

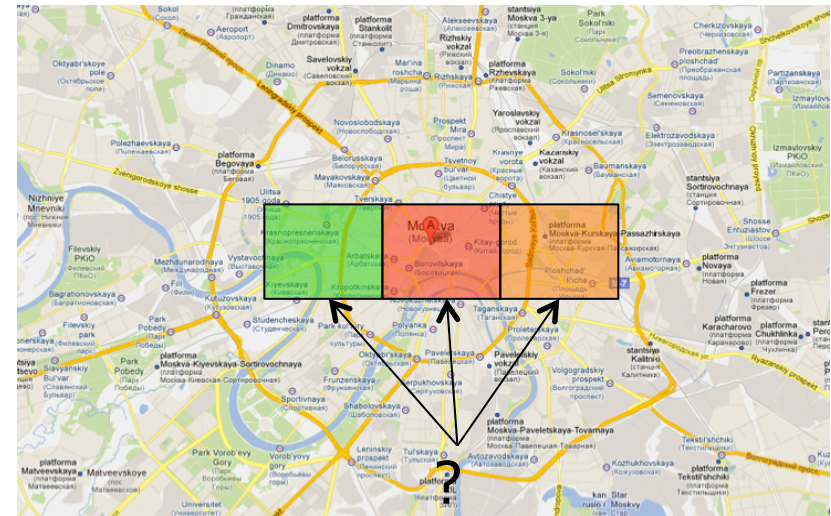
Traffic control using the Macroscopic Fundamental Diagram

Victor L. Knoop

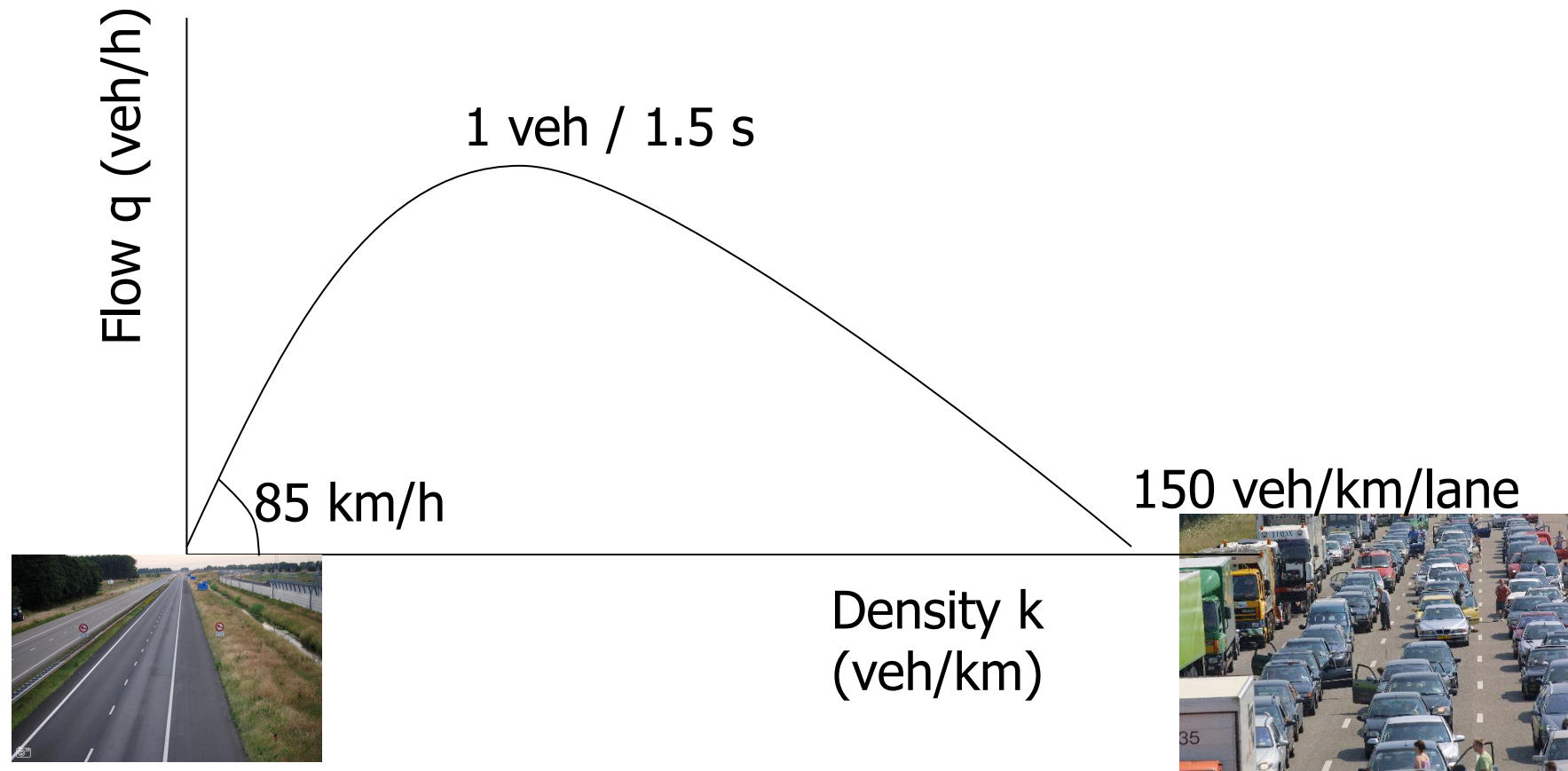
20-10-11

Contribution

- Macroscopic fundamental diagram claimed for perimeter control
- Relationship empirically proven
- Now: control!
("proof" by simulation)

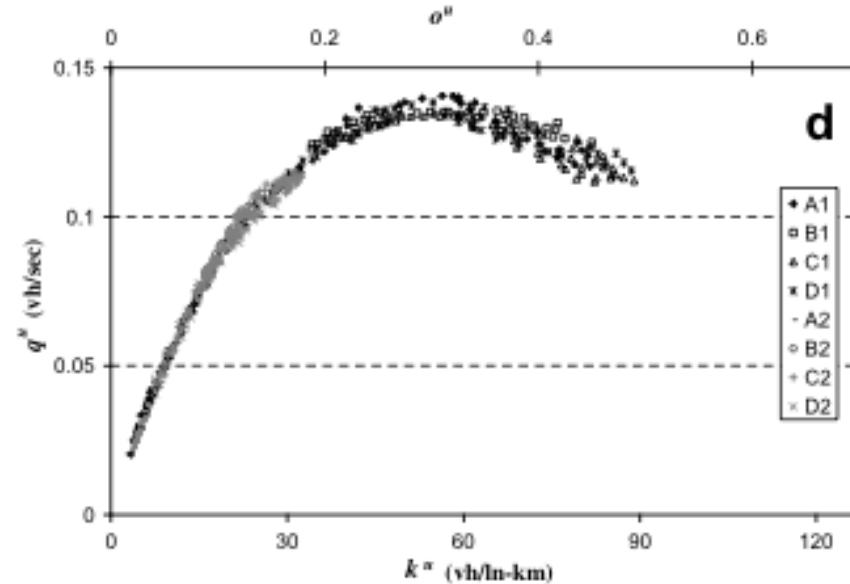
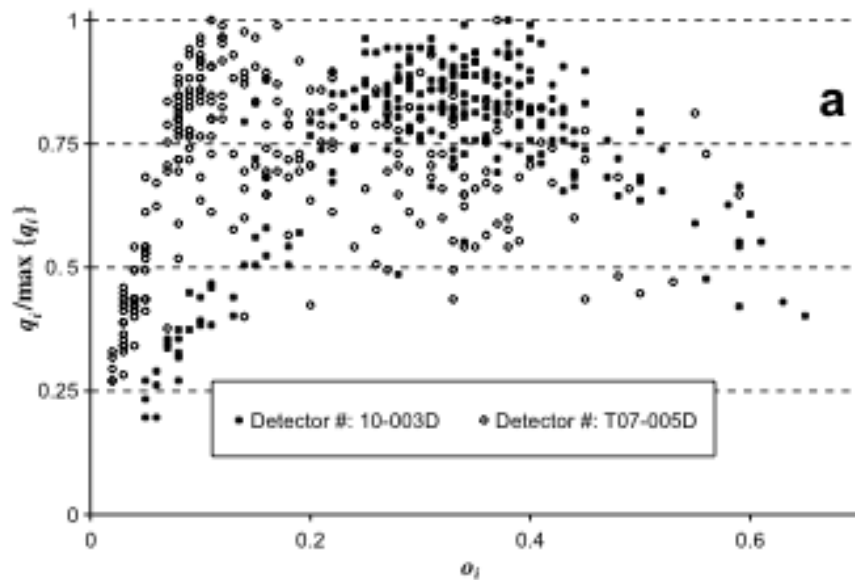


Traffic flow characteristics - links



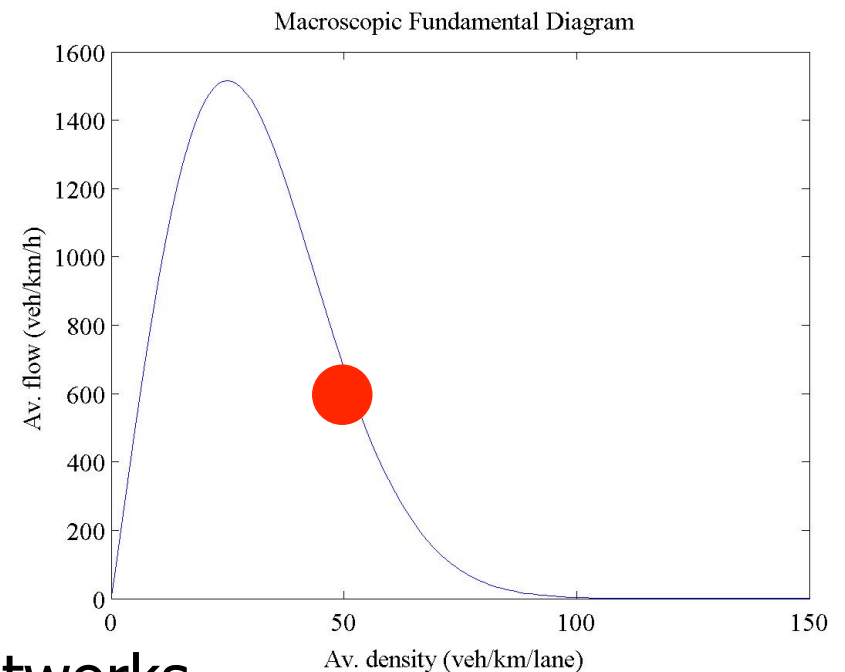
But now practice!

- Macroscopic fundamental diagram
- “Average” fundamental diagram for an area



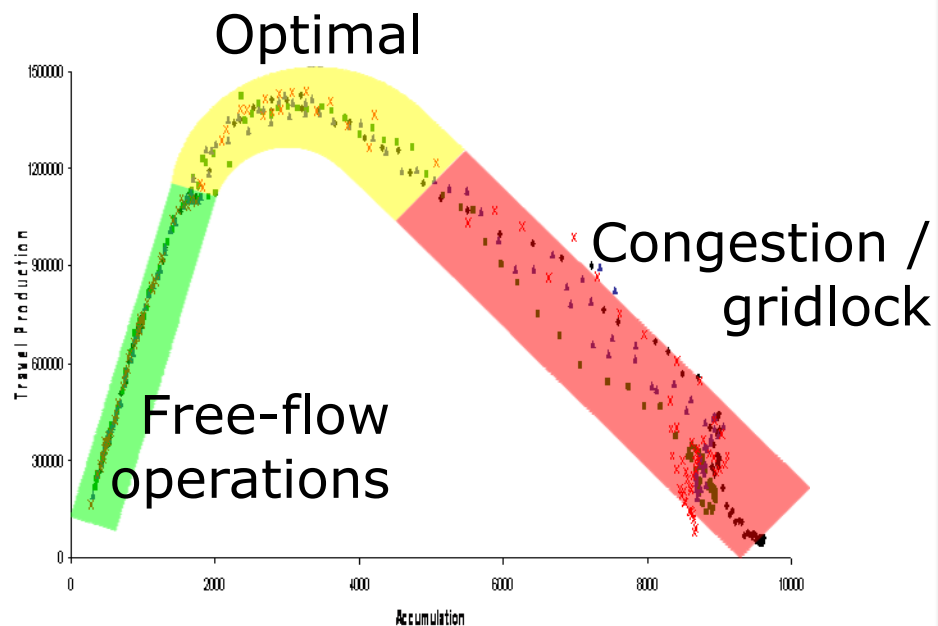
Control?

- Often: perimeter control
- Now: routing through subnetworks



What about info (and hence data) needs for (sub) networks?

- Use macroscopic fundamental diagram (MFD) as a monitoring concept
- Use Production & Accumulation as state indicators



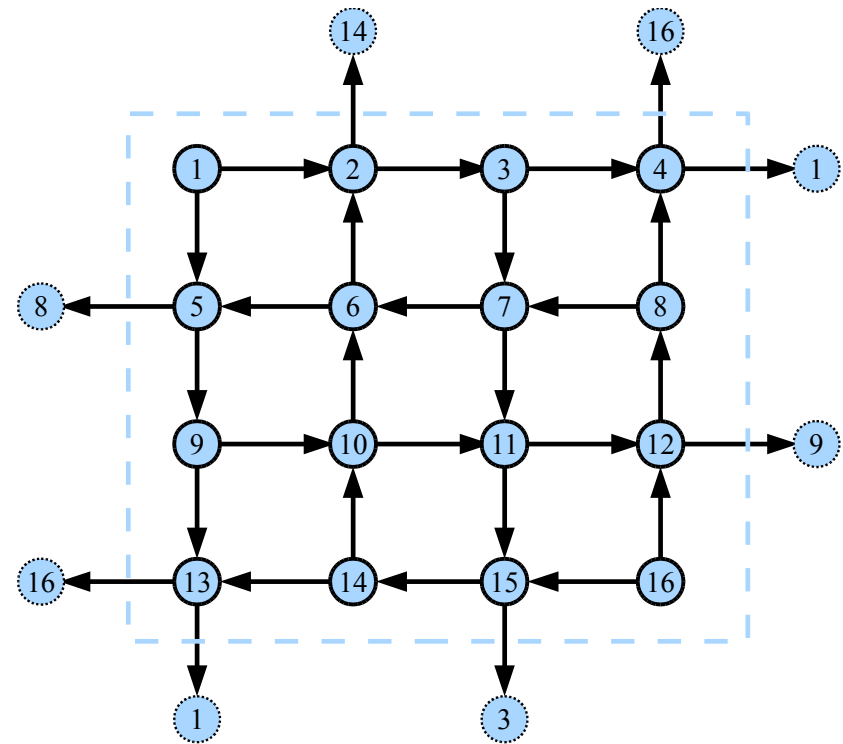
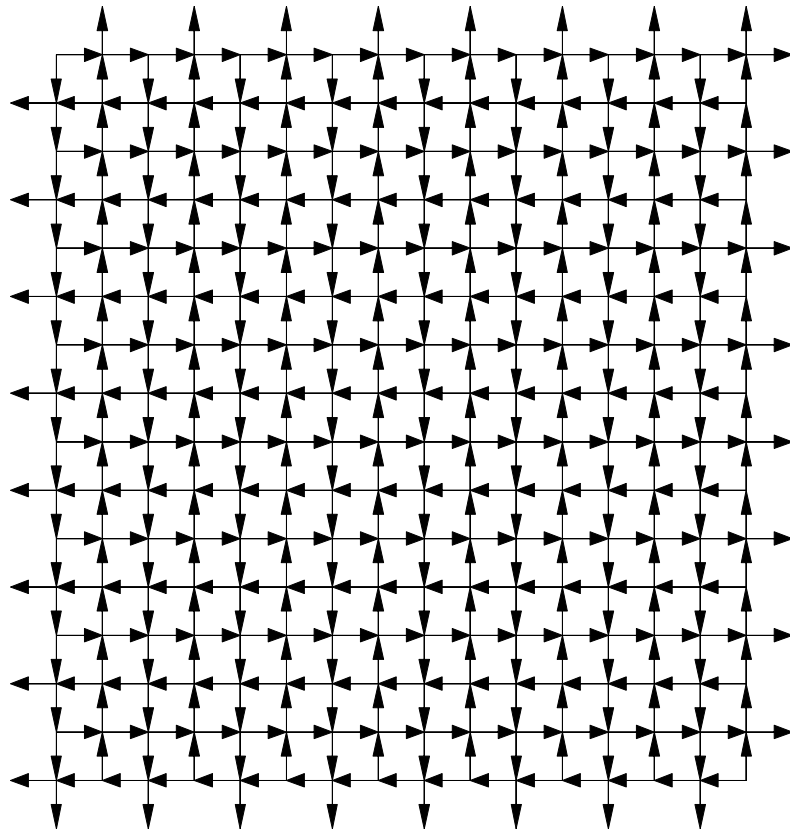
Problems

1. MFD not well defined for inhomogeneously congested networks (implies that $\{P, A\}$ state trajectory not very informative for control)
2. MFD requires lots of data to be determined (all links)!

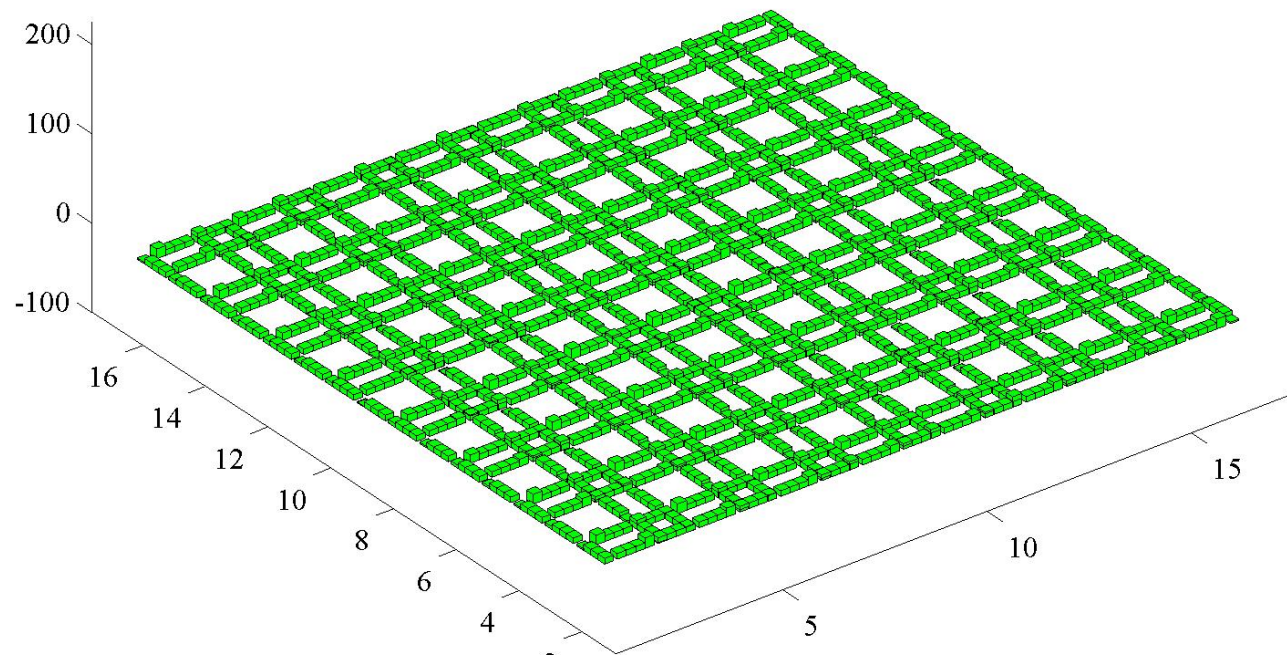
Test:

- Routing in a grid network
 1. Shortest path (distance)
 2. Shortest path (time)
 3. Area-based
 - a) Average speed
 - b) Macroscopic Fundamental Diagram approaches
 - Shape 1
 - Shape 2
 -
 - Etc.

Network with periodic boundary

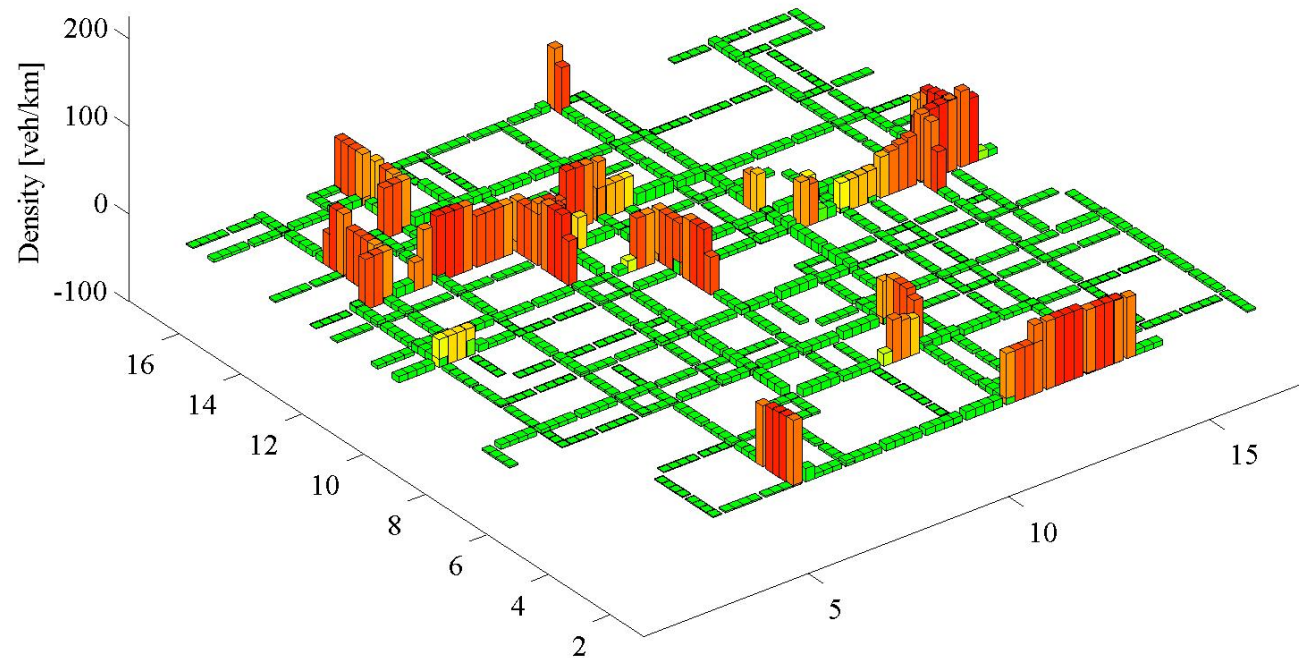


Build up of congestion



Build up of congestion

network no routing - $t=0.5h$

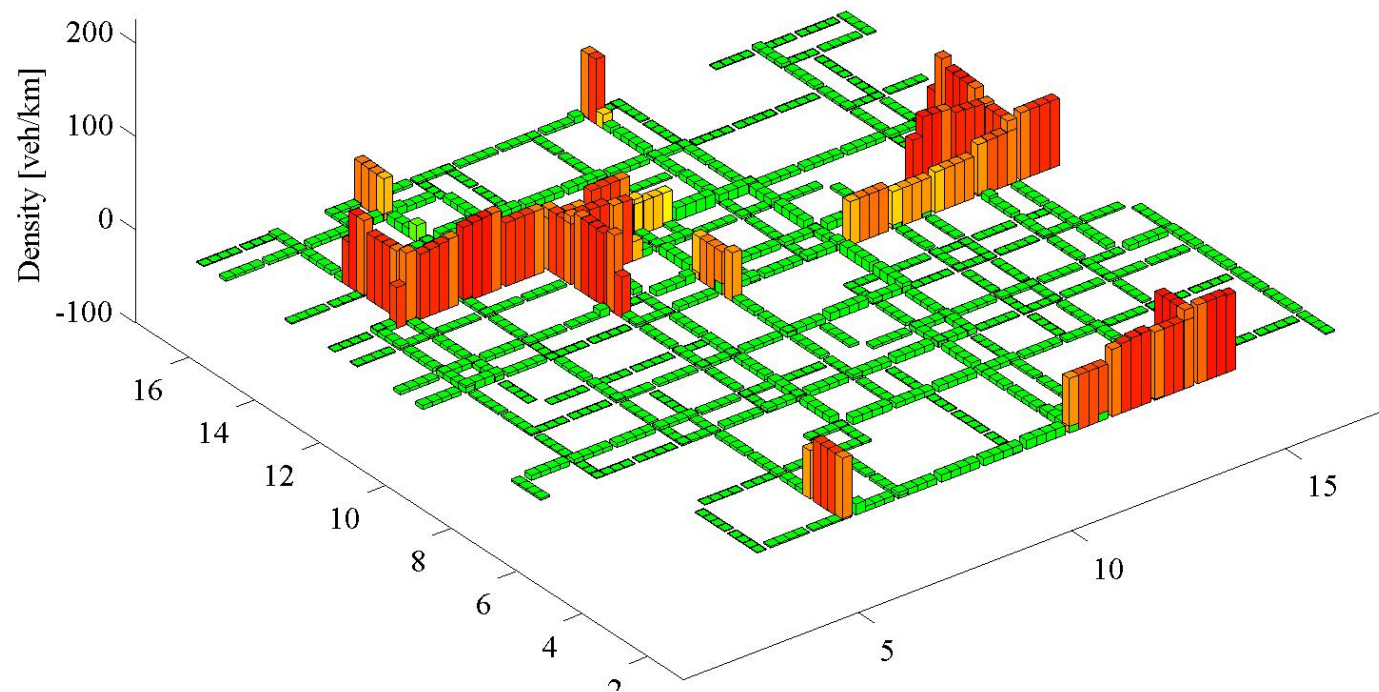


11

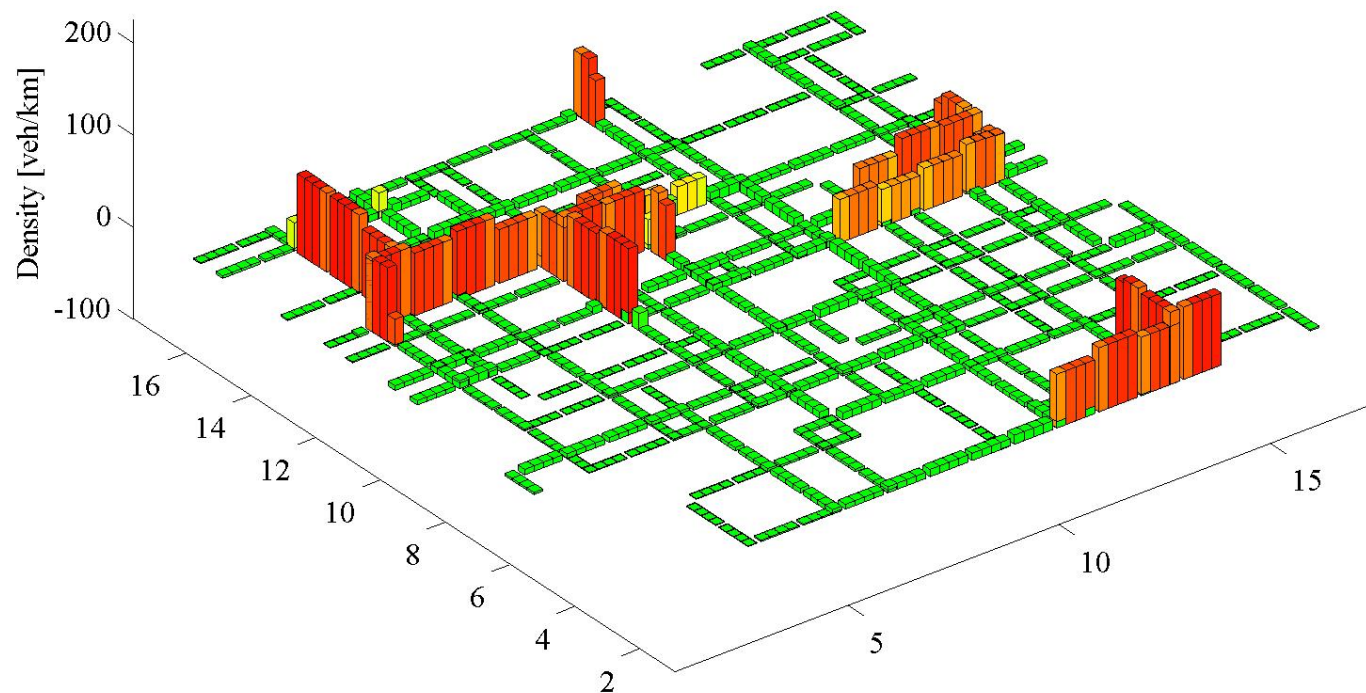
2

3

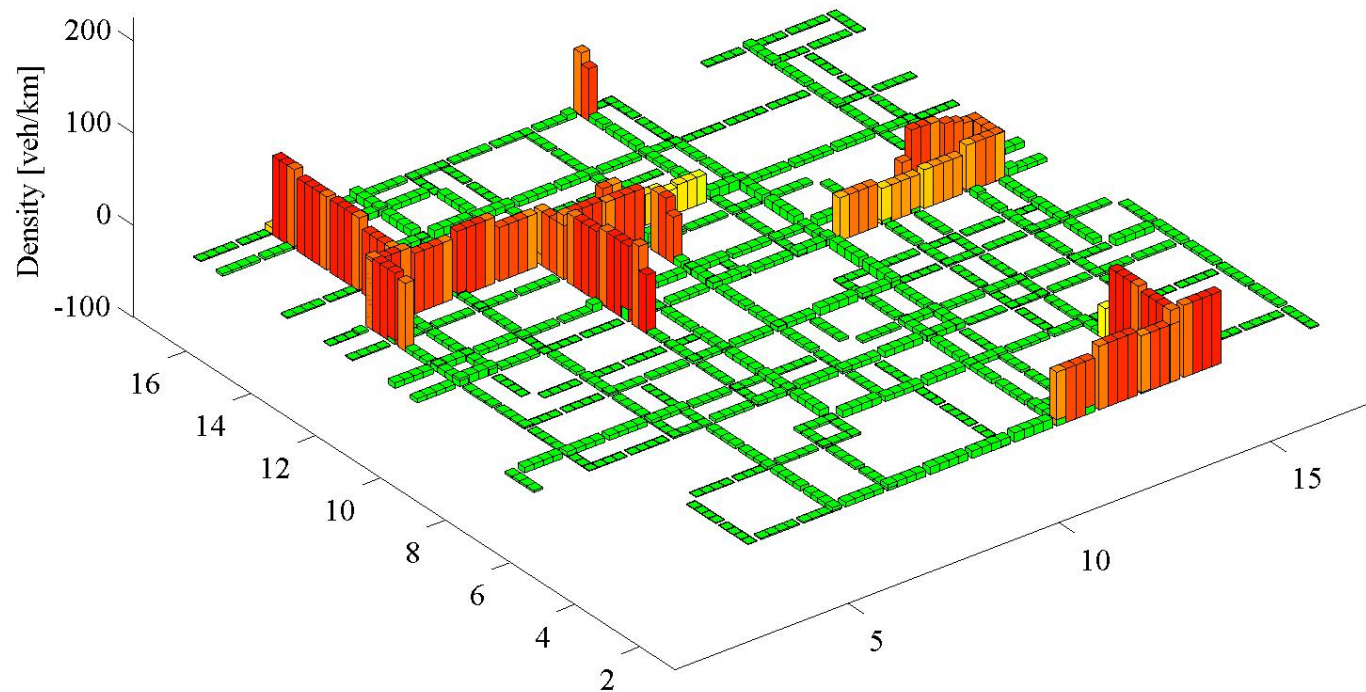
network no routing - $t=1h$



network no routing - $t=2h$

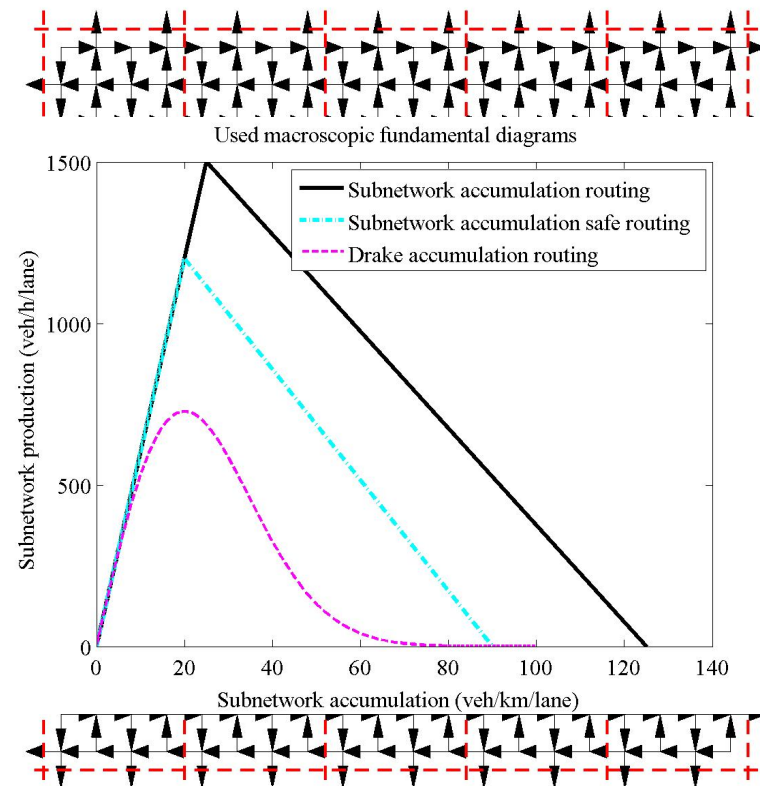


network no routing - $t=3h$



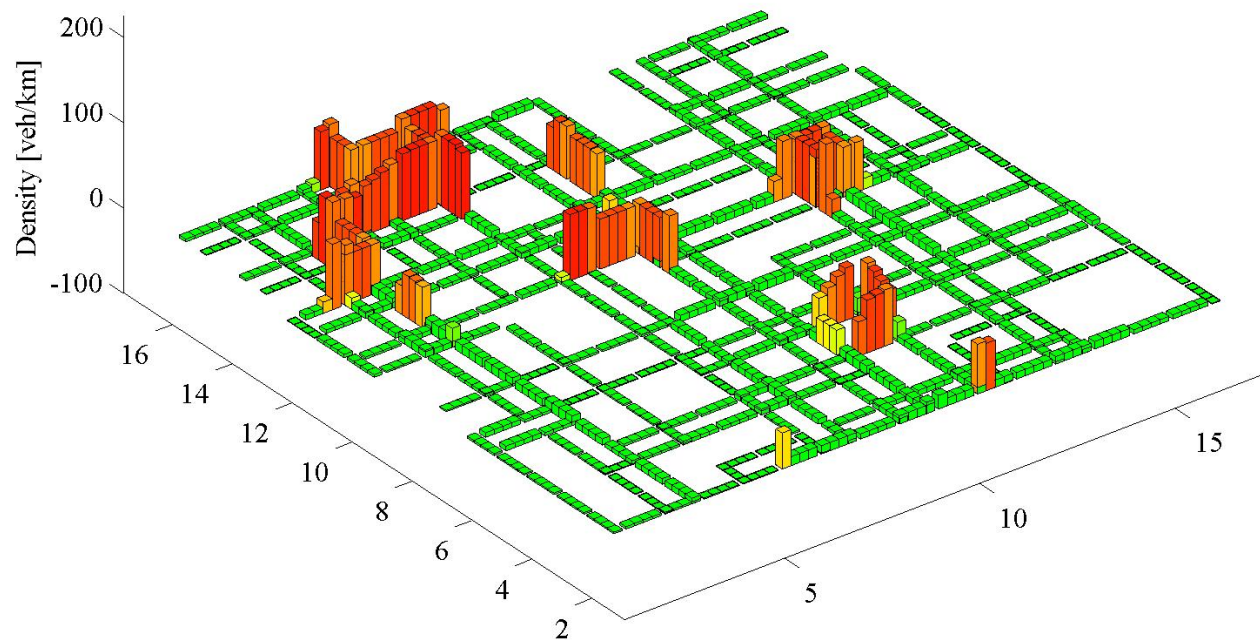
Create subnetworks

1. Shortest path (distance)
2. Shortest path (time)
3. Area-based
 - a) Average speed
 - b) Macroscopic Fundamental Diagram approaches
 - Same as links
 - Lower in flow
 - With tail

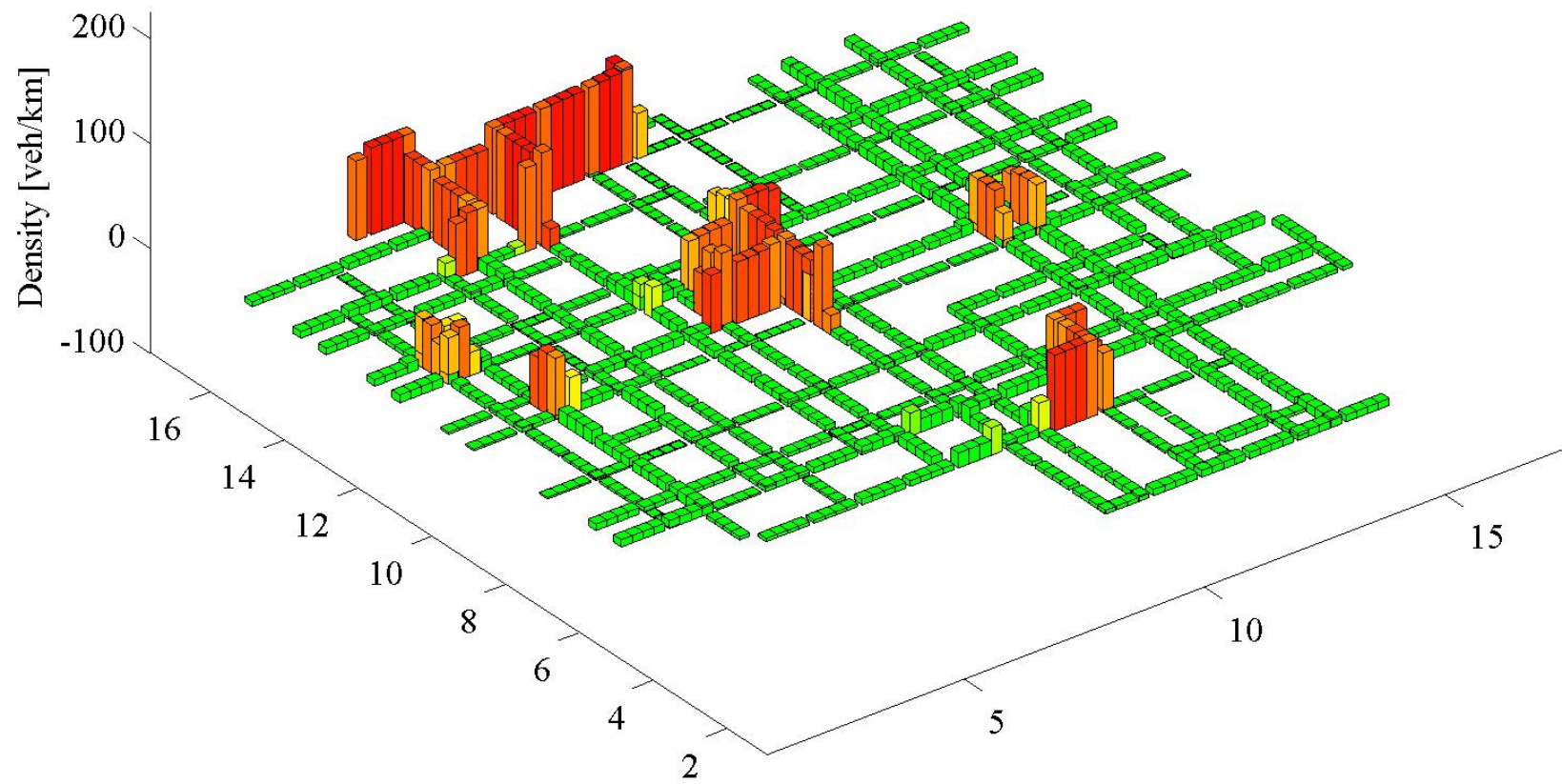


Build up of congestion

network subnetwork routing - $t=2h$

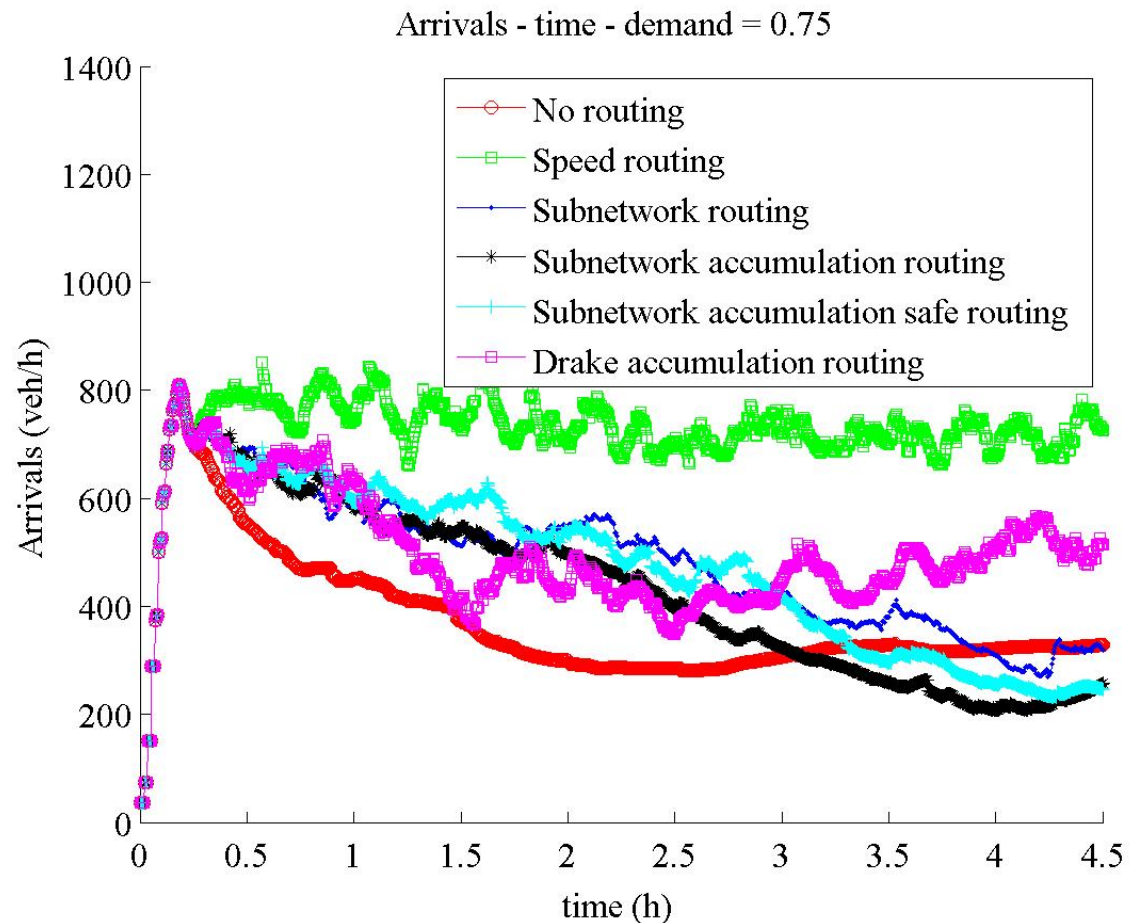


network subnetwork routing - t=3h



Good network performance

- Less than with “full routing”
- Factor 100 less data / computations needed



Conclusions en future research

- Performance reduces with clustering of congestion
- Clustering can be described by an aggregate variable – measured in an subnetwork
- Route advise based on subnetwork variables works
- Does a real network show the same relationship?





- Further reading:
 - Knoop, V.L., Van Lint, J.W.C. and Hoogendoorn, S.P. (2011) Route Advice Based on Subnetwork Accumulations - Control based on the macroscopic fundamental diagram, in: Proceedings of the 9th Conference on Traffic and Granular Flow, 28 September - 1 October 2011, Moscow, Russia