Welcome to SUMO 2021

Sept. 13th – 15th

Cyberspace

SUMO Tutorial

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SUMO2021, Online

Knowledge for Tomorrow

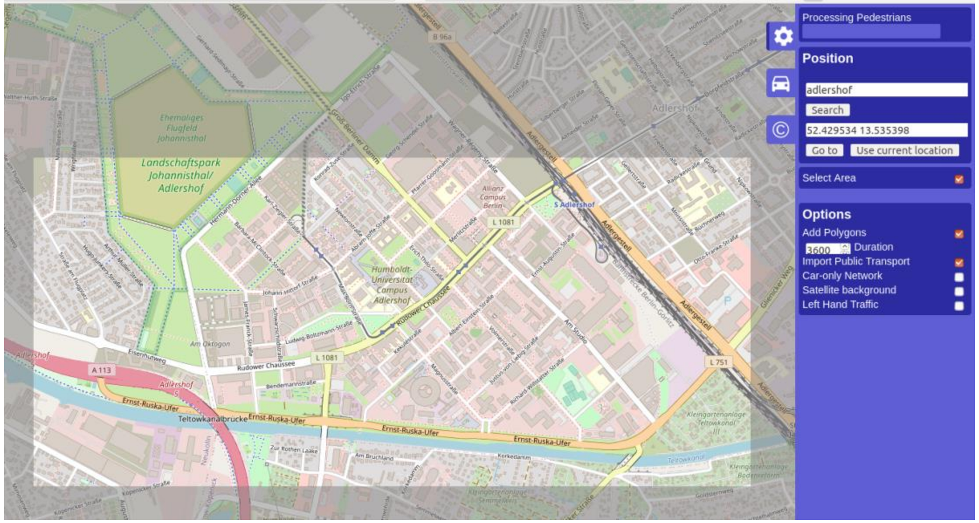
Outline

- Prerequisites
- 3-Click scenario generation with osmWebWizard.py
- Network editing
- Creating traffic with Origin-Destination Counts / TAZ
- GTFS Import

Prerequisites

- SUMO 1.10.0 for running simulations
- **Latest development version** for **netedit,od2trips**
  sumo.dlr.de/wiki/Downloads
- Python: python.org/download/
- Text Editor (i.e. notepad-plus-plus.org/)
- Data files: sumo.dlr.de/daily/sumo2021_tutorial.zip

osmWebWizard



Processing Pedestrians

Position

adlershof

Search

52.429534 13.535398

Go to | Use current location

Select Area ☑

Options

Add Polygons ☑

3600 Duration

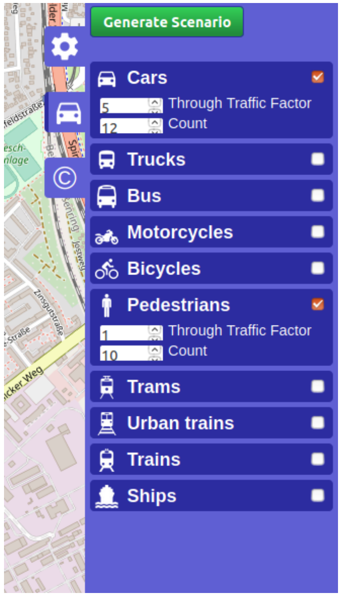
Import Public Transport ☑

Car-only Network ☐

Satellite background ☐

Left Hand Traffic ☐

- tools/osmWebWizard.py
- OpenStreetMap network data
- **Random traffic**
- Configure
  - Area
  - Traffic modes
  - Traffic volume
  - Fraction of through-traffic
  - Public Transport
  - Scenario duration
  - Building Shapes and Points-of-Interest (cosmetic)
  - Satellite background (cosmetic)
- Generated files allow rebuilding and adapting the scenario
- Example data in `01_wizard`



Generate Scenario

Cars ☑

5 Through Traffic Factor

12 Count

Trucks ☐

Bus ☐

Motorcycles ☐

Bicycles ☐

Pedestrians ☑

1 Through Traffic Factor

10 Count

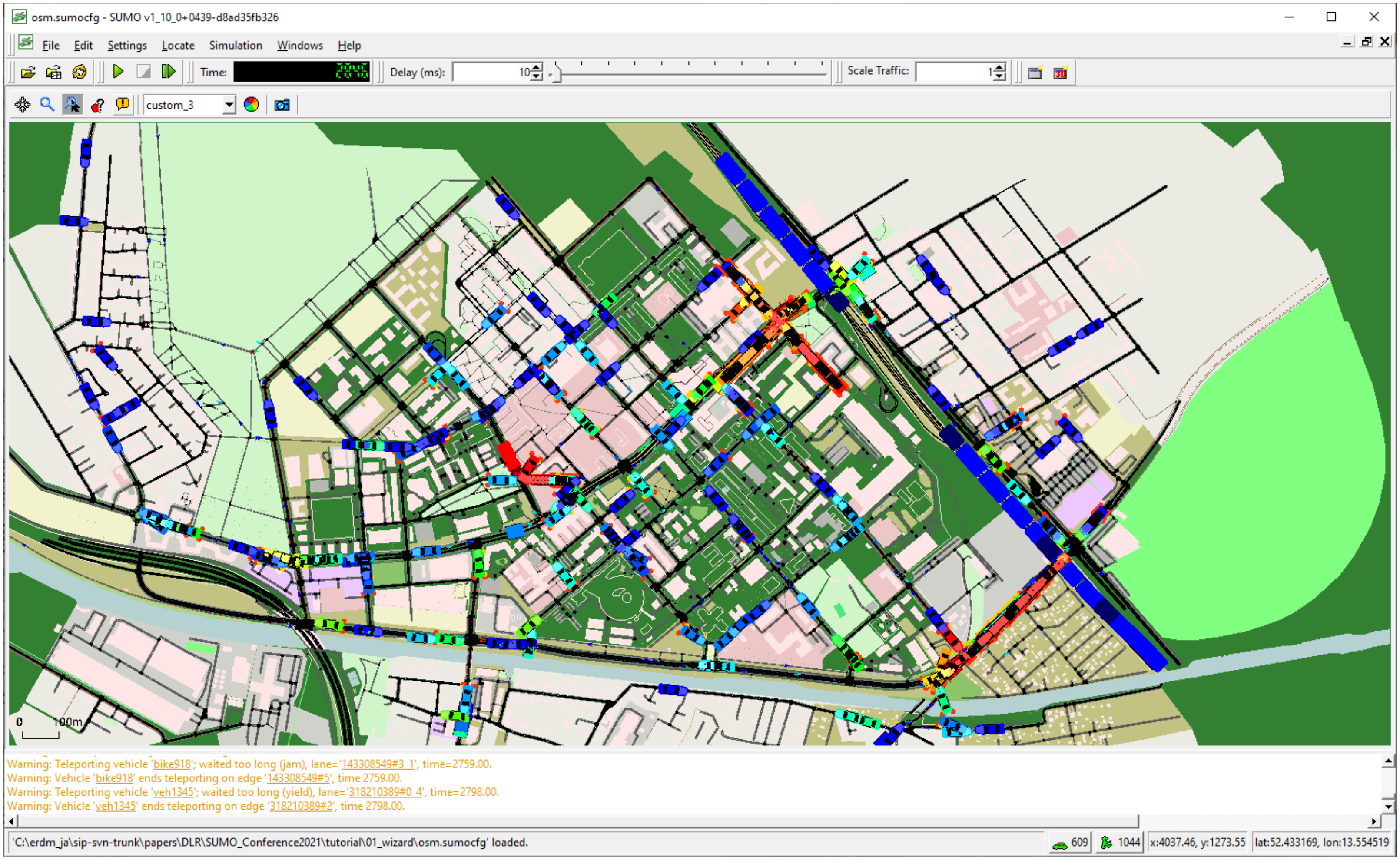
Trams ☐

Urban trains ☐

Trains ☐

Ships ☐

osmWebWizard - Simulation


osm.sumocfg - SUMO v1_10_0+0439-d8ad35fb326
File Edit Settings Locate Simulation Windows Help
Time:
Delay (ms): 10
Scale Traffic: 1
custom_3
0 100m

```
Warning: Teleporting vehicle 'bike918'; waited too long (jam), lane='143308549#3_1', time=2759.00.
Warning: Vehicle 'bike918' ends teleporting on edge '143308549#5', time 2759.00.
Warning: Teleporting vehicle 'veh1345'; waited too long (yield), lane='318210389#0_4', time=2798.00.
Warning: Vehicle 'veh1345' ends teleporting on edge '318210389#2', time 2798.00.
```

'C:\erdm_ja\sip-svn-trunk\papers\DLR\SUMO_Conference2021\tutorial\01_wizard\osm.sumocfg' loaded. 609 1044 x:4037.46, y:1273.55 lat:52.433169, lon:13.554519

osmWebWizard - Generated Files

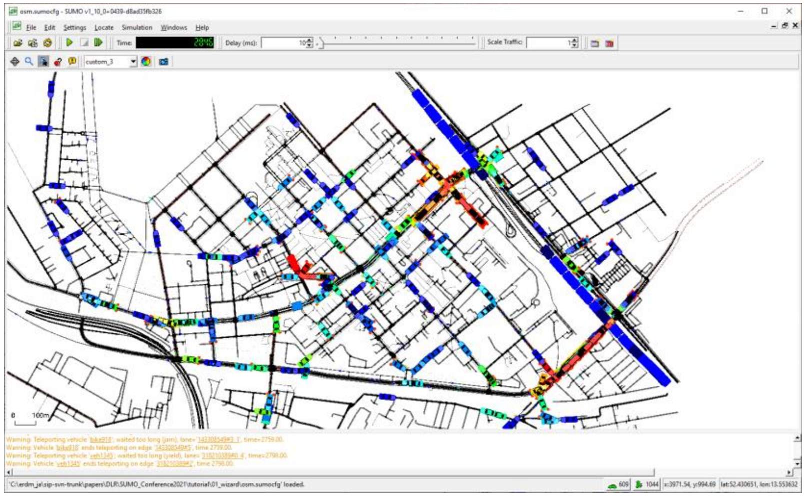
- Scenario input
  - `osm.sumocfg`: configuration file (load with **sumo**, **sumo-gui**)
  - `osm.net.xml`: simulation network
  - `osm.passenger.trips.xml`: passenger cars
  - `osm.pedestrian.rou.xml`: persons
  - `osm_pt.rou.xml`: busses, trams, …
  - `osm_stops.add.xml`: public transport stop locations
  - `osm.poly.xml`: building shapes and POIs
  - `osm.view.xml`: sumo-gui settings for delay, colors,...

- Rebuilding:
  - `osm_bbox.osm.xml`: raw OSM data
  - `osm.netccfg`: rebuild network and stops (**netconvert**)
  - `osm.polycfg`: rebuild shapes (**polyconvert**)
  - `build.bat`: rebuilt traffic (cars, persons, public transport schedule,…)
  - `osm_ptlines.xml`: intermediate public transport data

osmWebWizard - Simulation

- Lots of **Warnings**
- Investigate with
  - color vehicles *by accumulated waiting time*
  - draw vehicles with *constant size when zoomed out*

- Compared to last year：
  - more traffic (bikes)
  - new OSM data
  - added bike lanes to the network


osm.sumocfg - SUMO v1_10_0+0439-d8ad35fb326
File Edit Settings Locate Simulation Windows Help
Time:
Delay (ms):
Scale Traffic:
custom_3
0 100m

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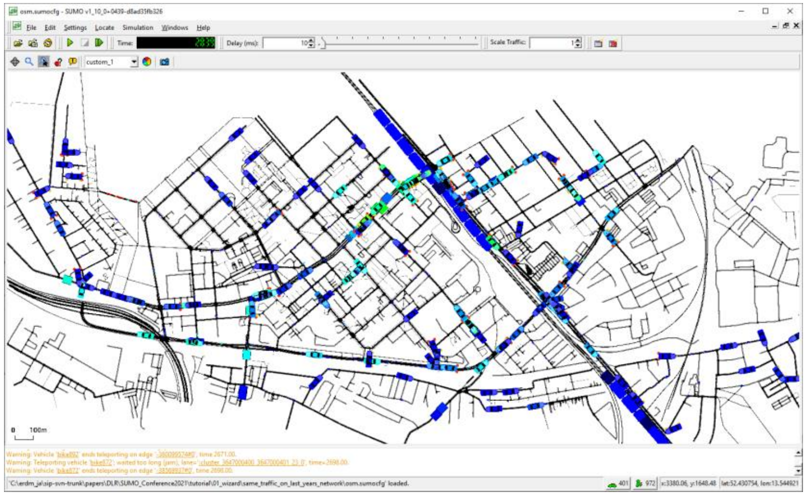
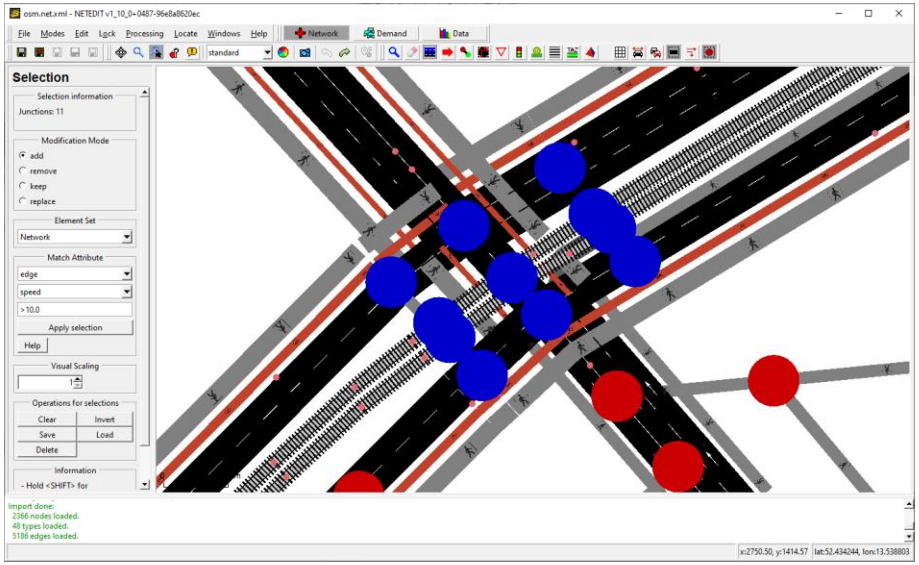
Warning: Teleporting vehicle 'bike918'; waited too long (jam), lane='143308549#3_1', time=2759.00.
Warning: Vehicle 'bike918' ends teleporting on edge '143308549#5', time 2759.00.
Warning: Teleporting vehicle 'veh1345'; waited too long (yield), lane='318210389#0_4', time=2798.00.
Warning: Vehicle 'veh1345' ends teleporting on edge '318210389#2', time 2798.00.
'C:\erdm_ja\sip-svn-trunk\papers\DLR\SUMO_Conference2021\tutorial\01_wizard\osm.sumocfg' loaded.
```


osm.sumocfg - SUMO v1_10_0+0439-d8ad35fb326
File Edit Settings Locate Simulation Windows Help
Time:
Delay (ms):
Scale Traffic:
custom_1
0 100m

```
Warning: Vehicle 'bike892' ends teleporting on edge '-38009957#0', time 2671.00.
Warning: Teleporting vehicle 'bike872'; waited too long (jam), lane=':cluster_3647000400_3647000401_23_0', time=2698.00.
Warning: Vehicle 'bike872' ends teleporting on edge '-38569937#0', time 2698.00.
'C:\erdm_ja\sip-svn-trunk\papers\DLR\SUMO_Conference2021\tutorial\01_wizard\same_traffic_on_last_years_network\osm.sumocfg' loaded.
```

Network Editing - Join Junctions

- Load network osm.net.xml (open from sumo-gui with **CTRL+t**)
- Select mode (S)
- Select cluster of junctions which should become a single junction
- press F7
- optionally press F5 to update
- save



Junctions: 11

● add
○ remove
○ keep
○ replace

Network

edge

speed

>10.0

1

- Hold <SHIFT> for

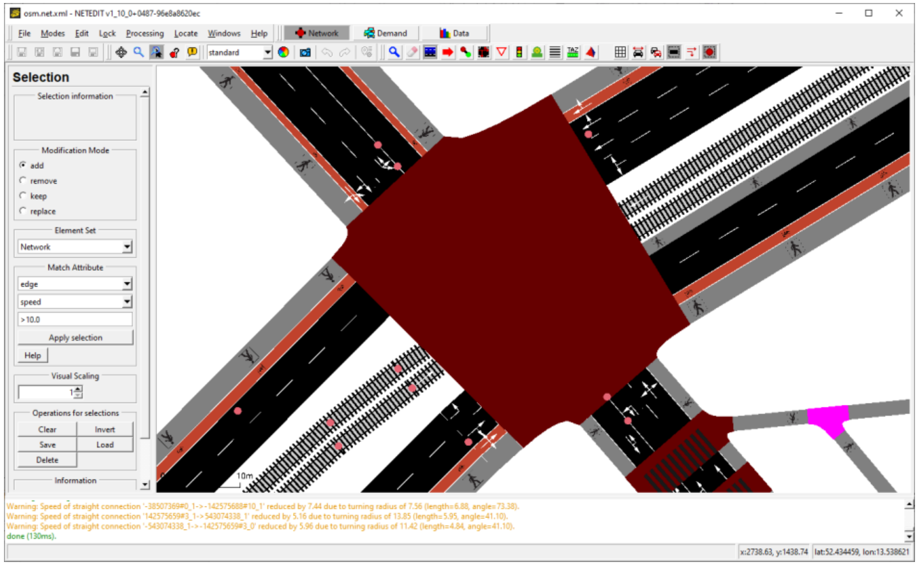
```
Import done:
  2366 nodes loaded.
  48 types loaded.
  5186 edges loaded.
```

x:2750.50, y:1414.57 lat:52.434244, lon:13.538803

- Background: The heuristic that joins junctions considers edge lengths and these are influenced by the presence of bicycle lanes (cf. 2020 tutorial).

Network Editing - Join Junctions

- Example data in `02_netedit`
- run **build.bat** to adapt traffic to changes
  - **On Windows, sumo-gui must be closed!**

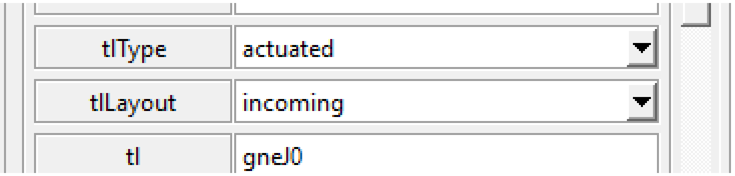


```
Warning: Speed of straight connection '-38507369#0_1->-142575688#10_1' reduced by 7.44 due to turning radius of 7.56 (length=6.88, angle=73.38).
Warning: Speed of straight connection '142575659#3_1->543074338_1' reduced by 5.16 due to turning radius of 13.85 (length=5.95, angle=41.10).
Warning: Speed of straight connection '-543074338_1->-142575659#3_0' reduced by 5.96 due to turning radius of 11.42 (length=4.84, angle=41.10).
done (130ms).
```

Trip Statistics	Original	Patched
RouteLength	2060	1935
Speed	6.19	7.24
Duration	501	291
WaitingTime	232	49
TimeLoss	319	118

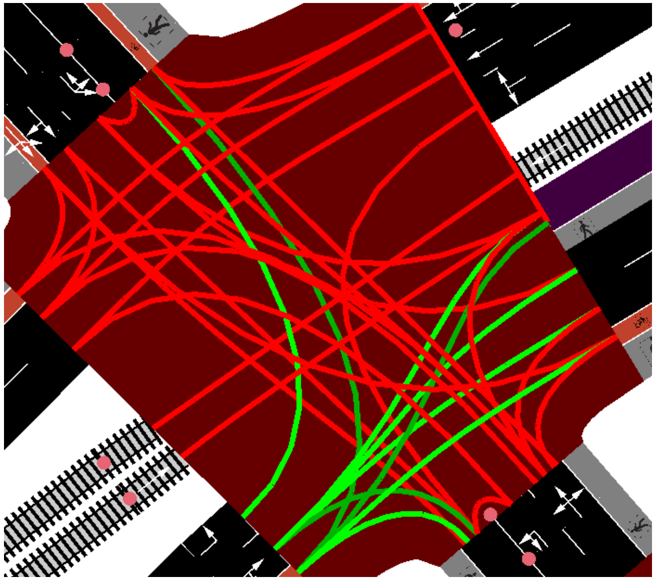
Network Editing - Change traffic light layout

- Load network `osm.net.xml`
- Inspect mode (**I**)
- Change 'tlLayout' of traffic light junction
- Check Signal plan in traffic light mode (**T**)
- Save network



tlType	actuated
tlLayout	incoming
tl	gneJ0

- Travel times in simulation increase by ~2% (more realism ≠ better performance)



- Example data in `03_netedit`

Network Editing - Indirect Bicycle Turns

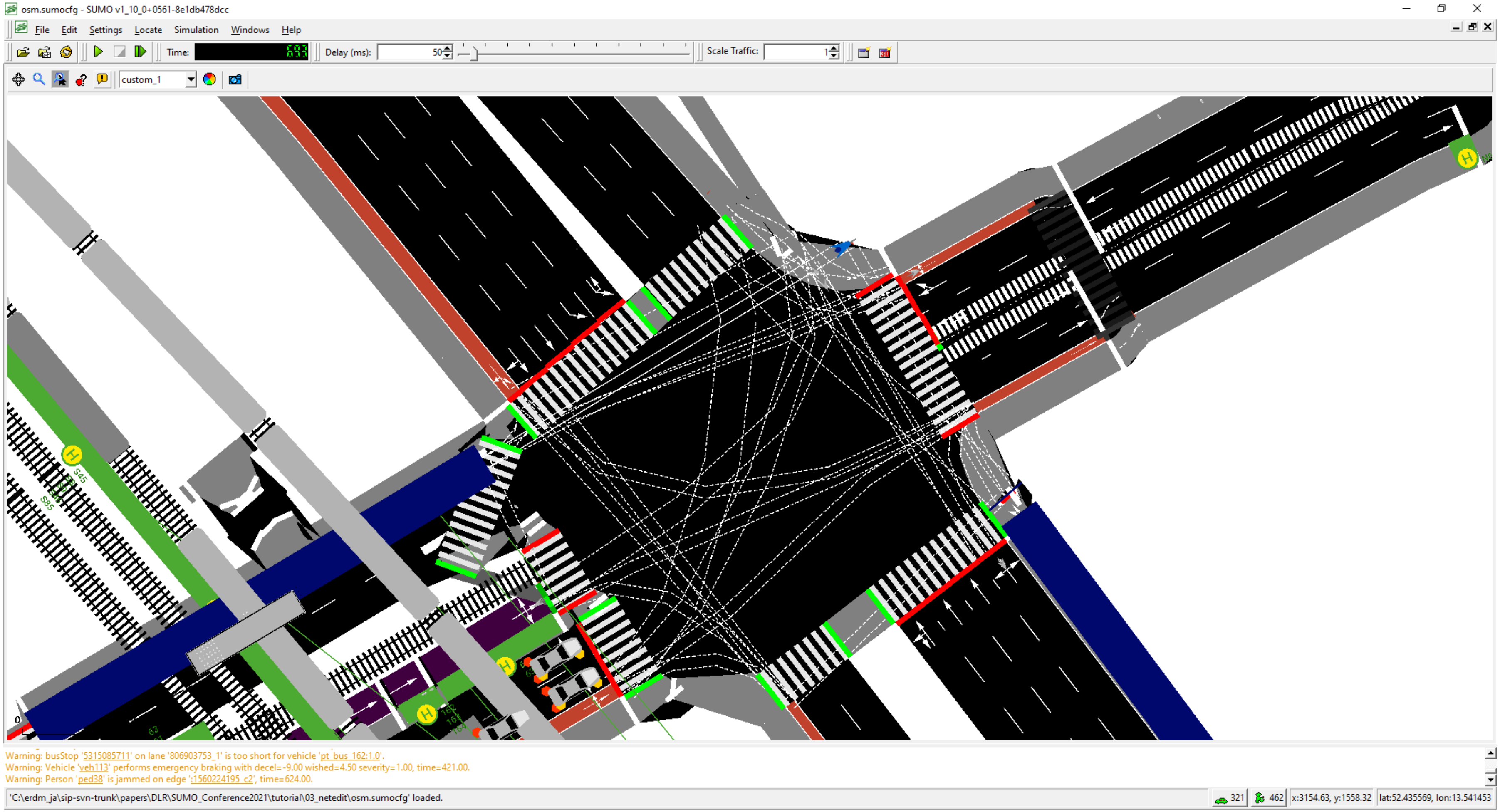
- Load network `osm.net.xml`
- Inspect mode (**I**)
- show connections (**ALT+5**)
- Click on bicycle connection
- Enable attribute "indirect"
- Recompute geometry (F5)
- Save network

Alternative to change many connections at once:

- Select mode (S)
- Lock all objects except connection
- Select connections in area
- Filter selection for connections with 'allow =bicycle'
- Filter selection for connections with 'dir =l' ('dir =L')
- use Inspect mode to click on selected connection
- Enable attribute "indirect"

- Example data in `03_netedit`

Simulation- Indirect Bicycle Turns



Time: 693

Delay (ms): 50

Scale Traffic: 1

custom_1

```
Warning: busStop '5315085711' on lane '806903753_1' is too short for vehicle 'pt_bus_162:1.0'.
Warning: Vehicle 'veh113' performs emergency braking with decel=-9.00 wished=4.50 severity=1.00, time=421.00.
Warning: Person 'ped38' is jammed on edge ':1560224195_c2', time=624.00.
```

'C:\erdm_ja\sip-svn-trunk\papers\DLR\SUMO_Conference2021\tutorial\03_netedit\osm.sumocfg' loaded.

321 | 462 | x:3154.63, y:1558.32 | lat:52.435569, lon:13.541453

Traffic

- Example scenario traffic has three components
  - Cars: random origin, destination, "fastest" route
  - Public transport (routes, stops, interval from OSM, schedule random/synthetic)
  - Persons: random origin, destination, "fastest" intermodal route

- Regenerate car traffic based on origin/destination counts (OD-matrix)
- Replace synthetic public transport schedule with GTFS

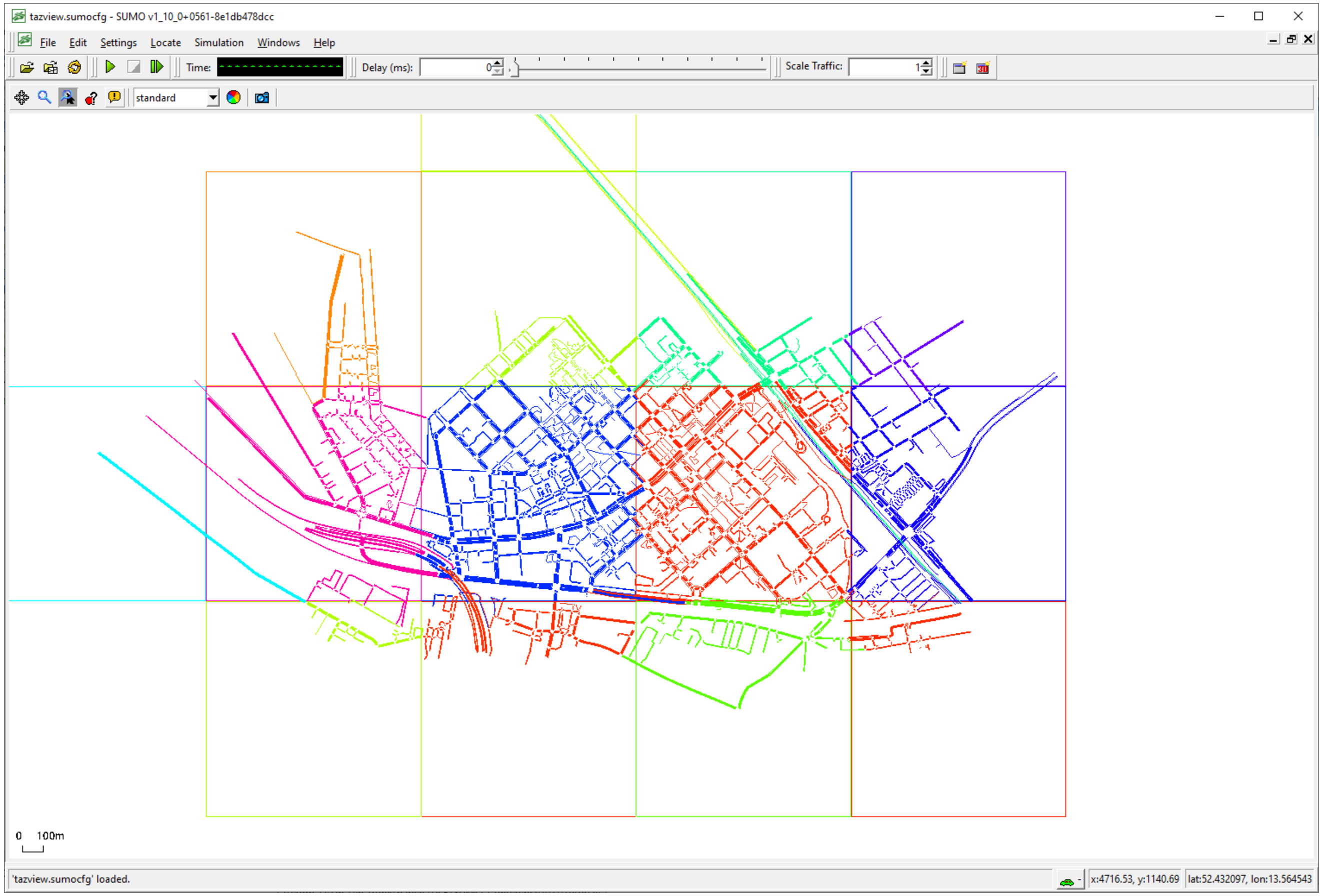
Traffic from OD-Matrix

- **od2trips** input data:
  - districts a.k.a traffic analysis zones (TAZ)
  - origin-destination counts (matrix)

- Defining TAZ
  - import directly with **netconvert** (supported for VISUM import)
  - import shapes with **polyconvert**, assign edges with **tools/edgesInDistrict.py**
  - generate a grid with **tools/district/gridDistricts.py**
    - `-n osm.net.xml -o tazgrid.add.xml -w 1000 --vclass passenger`
    - or run `04_odtraffic\gridDistricts.bat`

  - draw/edit with **netedit**

gridDistricts



'tazview.sumocfg' loaded.

x:4716.53, y:1140.69 lat:52.432097, lon:13.564543

- View with `04_odtraffic\tazview.sumocfg`

Netedit - Define OD-Matrix

- Load `osm.net.xml`
- Load `tazgrid.add.xml` **(CTRL+a)**
- Enter Data supermode (**F4**)
- Enter tazRelation mode (**Z**)
- Create new dataset
- Create new interval
- Define (default) data attribute "`count=1000`"
- define relation with 2 clicks + ENTER
- Modify default attribute or edit specific relation attributes in inspect mode (**I**)
- Save Data Elements to file `od.xml`

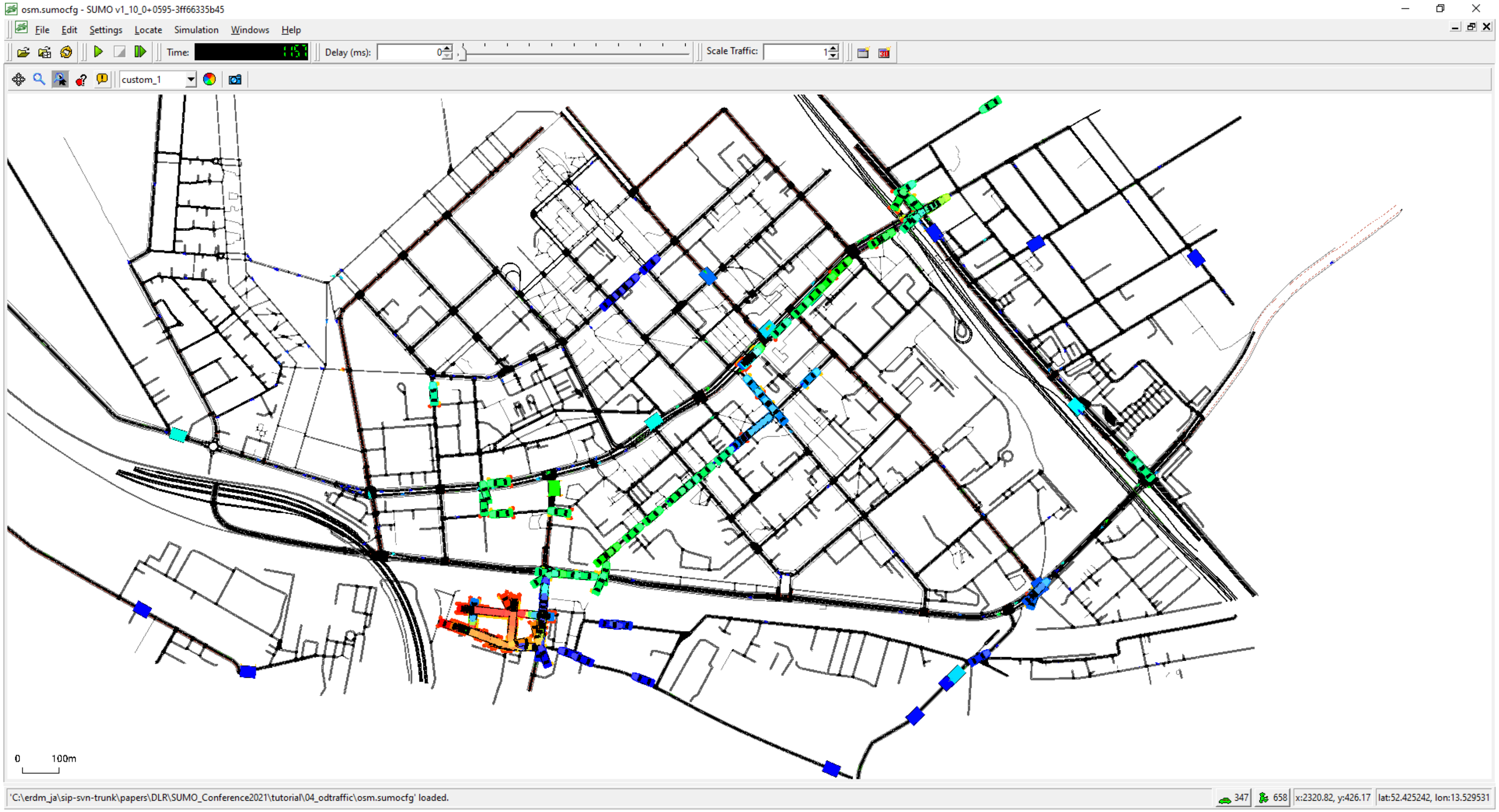
od2trips - generated traffic

-
  ```
  > od2trips -n tazgrid.add.xml --tazrelation-files od.xml --ignore-vehicle-type -o odtrips.xml
  ```

-
  ```
  > duarouter -n osm.net.xml -r odtrips.xml --ignore-errors --write-trips -o odtrips_valid.xml
  ```

- od2trips knows nothing about the network so duarouter is used to filter out invalid (disconnected) trips - 964 trips remain.
- run `04_odtraffic\build_odtrips.bat`

OD-Traffic Simulation



'C:\erdm_ja\sip-svn-trunk\papers\DLR\SUMO_Conference2021\tutorial\04_odtraffic\osm.sumocfg' loaded.

- Sample data in `1_netedit`

GTFS-Import

- download GTFS - General Transit Feed Specification (transitfeeds.com/)
- Data Providers are sometimes relaxed in their interpretation of the standard
- python %sumo_home%\tools\import\gtfs\gtfs2pt.py -n osm.net.xml --gtfs GTFS.zip --date 20210913 --osm-routes osm_ptlines.xml --repair
    - or run `05_gtfs\gtfs_osm.bat`
    - generates
        - vTypes.xml
        - gtfs_publictransport.add.xml (stops)
        - gtfs_publictransport.rou.xml (vehicles)

- rebuild person plans using the generated data (**`randomTrips.py`**, **`duarouter`**)
    - `run 05_gtfs\build.bat`

GTFS-Import - Intermodal Journeys

- `analyzePersonPlans.py -r osm.pedestrian.rou.xml -w`
- plans from osmWebWizard:
  - 9: walk public walk public walk public walk
  - 118: walk public walk public walk
  - 442: walk public walk
  - 785: walk
- plans using GTFS public transport:
  - 162: walk public walk
  - 1192: walk

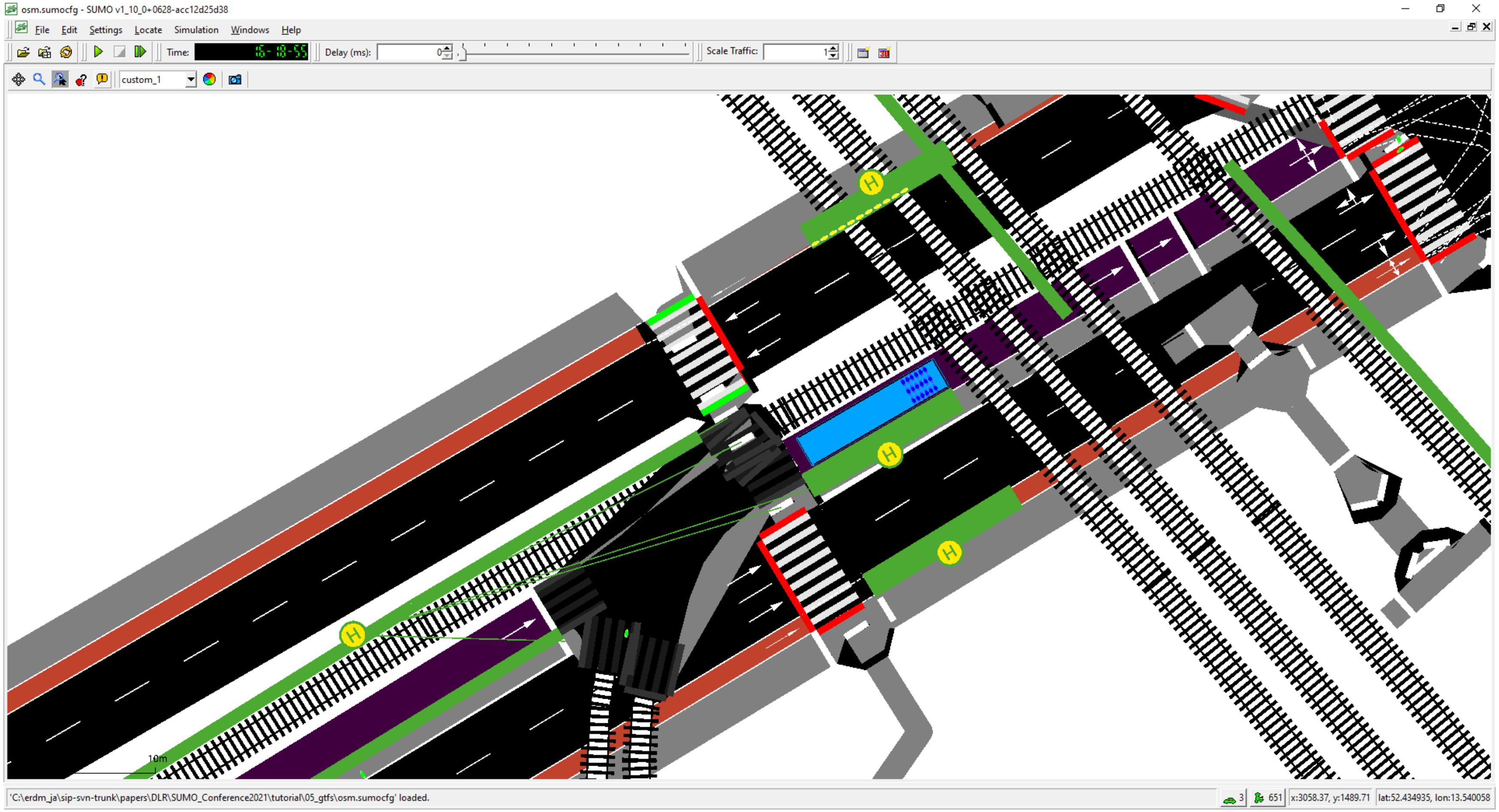
- why so much walking?

GTFS-Import - Intermodal Journeys

- absolute times are important: few public transport at time 0 in a day
- generate persons from **16:0:0 to 16:30:0**
  - 3: walk public walk public walk
  - 283: walk public walk
  - 1068: walk

- Dates are important too! No Tram service due construction work in our area
- set date in gtfs2pt call to **20211206**
  - 34: walk public walk public walk
  - 315: walk public walk
  - 1005: walk

GTFS - Simulation



osm.sumocfg - SUMO v1_10_0+0628-acc12d25d38
File Edit Settings Locate Simulation Windows Help
Time: 16-18-55
Delay (ms): 0
Scale Traffic: 1
custom_1
H
10m
3
651
x:3058.37, y:1489.71
lat:52.434935, lon:13.540058

'C:\erdm_ja\sip-svn-trunk\papers\DLR\SUMO_Conference2021\tutorial\05_gtfs\osm.sumocfg' loaded.

Conclusion

- Use tools/osmWebWizard.py to get a quick start
- Read the documentation / FAQ at http://sumo.dlr.de/docs
- Report any bugs you find to sumo-user@eclipse.org
- Share your scenarios and results

- Talks to us. We are always looking for project partners! sumo@dlr.de