Quasi unveränderte Nutzen, Reisezeiten oder Reisedistanzen (±2.5 %)

Statistics

„Route Switchers“
Summary / Discussion
Summary / Discussion

• MATSim is truly a large scale, time dynamic, micro-simulation
  ◦ Events delivers a large and very detailed information set.
  ◦ Plans make it possible to connect trips and activities with socio-demographics
  ◦ Network (and facilities) map the outcome to coordinates.

• ➔ Sweet!

• But:
  ◦ Programming is necessary. ➔ More about it Thursday morning
  ◦ Not many standard analysis tools are available already in the MATSim toolkit ➔ Feel free to participate!
  ◦ GIS visualization is not part of MATSim ➔ external software needed
Questions? Comments?

http://matsim.org/