Preparation of Digital Maps for Traffic Simulation; Part1: Approach and Algorithms

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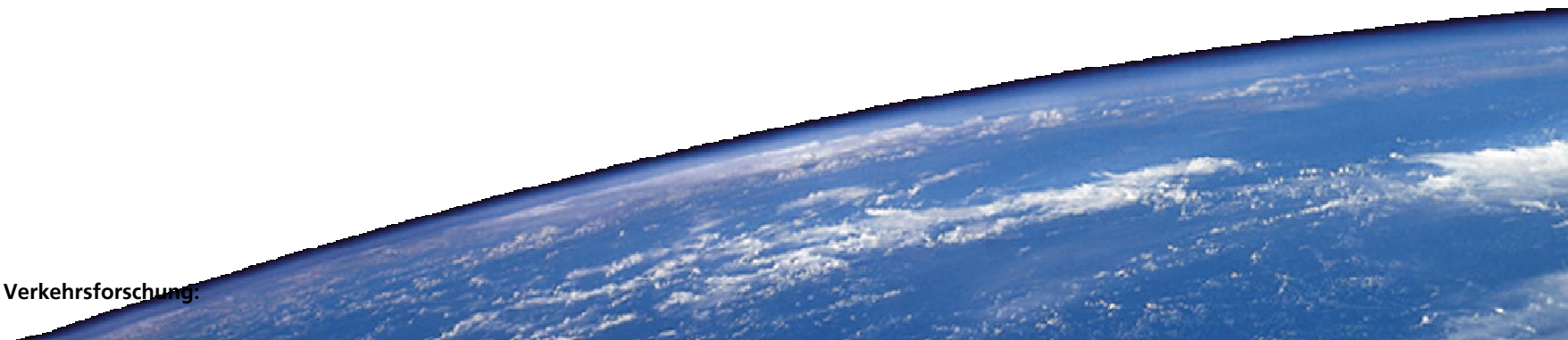


Problem Description

What we do: microscopic simulation of large road networks.

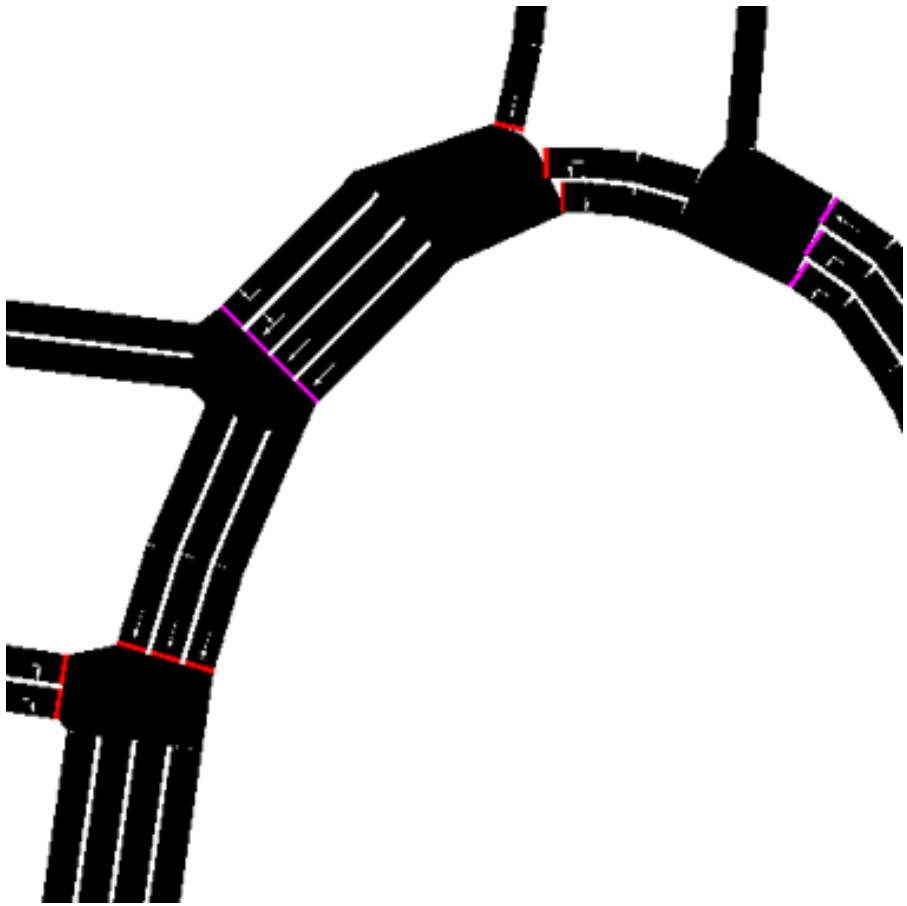
Mainly needed for this:
a fast simulation (SUMO) and road networks

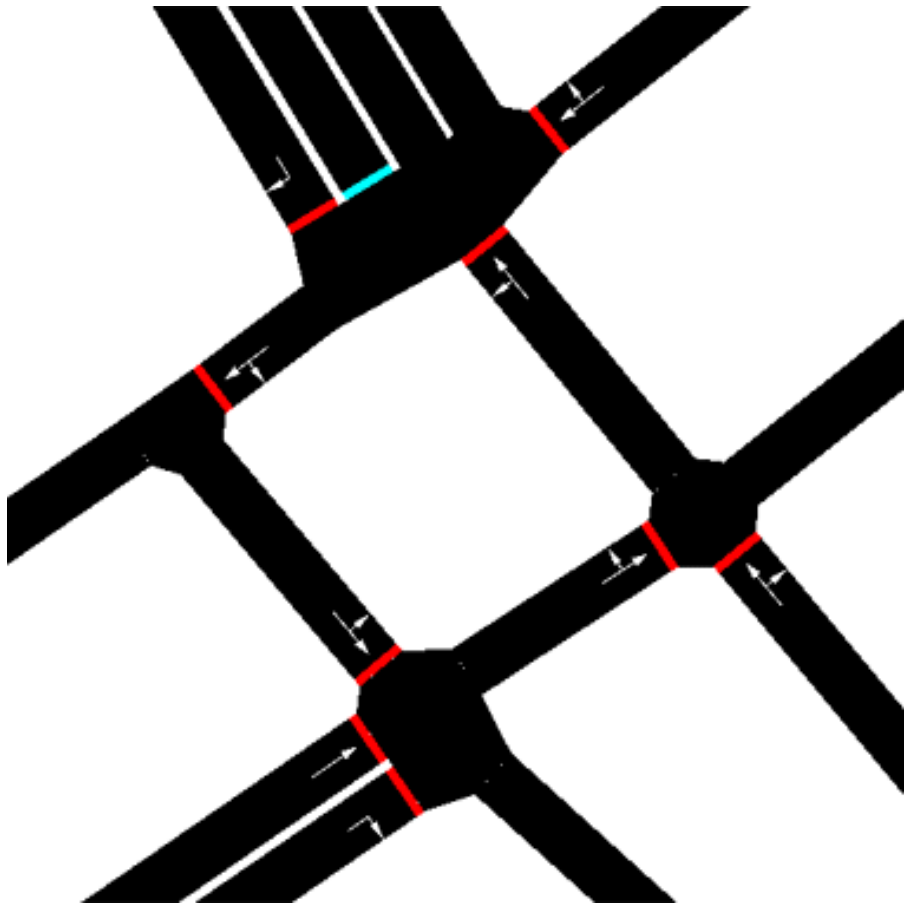
For microscopic modelling, following information is necessary for every junction:

- **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



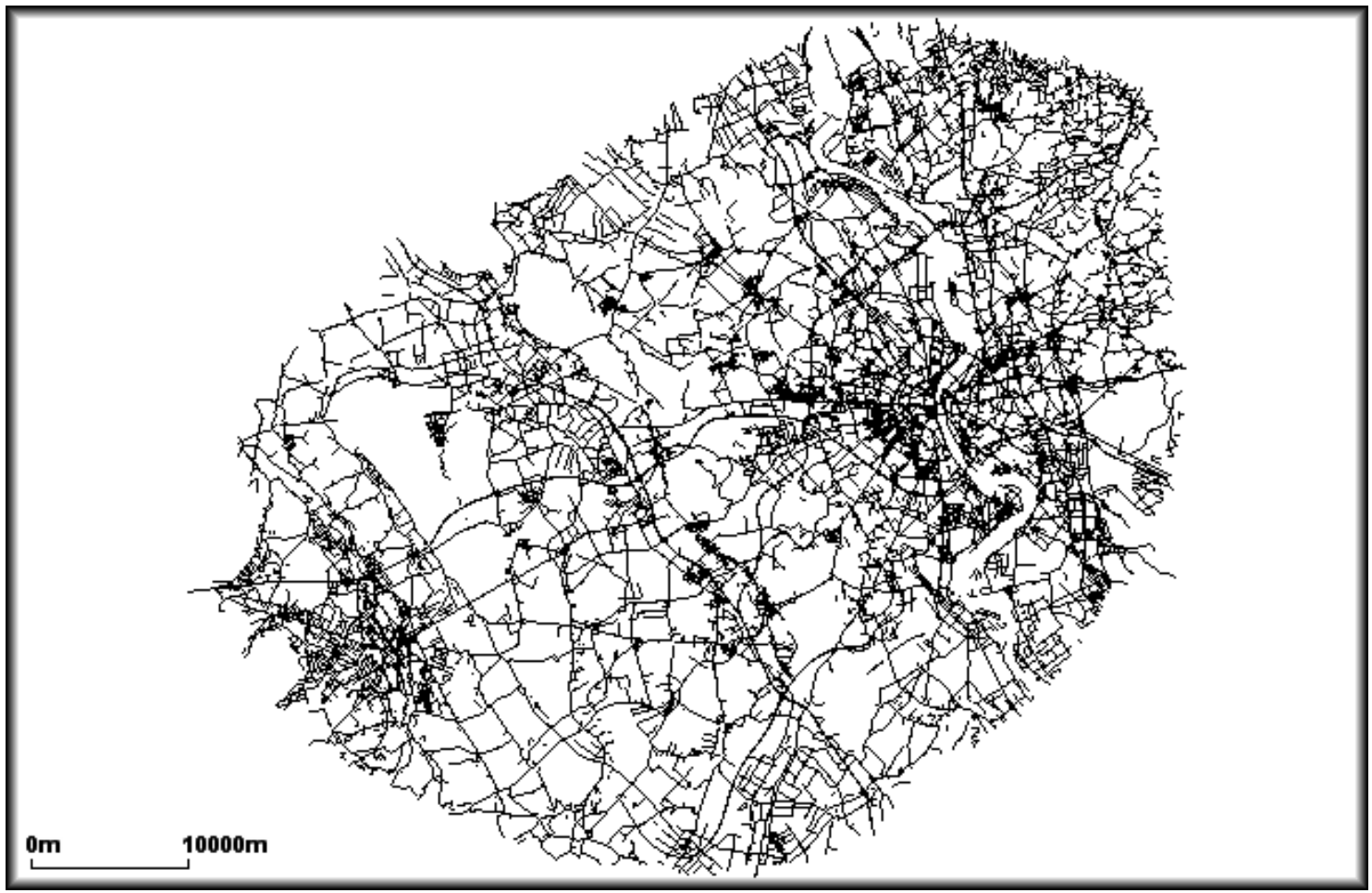


Problem Description

Mostly used approach: Edit the network by hand

...but: we deal with REALLY LARGE networks

Problem Description



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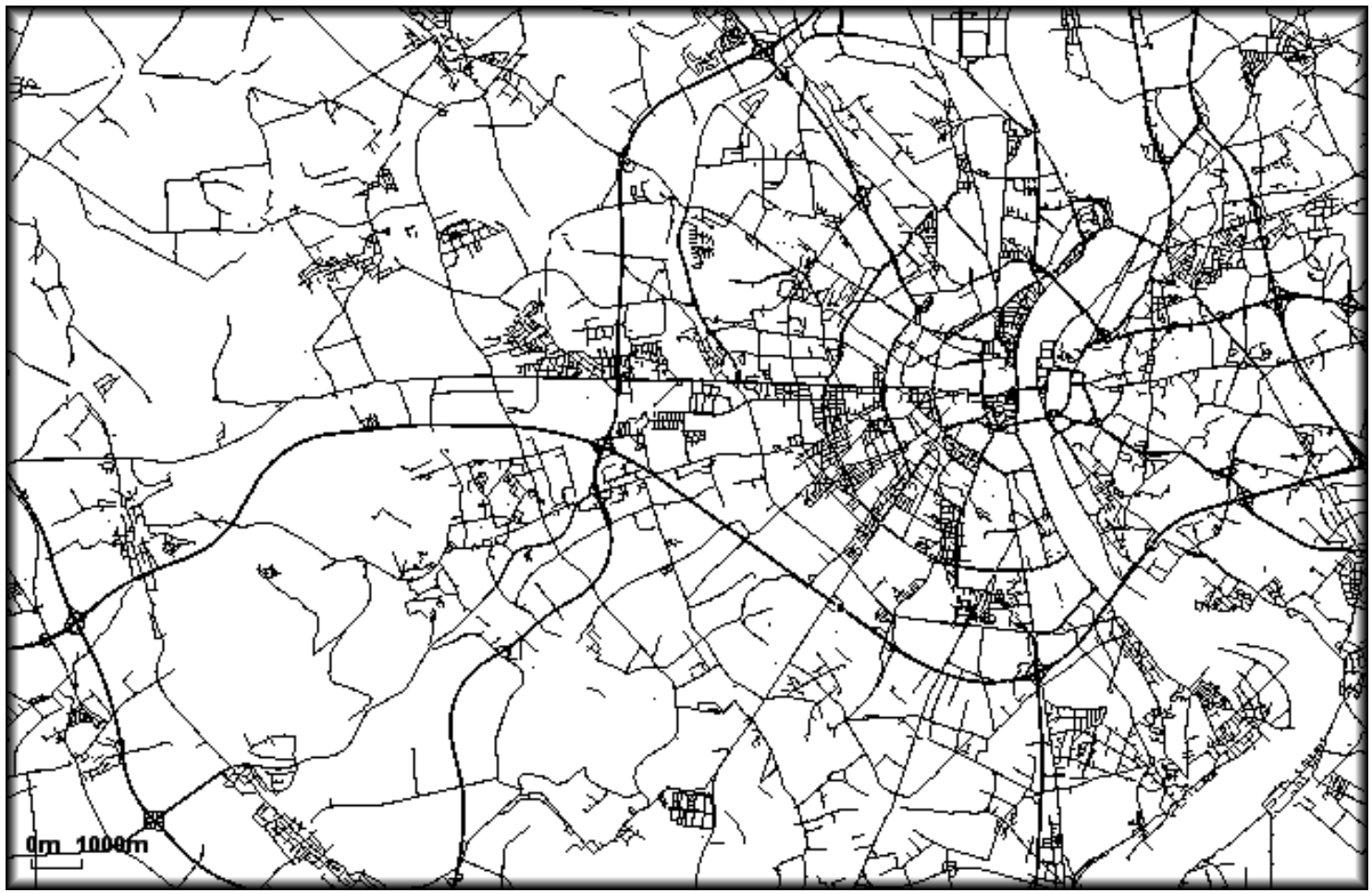

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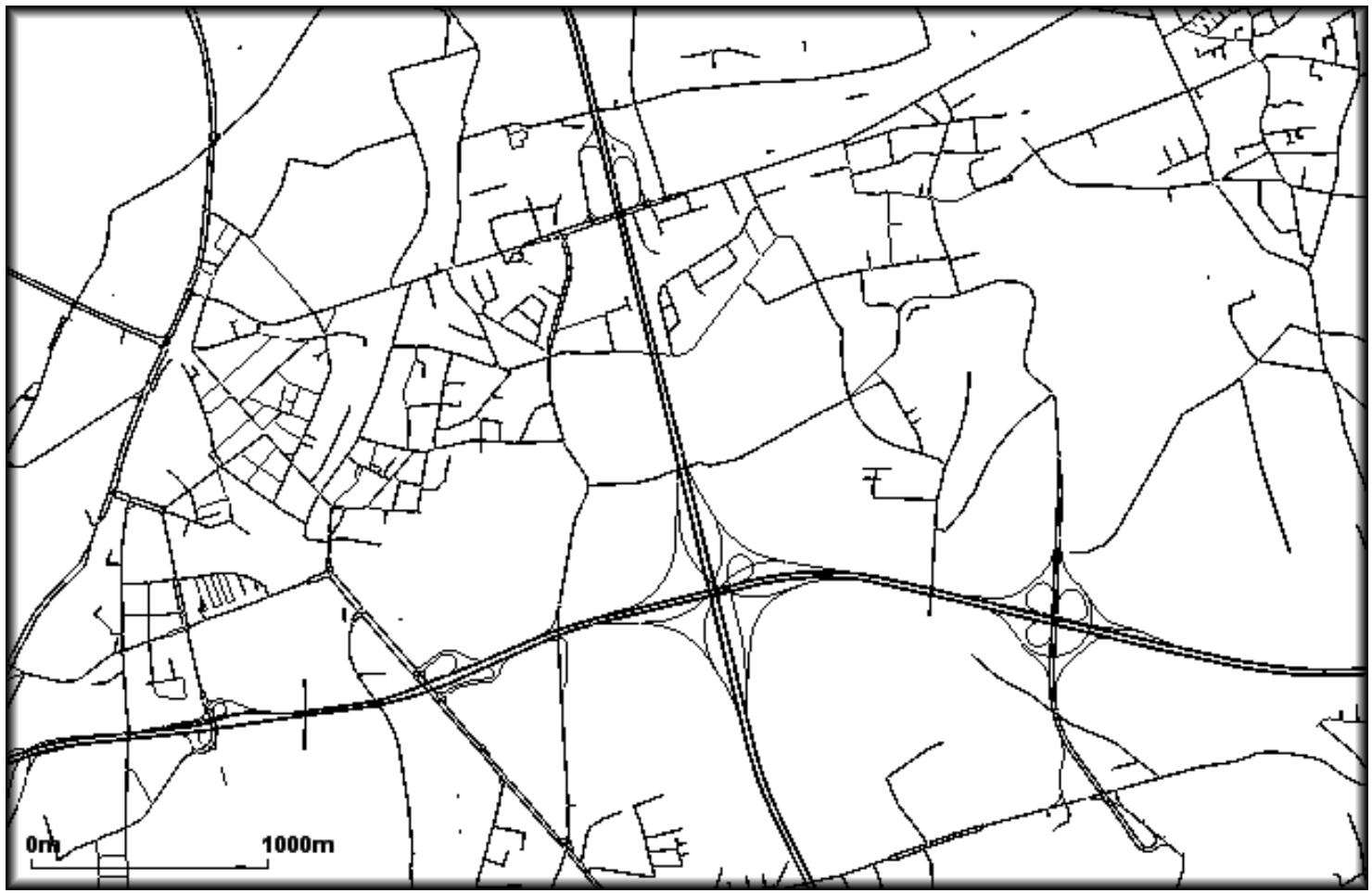

Problem Description

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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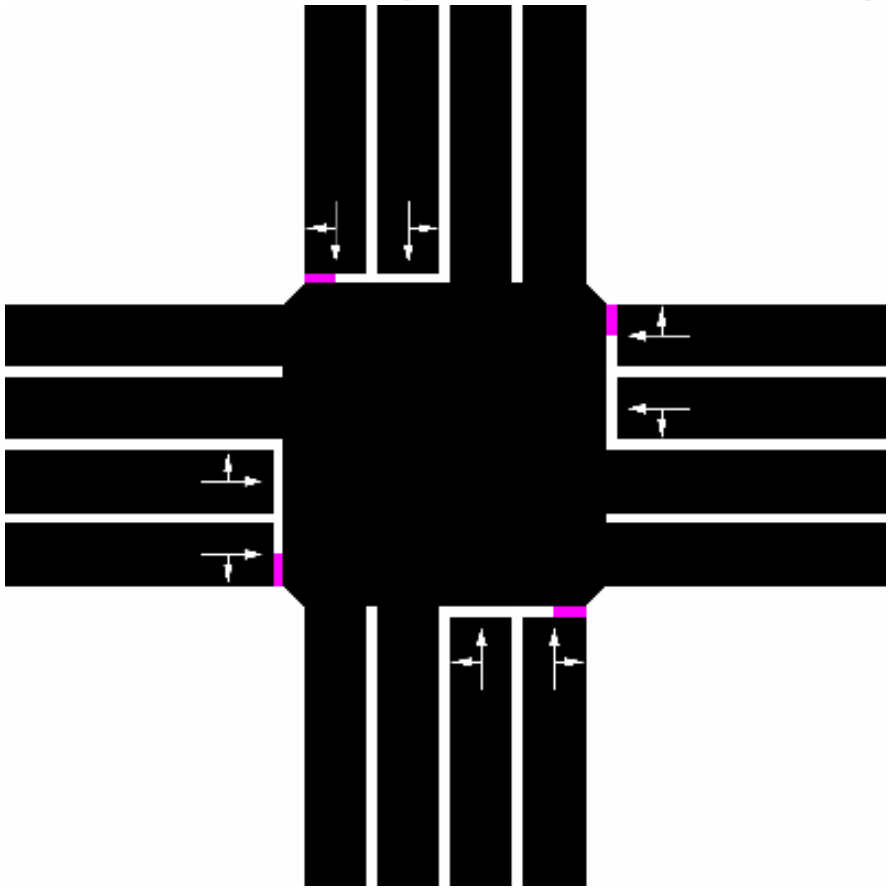
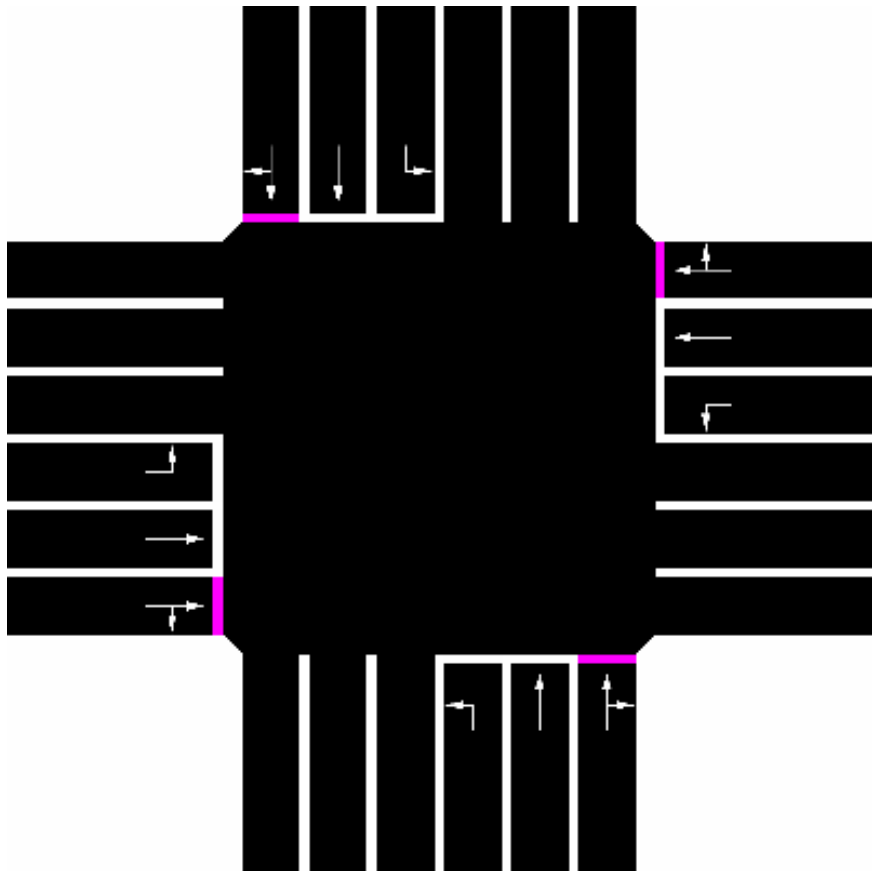
Determining lanes-to-edge connections





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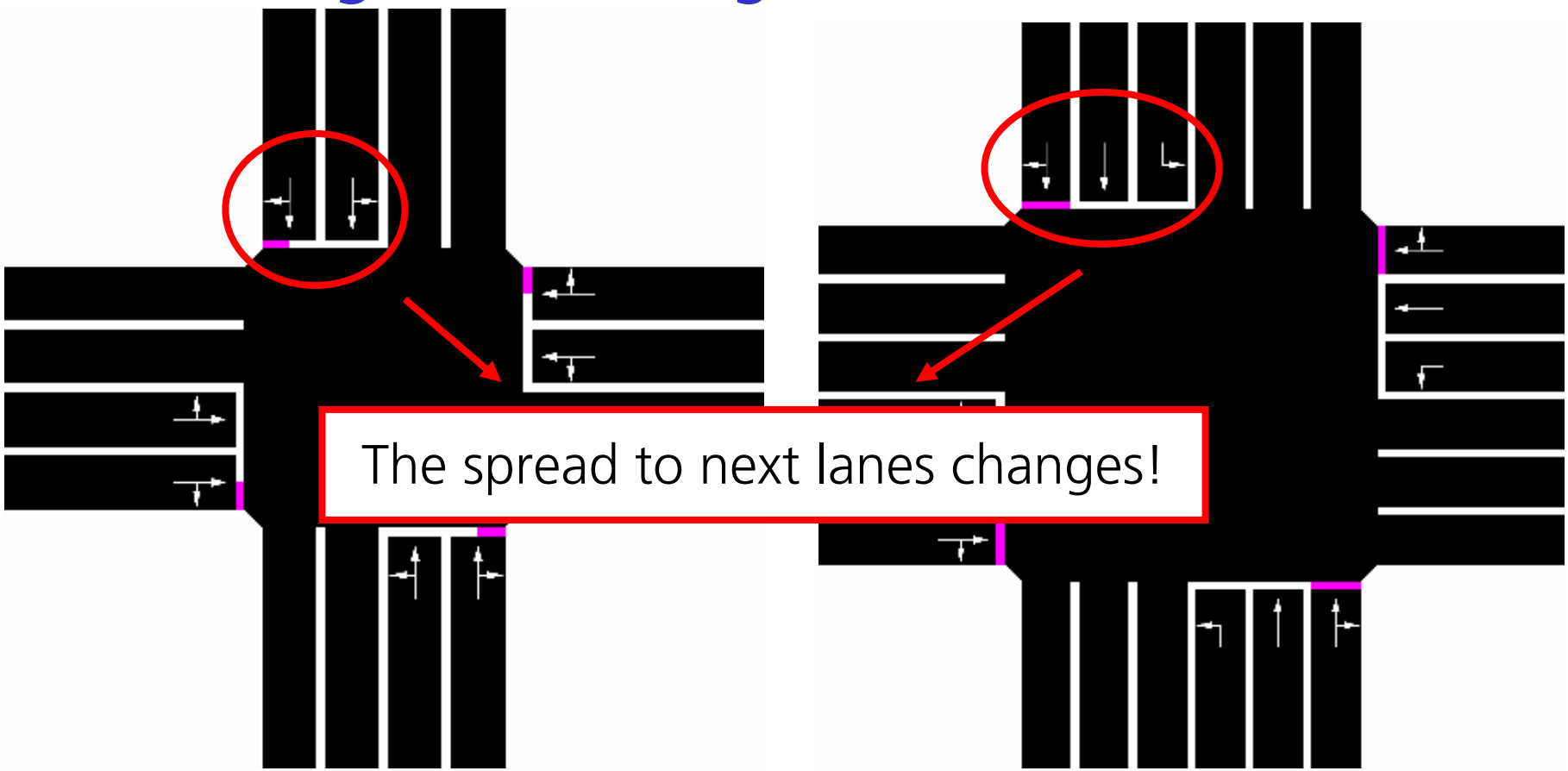

Determining lanes-to-edge connections

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 priorised 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 then 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

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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**

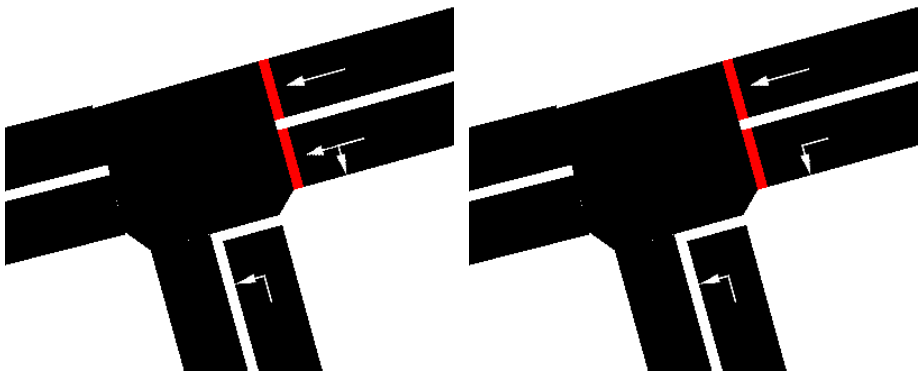
  Reason: right-turning vehicles move faster than left-turning (because they do not have to wait for vehicles coming from the opposite direction)

Validation

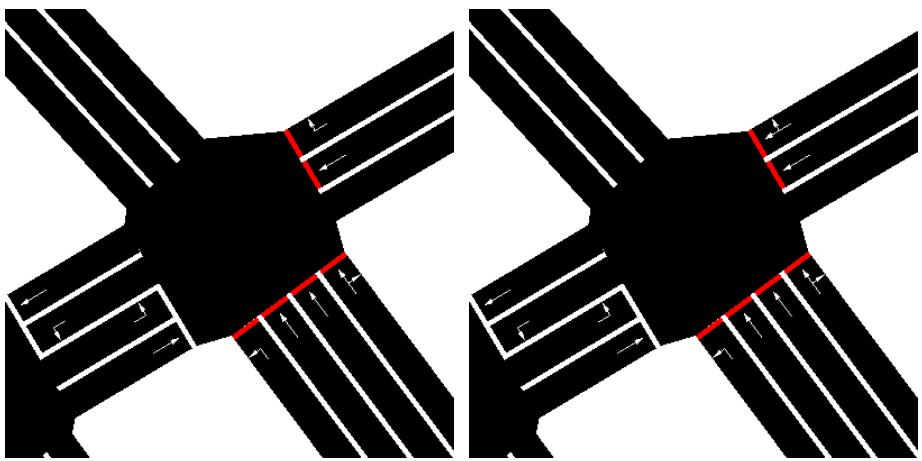
A validation has been done for the OIS-Scenario:

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**
contact:	**Daniel.Krajzewicz@dlr.de**