SUMO - More on...
Parsing ArcView Files

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Chapter 1. Introduction

Document Information

This document is a part of *SUMO* - *S*imulation of *U*rban *MO*bility. SUMO is an open source microscopic road traffic simulation. It can be found under http://sumo.sourceforge.net/.

This document fits to version 0.9.5. We will try to keep it up to date with the next versions.

Document Scope

Several people had problems when trying to import streets from ArcView databases. The reason is that the original importer was meant to import networks from ArcView databases which use the scheme used by NavTeq. During the time, we had to recognize that this scheme is used only very seldom. In the real world, every network supplier uses an own scheme and when importing networks from ArcView-databases, the user has to give some additional information about it.

This documentation shows how to use the importer to import networks from other suppliers than NavTeq by example.

Note

Please remark, that this document is "for fun only". Internally, we are using commercial road network databases of high quality. The networks presented here are available for free and due to this their quality may be not as good as needed for a somehow meaningful simulation of real world traffic.

Audience

This document contains information for *users* who want to import ArcView-based maps.

Document Structure

The document describes the usage of the ArcView importer by giving examples. Each of the next chapter describes one example.

Chapter 2. Importing Networks from the National Transportation Atlas Database

Data Availability

At http://www.bts.gov/publications/national_transportation_atlas_database/2006/ the National Transportation Atlas Database is set of maps supplied by the Bureau of Transportation Statistics. Among several other data, also road networks can be downloaded. Within the next chapters using the data set "Region 10 (AK, ID, OR, and WA)" (nhpn_10.zip [http://www.bts.gov/publications/national_transportation_atlas_database/2006/zip/nhpn_10.zip]) from the "National Highway Planning Network" section is described.

Conversion

Two datasets can be found within the downloaded package, `nhpnLinRegion10` and `nhpnNodRegion10`. We are interested in the lines in order to get the road network, node features seem to be not interesting for us. After reading the data description "`nhpnlinDataDictionary.htm`" we know that:

--arcview.from-id FNRECID --arcview.to-id TNRECID --arcview.street-id RECID --arcview.use-defaults-on-failure -v --use-projection --arcview.utm 10

- The origin node of a street is named "FNRECID" in the table; that means we should add the option `--arcview.from-id FNRECID` to our call
- The destination node of a street is named "TNRECID" in the table; that means we should add the option `--arcview.to-id TNRECID` to our call
- The street identifier should be read from the column RECID; that means we should add the option `--arcview.street-id RECID` to our call

There seems to be no information about the number of lanes or allowed speeds within the table. By now, we will simply use the defaults and force NETCONVERT to do this using `--arcview.use-defaults-on-failure`. Also, as shapefiles are using a geocoordinate system, we want to reproject the network to the cartesian coordinates using `--use-projection` and setting the utm-zone to 10 using `--arcview.utm 10`. So, the complete call is:

```
netconvert --arcview nhpnLinRegion10 -o nhpnRegion10.net.xml \
    --arcview.from-id FNRECID --arcview.to-id TNRECID \
    --arcview.street-id RECID --arcview.use-defaults-on-failure \
    --use-projection --arcview.utm 10
```

After some seconds of waiting, we get a network which looks as following:

Figure 2.1. The converted Region10-network

A look at a part of the complete network shows that although the whole network is not fully connected, some smaller parts may be interesting:

Figure 2.2. A detail from the converted Region10-network

Still, all streets are unidirectional, have the same number of lanes and allow the same maximum velocity. While looking for some further information, a more detailed description here [http://www.fhwa.dot.gov/Planning/nhpn/docs/aat.html]. Based on this, we decided the field FCLASS to differ between the road types. To make a relationship between the values in FCLASS and the physical attributes of the network to build we defined a type-file (see "Types Descriptions [http://sumo.sourceforge.net/docs/gen/user_chp04.shtml#user_chp04-xml_descriptions-types]"). The values are just guess, but should assuming a speed limit of 65mph on interstate highways and of 30mph for urban roads. The number of lanes is guessed, too. Please remark that there is also a field which describes the number of lanes on a street. We do not use it because we would have to divide it by two - something not yet implemented in the current version of SUMO. The complete types-file (`nhpnLinRegion.typ.xml`) looks like this:

```
<types>
   <!-- Rural Interstate -->
   <type id="01"  priority="6" nolanes="3" speed="25"/>
   <!-- Rural Principal Arterial -->
   <type id="02"  priority="6" nolanes="3" speed="25"/>
   <!-- Rural Minor Arterial  -->
   <type id="06"  priority="6" nolanes="3" speed="25"/>
   <!-- Rural Major Collector -->
   <type id="07"  priority="5" nolanes="2" speed="25"/>
   <!-- Rural Minor Collector -->
   <type id="08"  priority="4" nolanes="1" speed="25"/>
   <!-- Rural Local -->
   <type id="09"  priority="1" nolanes="1" speed="25"/>
   <!-- Urban Interstate -->
   <type id="11"  priority="2" nolanes="2" speed="13.4"/>
   <!-- Urban Freeway or Expressway -->
   <type id="12"  priority="2" nolanes="2" speed="13.4"/>
   <!-- Urban Principal Arterial -->
   <type id="14"  priority="2" nolanes="2" speed="13.4"/>
   <!-- Urban Minor Arterial -->
   <type id="16"  priority="2" nolanes="2" speed="13.4"/>
   <!-- Urban Collector -->
   <type id="17" priority="1" nolanes="1" speed="13.4"/>
   <!-- Urban Local -->
   <type id="19" priority="1" nolanes="1" speed="13.4"/>
</types>
```

The new call, which adds the types definition and builds all roads bidirectional is:

```
netconvert --arcview nhpnLinRegion10 -o nhpnRegion10.net.xml \
    --arcview.from-id FNRECID --arcview.to-id TNRECID \
    --arcview.street-id RECID --arcview.use-defaults-on-failure \
    --use-projection --arcview.utm 10 \
    --arcview.all-bidi -t nhpnLinRegion.typ.xml --arcview.type-id FCLASS
```

Here, some pictures from the resulting network:

Figure 2.3. A close-up view on the converted Region10-network (1)

Figure 2.4. A close-up view on the converted Region10-network (2)

Figure 2.5. A close-up view on the converted Region10-network (3)

Data Quality

The Bureau of Transportation Statistics states a "maximal positional error of 80 meters" for the networks (see `nhpnlinDataDictionary.htm`). The network we had was not fully connected. Beside this, it seems to be not complete - or - better to say - one should state that it is not "dense" in the means that due to its size it only contains major roads.

Demand

The database contains a filed named "AADT", documented as: "The Annual Average Daily Traffic field comes from the 2002 Highway Performance Monitoring System." (from `nhpnlinDataDictionary.htm`). One could use this to fill the network with traffic, we didn't.

Conlusion

Due to its size the network seems to be quite interesting for simulating large-area traffic. Still, it is not fully connected, so one should maybe try one of the other parts located at http://www.bts.gov/publications/national_transportation_atlas_database/2006/.

Data

You can download the converted networks from the additional data [http://sumo.sourceforge.net/downloads/add_data.shtml#ntad] page.

Chapter 3. Importing the Network of Osnabrück from the Frida-project

Data Availability

The network is available at the Frida-homepage [http://frida.intevation.org/] and is licensed under the GPL.

Conversion

Our main interest are of course the street networks within the package. The following files describe them: `strassen.dbf`, `strassen.shp`, `strassen.shx` ("strassen" is the german word for "streets"). When opening "`strassen.dbf`" we have to realize that there is only a few information stored herein - neither the node names are given nor the street attributes. Instead, the street attributes seem to be stored in an additional database and are references by type names (column "strTypID" - strassen_typ_id = street_type_id). Also, the names of this database's columns have other names than expected.

Ok, let's solve these problems one after another.

- Different field naming

  The only problem with this is that we can not extract street names properly. Still, within FRIDA, the edges are numbered. We have extended NETCONVERT by the possibility to use any information as node name and will use the shape id as name.

  The call has to be extended by: `--arcview.street-id strShapeID`

- Missing node names

  NETCONVERT can deal with networks which do not have node names; a small extension to NETCONVERT (available in version 0.9.4) solves the problem - now nodes are built when edges begin/end at the same position.

- Parsing street attributes from a type file

  The possibility to describe edges using attributes was already available in NETCONVERT; to use types in combination with ArcView-files, only a small extension was necessary (available in version 0.9.4). Still, the types have to be translated into XML. The generated file (`frida.typ.xml`) looks like this:

```
<types>
   <!-- "noch nicht attributiert" (= not yet attributed) -->
   <type id="0"  priority="1" nolanes="1" speed="13.89"/>
   <!-- "Autobahn" (highway) -->
   <type id="1"  priority="5" nolanes="3" speed="41.67"/>
   <!-- "Bundesstrasse" (motorway) -->
   <type id="2"  priority="4" nolanes="1" speed="22.22"/>
   <!-- "Hauptstrasse" (main (city) road) -->
   <type id="3"  priority="3" nolanes="2" speed="13.89"/>
   <!-- "Nebenstrasse" (lower priorised (city) road) -->
   <type id="4"  priority="2" nolanes="1" speed="13.89"/>
   <!-- "Weg" (path) -->
   <type id="5"  priority="1" nolanes="1" speed="5"/>
```

```
    <!-- "Zone 30" (lower street with a speed limit of 30km/h) -->
    <type id="6"  priority="2" nolanes="1" speed="8.33"/>
    <!-- "Spielstrasse" (a street where children may play (10km/h)) -->
    <type id="7"  priority="1" nolanes="1" speed="1.39"/>
    <!-- "Fussgaengerzone" (pedestrains zone) -->
    <type id="8"  priority="0" nolanes="1" speed="0.1"/>
    <!-- "gesperrte Strasse" (closed street) -->
    <type id="9"  priority="0" nolanes="1" speed="0.1"/>
    <!-- "sonstige Strasse" (something else) -->
    <type id="10" priority="0" nolanes="1" speed="0.1"/>
    <!-- "Fussweg" (way for pedestrians) -->
    <type id="11" priority="0" nolanes="1" speed="0.1"/>
  </types>
```

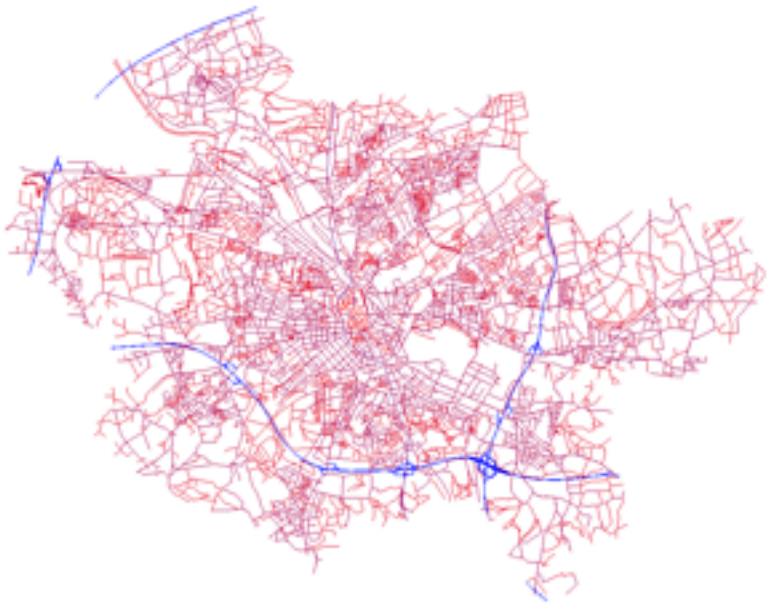
The call has to be extended by: `-t frida.typ.xml --arcview.type-id strTypID`

After having applied all those changes, the network was buildable, but looked quite messy. After having played with geocoordinate projections, this was fixed. So the call (so far) looks like this:

```
netconvert --arcview strassen -o frida.net.xml \
   --arcview.street-id strShapeID -t frida.typ.xml \
   --arcview.type-id strTypID --use-projection
```

The network looks as shown below:

Figure 3.1. The converted Frida-network of Osnabrück (using allowed speed for coloring)



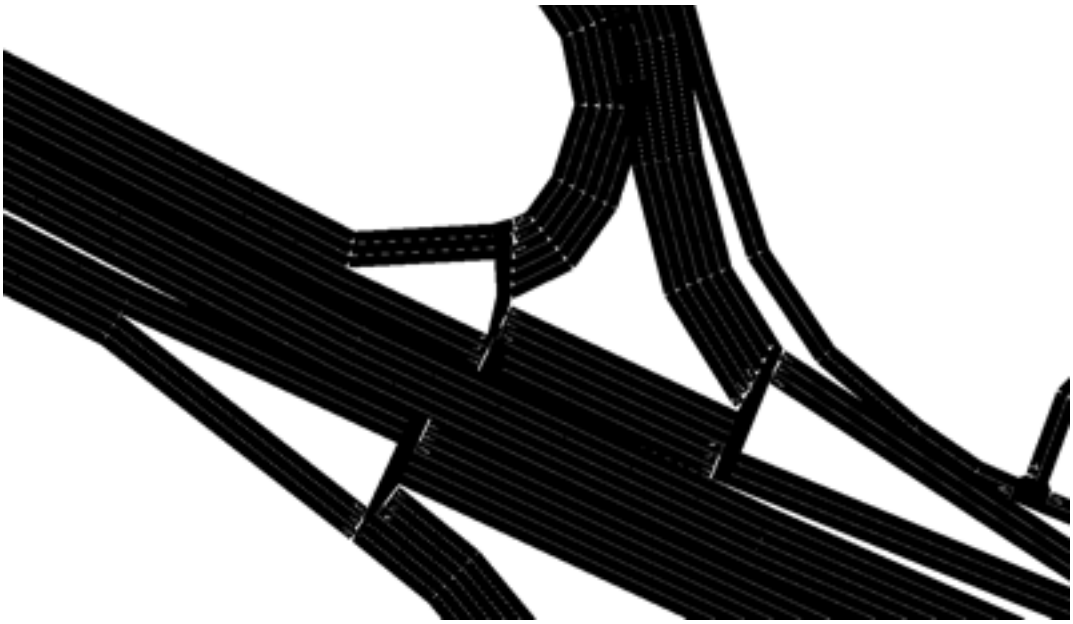
Data Quality

Looking a bit deeper at the network, we had to realise two further problems. At first, highway on- and off-ramps are marked as "highway". this yields in a network where on- and offramps have the same number of lanes as the highways themselves. And it's definitely not fitting to reality, as the next picture shows:

Figure 3.2. Detail view showing problems with (unidirectional) highway on-/off-ramps

Furthermore, all streets are unidirectional - even highways. This makes the network not usable for traffic simulations when left in the orignal state. Trying to convert the network with `--arcview.all-bidi`, that means trying to insert edges bidirectional, makes the city usable, but the highways are even worse, now, because also the on-/off-ramps are bidirectional, then...

Figure 3.3. Detail view showing problems with (bidirectional) highway on-/off-ramps



Demand

There is no demand available for Osnabrück - at least none we know about.

Conlusion

Using the current features we are able to parse the network from the Frida-project but we can not state it is completely usable for traffic simulations. At least areas around highways are not realistic, because on-/offramps lack an explicite declaration and are due to this as wide as the highways themselves. Furthermore, all streets within the network are coded in just one direction. Extending them to be bidirectional solves the problem in inner-city areas, but yields in an unacceptable result for highways. Still, if one wants to simulate only the inner city traffic, the error made when inserting edges bidirectional should be small enough to get a working, realistic network at no cost.

Data

You can download the converted networks from the additional data [http://sumo.sourceforge.net/downloads/add_data.shtml#frida] page.