

Evacuation Queue Simulation Tutorial

This tutorial is based on MATSim Version 2007-10-06

This documentation is an introduction to the *Evacuation Queue Simulation*. The reader is expected to have successfully managed the basic MATSim tutorial ('Getting Started with MATSim') that is located at <http://matsim.org/node/64>. The evacuation simulation is demonstrated on the well known Sioux Falls network. But it is planned to eventually apply the system to the Indonesian city of Padang, to simulate a pedestrian evacuation in case of a Tsunami warning. Because of the early stage of the project (October 2007), this tutorial refer to an evacuation of Sioux Falls by car.

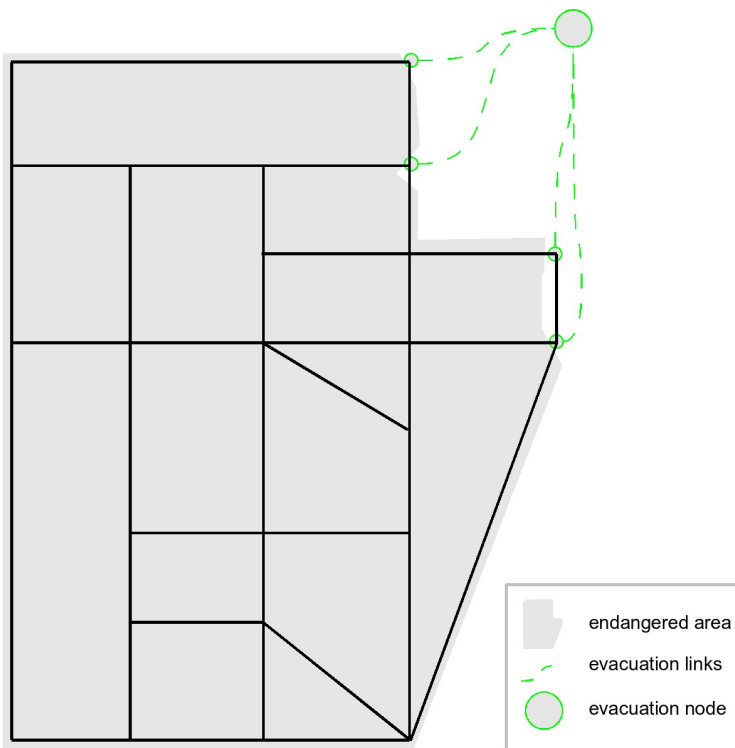
Content

- Introduction
- Requirements
- EvacuationQSim package
- Day-to-day re-planning evacuation simulation

Introduction

In the current version of MATSim it is possible to run evacuation simulations. – *Evacuation Queue Simulation*. **EQSim** is being developed in context of the “Numerical 'Last-mile' Tsunami Early Warning and Evacuation Information System” for simulating mobility flow and traffic patterns of Padang in case of a tsunami warning/evacuation. **EQSim** fits quite well into the MATSim architecture and is part of the MATSim Queue Simulation.

This tutorial will show how to run basic evacuation simulations in a particular test case namely Sioux Falls. In the last 35 years the Sioux Falls network has become a standard reference in transportation science. Because of its topology it is also well suited for a demonstration of an evacuation simulation. Since we integrate the **EQSim** into the MATSim framework, we want to keep as many parts of MATSim untouched as possible. The **EQSim** modifies the agents' plans in such a way that an evacuation plan only consists of 2 activities (home, save place). While simulating, these plans will be optimized to achieve Nash equilibrium. For the router it is not clear where the target of the shortest path calculation should be, as the agents have more than one safe place to run to. Instead, in the underlying domain every node outside the evacuation area is a possible destination for an agent that is looking for an escape route. In order to use the Dijkstra router, the network has to be extended in a way that from all locations in the evacuation area only one evacuation destination exists. This is done by connecting all links, which lead out of the evacuation area, using virtual evacuation links with infinite flow capacity und zero length to a special “evacuation node”. Doing so, Dijkstra's algorithm will always find the shortest route from any node inside the evacuation area to this evacuation node. A sketch of the Sioux Falls network including the evacuation links/nodes is given in the figure below.



Requirements

For **EQSim** three different input files are needed. At first the config file: For the most part it is conforming to a common config file and only one additional module has to be added:

```
<module name="evacuation">
  <param name="inputEvacuationAreaLinksFile" value
    ="&INPUTBASE;/evacuationarea_siouxfalls.xml.gz"/>
</module>
```

This module defines the location of the evacuation-area file. This XML-file contains the ID of all links within the evacuation area and the evacuation time information for this links (latest point in time when a link has to be evacuated). At the moment the information about the evacuation time is ignored and will become important for the projected within-day re-planning simulation.

The actual position, capacity and free speed of all the links and the position of the corresponding nodes are defined in the network file. As already mentioned, we choose to use the Sioux Falls network in this example. To generate an evacuation scenario we additionally need a population. The population is defined in a common plans file with a slightly difference. Since we only need the position of the agent for a given time all other information like routes can be neglected. Therefore for every agent only one plan with only one act (contains actual position) is stored in the plans file. The population in this case is a 10 percent sample of randomly generated an uniform distributed population of 50000 agents.

Therefore, the flow capacity and storage capacity factor was set to 0.1.

The needed input files are stored in the `./data` directory. You can open these files with your favorite text editor. An editor that supports syntax highlighting for XML is recommend.

The evacuation package

The evacuation package consists of following classes:

EvacuationAreaFileReader – a XML-file reader for the evacuation-area file

EvacuationAreaFileWriter – a XML-file writer for the evacuation-area file

EvacuationAreaLink – a evacuation area link holds the ID and the evacuation time of a link in the network

EvacuationPlansGeneratorAndNetworkTrimmer – generates the initial evacuation plans for agents and removes all nodes and links outside the evacuation area besides such nodes that are direct reachable from inside the evacuation area.

EvacuationQSimControler – derived from Controler

Day-to-day replanning evacuation simulation

```
java org.matsim.evacuation.EvacuationQSimControler ./examples/evacuation-tutorial/evacuationConf.xml
```

This will run so many iterations as in the config file specified. Per default there are 100 iterations, however you can change this if you want. I suggest, to run at least 50 iterations, so that all agents have good chance to be drawn several times for re-planning. Doing so, the system should move towards Nash equilibrium. Because of the limited size of the evacuation area you will see that the simulation is very fast. On current hardware it takes about only a few second per iteration.

After the run is finished you will find the results in the `./output` directory in the same manner as you know it from other iteration. Additional, you will find file that is called `evacuation_net.xml` in this directory. The file represents the modified network with the virtual evacuation links. This file has no particular importance, since the modified network will be create on the fly when you start up the evacuation simulation. But if you open this file in the visualizer you get an idea how the evacuation scenario looks like.

Visualization

You can start NetVis with the following command:

```
java org.matsim.utils.vis.netvis.NetVis
```

For detailed description how to use the visualizer please consult the 'Getting Started with MATSim' tutorial. For example you could open `t./output/ITERS/it.0/SnapshotCONFIG.vis` to view the initial evacuation of Sioux Falls.