Preparation of Digital Maps for Traffic Simulation; Part 1: Approach and Algorithms

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Problem Description

What we do: microscopic simulation of large road networks.

Mainly needed for this:
   a fast simulation (SUMO) and road networks

For microscopic modelling, following information is necessary for every junction:
- The lane-to-lane connections
  Which lanes may be reached from which lane?
- The right-of-way rules
  Which flow has to wait for another flow?

(Not regarded herein: junction’s geometry)
Problem Description
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Mostly used approach: Edit the network by hand
...but: we deal with REALLY LARGE networks
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Assume you need 1min for each junction (if you have the data): 10.000 junctions → 4 weeks of hard (error-proned) work

The only solution: use algorithms that do the job
Computing lane-to-lane connections - Overview

Steps:
1. for each edge: compute turnaround edges
2. for each node: sort each node’s edges
3. for each node: compute each node’s type
4. for each node: set edge priorities
5. for each edge: compute edge-to-edge connections
6. for each edge: compute lanes-to-edge connections
7. for each node: compute lane-to-lane connections
8. for each edge: recheck lanes
9. for each edge: append turnarounds

... quite many; we will not present them all herein. A complete description may be found in the publication and the source.
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Determining lanes-to-edge connections
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The spread to next lanes changes!
Determining lanes-to-edge connections

Solution is using heuristics in step 6:
- get the list of connected edges beside the turnaround
- sort them by their angle
- for each edge in this list, compute its priority for the current edge:
  (priority = (connected edge’s junction_priority + 1) * 2)
  - if one of the lower prioritised outgoing roads goes to the right:
    - divide his importance by 2 as vehicles using it can leave the junction faster
  - if there are no major roads at this junctions:
    - multiply the outgoing road that goes straight by 2, making it more important than the others
- compute the number of lanes that shall approach each of the connected edges:
- sum up all priorities
- for each outgoing (connected) edge:
  - number of lanes to use to reach this edge = this edge’s priority for the current edge / priority sum
  - if number > number of current edge’s lanes:
    - number = number of current edge’s lanes
Determining lanes-to-edge connections

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Determining lanes-to-edge connections

What does it mean?

• All edges get a weight in dependence to their „priority“ (major roads get a higher)

• The right turn gets only half priority if the destination is not a major road

  Reason: right-turning vehicles move faster than left-turning (because they do not have to wait for vehicles coming from the opposite direction)
Validation

A validation has been done for the OIS-Scenario:

4 of 177 junctions were not proper, yielding in a accuracy of ~98%
Validation - falsely computed Junctions

Reason: unknown flow
(many more vehicles drive left)

Reason: unknown continuation
Conclusion

- The algorithm seems to be useful for most cases;
- In some certain cases, the computed information still has to be edited by hand;
- But: several heuristics are used, which
  - Should be verified against reality more deeply
  - Which should be grounded in theory
- Next Steps:
  - Further validation
  - Validation for networks lying within other regions of the world
  - Guessing of traffic light positions, highway on-/off-ramps (in work)
SUMO Project Details

Participants:
- Institute of Traffic Research / DLR
- Zentrum für angewandte Informatik, Köln

current version: Version 0.8.2.4
free download: http://sumo.sourceforge.net
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