Construction of a Simulation of On-Demand Mobility Concepts in SUMO

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On-Demand Mobility and Bundling of Matching Requests
Simulation of Urban Mobility (Eclipse SUMO)

SUMO is a free and open microscopic multi-modal traffic simulation package designed to handle large networks.

SUMO allows modelling of intermodal traffic systems including road vehicles, public transport and pedestrians.

→ route finding, visualization, effects on traffic, emission calculation...

See also: https://www.eclipse.org/sumo/
Example of the Assignment of Demand in SUMO NETEDIT

- **Definition of Traffic Assignment Zones (TAZ):** A TAZ defines the area where participants depart and does typically contain several network edges.

- **Zone-to-Zone flow definition:** Definition of the number of OD-flows, that means trips between each zone of origin and a zone of destination. OD-flows are defined for different time intervals of the day and/or for different transport modes.

- **Trip generation:** Each OD-flow is disaggregated into a discrete number of individual trips, creating an OD-matrix.

- **Routing:** A route is computed for each individual trip, connecting the edge within the zone of origin with the edge within the zone of destination.

See also:
https://sumo.dlr.de/docs/Definition_of_Vehicles,_Vehicle_Types,_and_Routes.html#traffic_assignement_zones_taz
Vehicles can depart and arrive at traffic assignment zones (TAZ). This allows the departure and arrival edges to be selected from a predefined list of edges.

The figure shows an examination area with defined Traffic Assignment Zones (TAZ) in SUMO Netedit.

Four TAZ are defined (blue).

An example for defined stop-lanes is shown in taz_1 (purple).
Information about the traffic volume in the examination area is required and can be converted to an hourly demand by SUMO.

The figure shows an example of a generated 24 hour traffic load curve.
**Input: Demand/Traffic load**

- **hourly traffic load curve**
- **origin and destination matrix**

Example of a 24 hour traffic load curve and the demand from each TAZ to every other TAZ in SUMO.

```
od2trips.exe -n osm_taz.add.xml -d od-matrix.txt --persontrips true -s 1 --timeline.day-in-hours -timeline
0.1,0.1,0.1,0.1,0.1,0.4,0.4,0.4,0.9,0.9,0.6,0.4,0.4,0.5,0.5,0.4,0.4,
0.9,0.9,0.6,0.6,0.3,0.2,0.1,0.1 -o person.trips.xml --verbose -c
persons.odconfig
```

* From-Time  To-Time
0.00 24.00

<table>
<thead>
<tr>
<th>TAZ</th>
<th>TAZ</th>
<th>Traffic Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>taz_1</td>
<td>taz_1</td>
<td>130.00</td>
</tr>
<tr>
<td>taz_1</td>
<td>taz_2</td>
<td>41.00</td>
</tr>
<tr>
<td>taz_1</td>
<td>taz_3</td>
<td>5.00</td>
</tr>
<tr>
<td>taz_1</td>
<td>taz_4</td>
<td>0.00</td>
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<tr>
<td>taz_2</td>
<td>taz_2</td>
<td>41.00</td>
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<td>taz_2</td>
<td>taz_3</td>
<td>15.00</td>
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<tr>
<td>taz_2</td>
<td>taz_4</td>
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<td>41.00</td>
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</tr>
<tr>
<td>taz_4</td>
<td>taz_4</td>
<td>15.00</td>
</tr>
</tbody>
</table>
Simulation of On-Demand Mobility running in SUMO

Vehicles (yellow) are picking up passengers (blue) at their requested pick-up-spots (example).
Next Steps and Further Desired Research Questions

Next steps:
• Refining the frame conditions and the assumptions of the simulation (demand, user requirements, …)
• Running the simulation and considering the results
• Varying the assumptions to gain insights about effects and interrelations
• Creating several scenarios to consider further aspects

Further desired research questions:
• Is an On-Demand service a reasonable supplement with other transport systems? → Intermodal trips, for example with inclusion of a mode choice model
• What effect do different time windows of passenger requests have on operational parameters?
• … and many more
Thank you for your attention.

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Institutes Website:
https://www.dlr.de/ts/en/

SUMO Website:
https://www.eclipse.org/sumo/