

Simulation Model for Traffic using Network Fundamental Diagrams

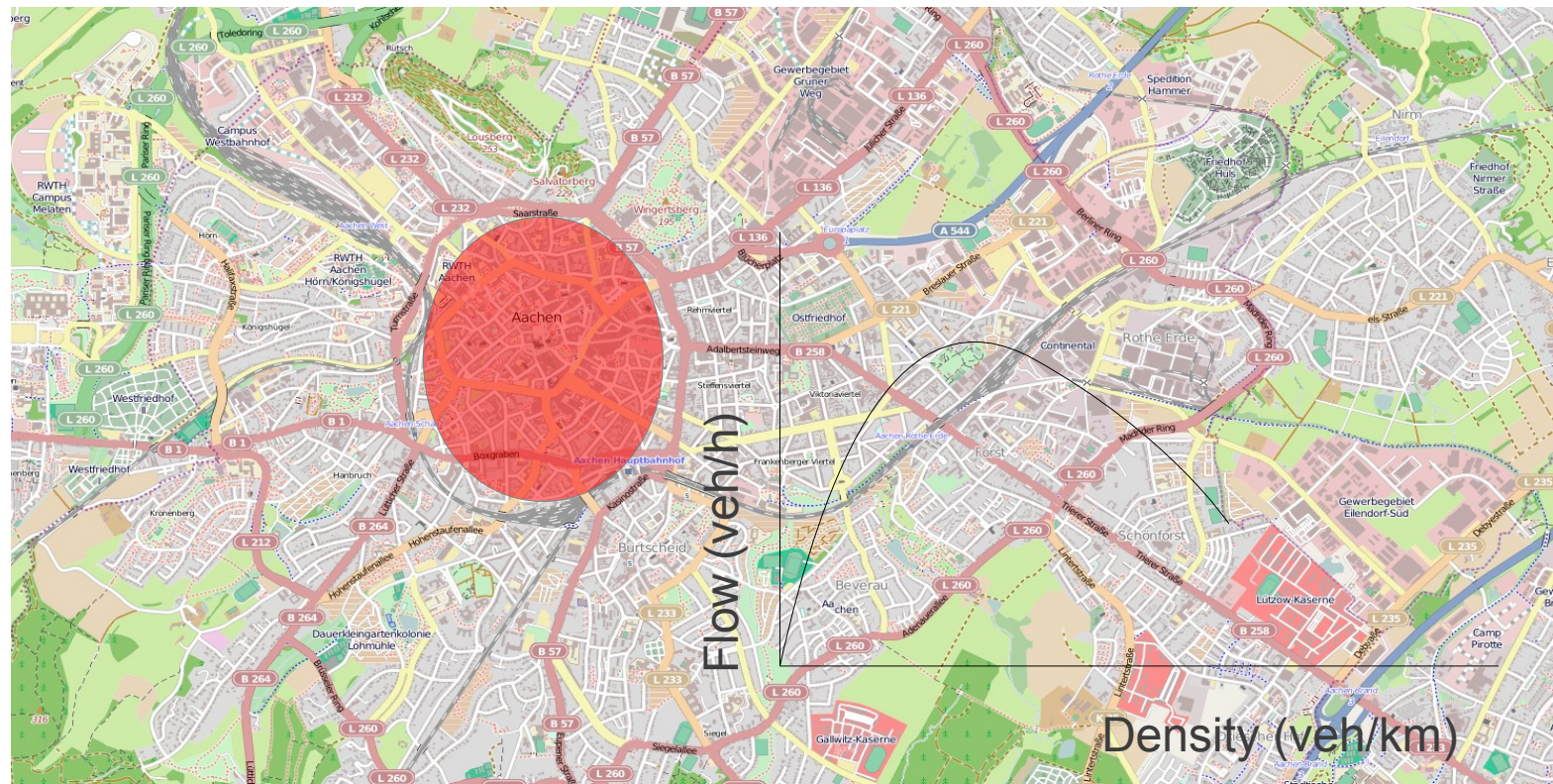
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25-09-13

Network Transmission Model

Introduction

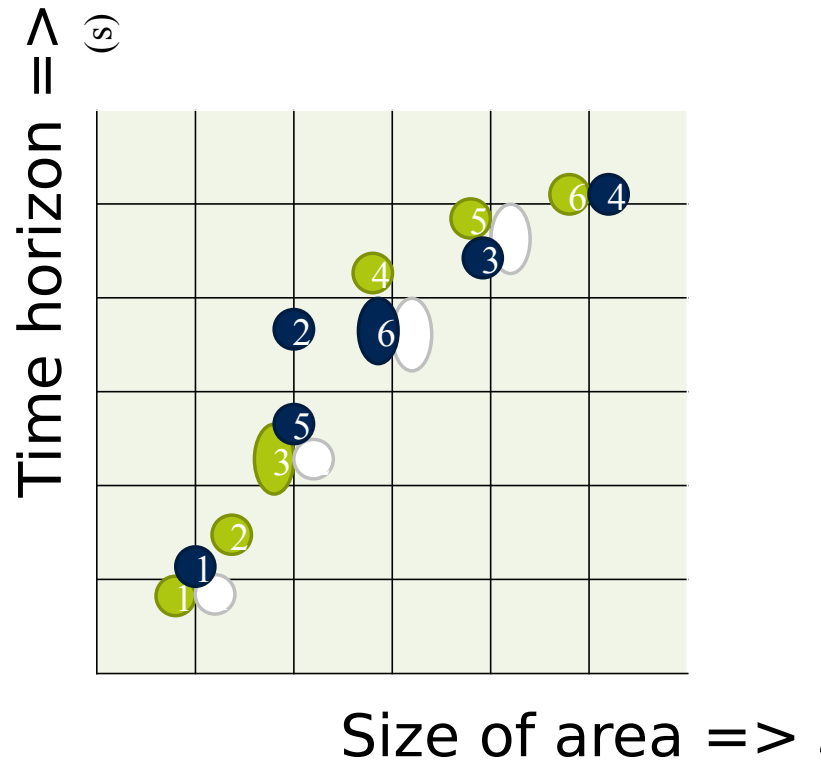
- Network Fundamental Diagram (NFD) relates accumulation to production



Background

- Network Fundamental Diagram (NFD) relates accumulation to production
 - Studied and empirically checked – statically OK
- Influence of inhomogeneity: gNFD
- What are the dynamics?
 - Useful to have a model describing network dynamics

Data increase with scale



- Data requirement increases with scale
- Time horizon increases with scale
- Solution space increases with scale

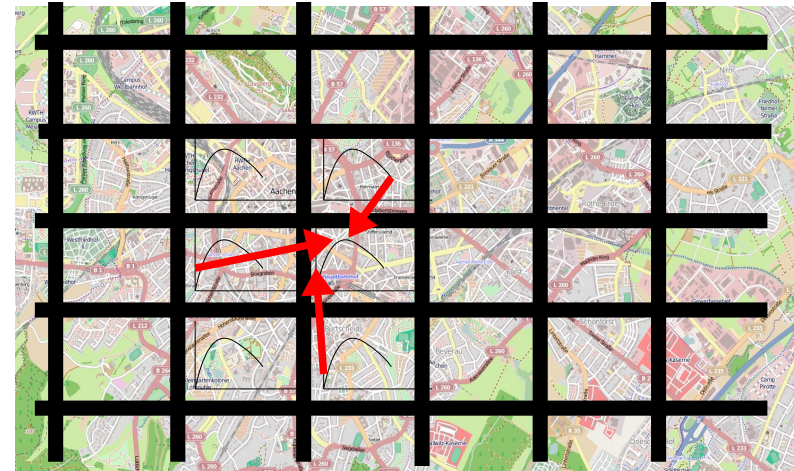
Simplified dynamic large scale model needed

- Network Fundamental Diagram (NFD) relates accumulation to production



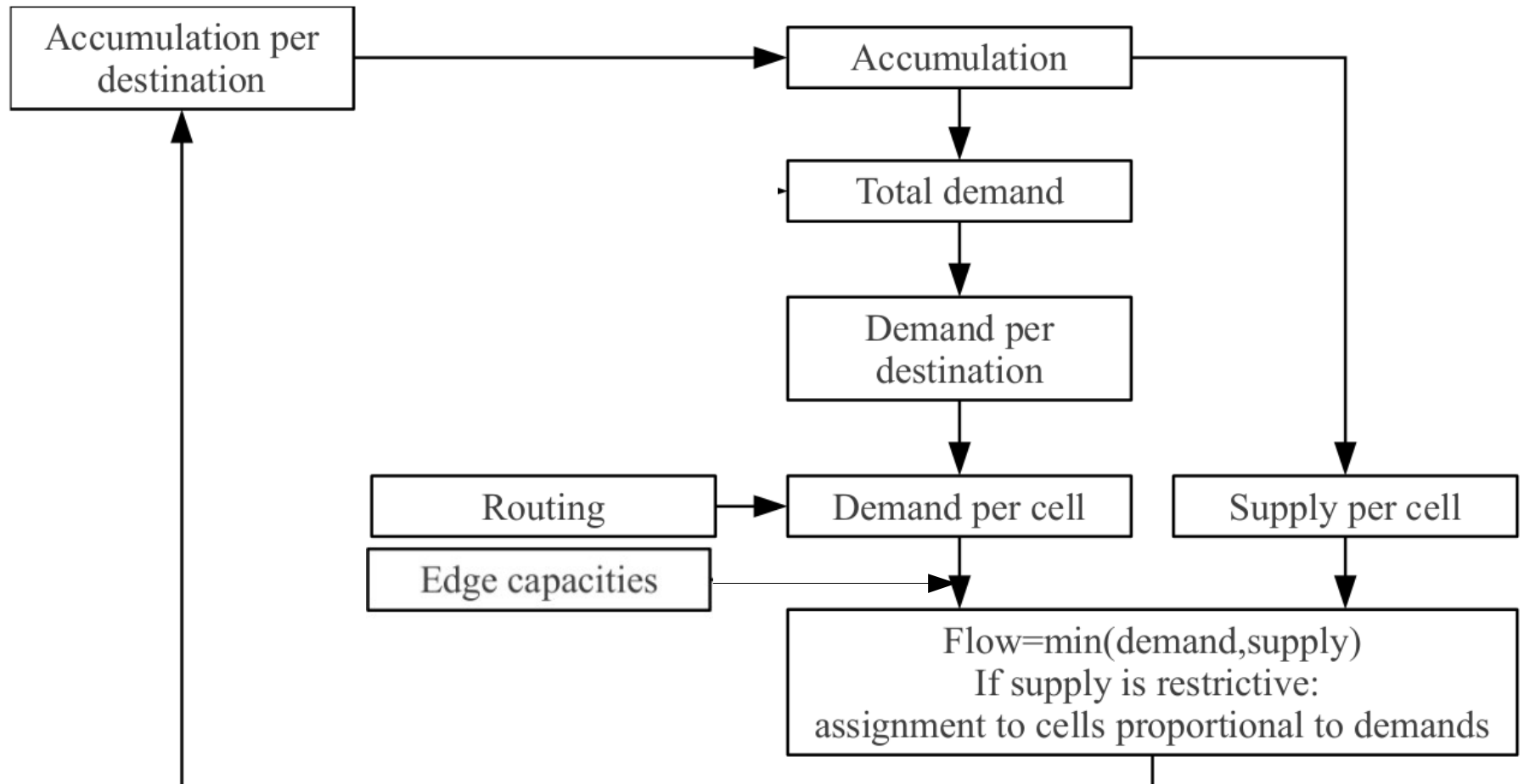
Model principles

- Multi-class traffic
class=destination
- Add accumulations in cell
- Compute **demand** to each
neighboring cells
- Compute supply
- Flow = $\min(\text{demand}, \text{supply}, \text{capacity})$
- If flow < demand: proportional for all classes



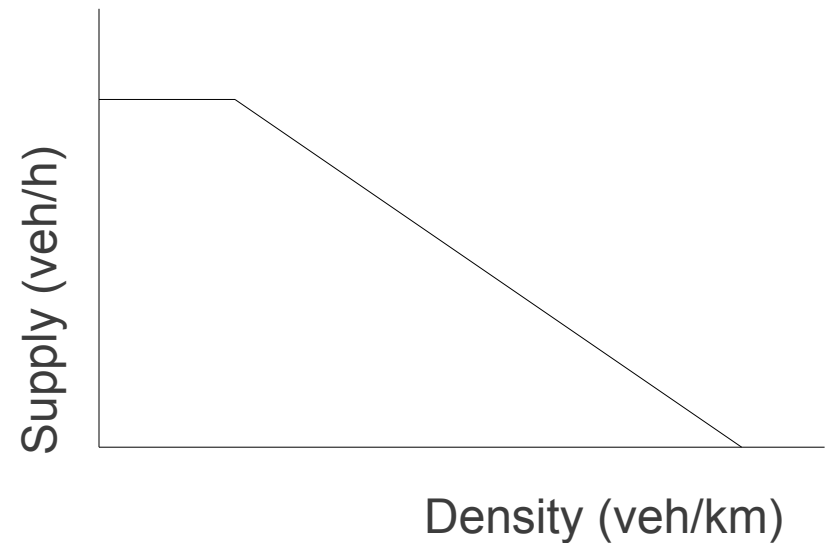
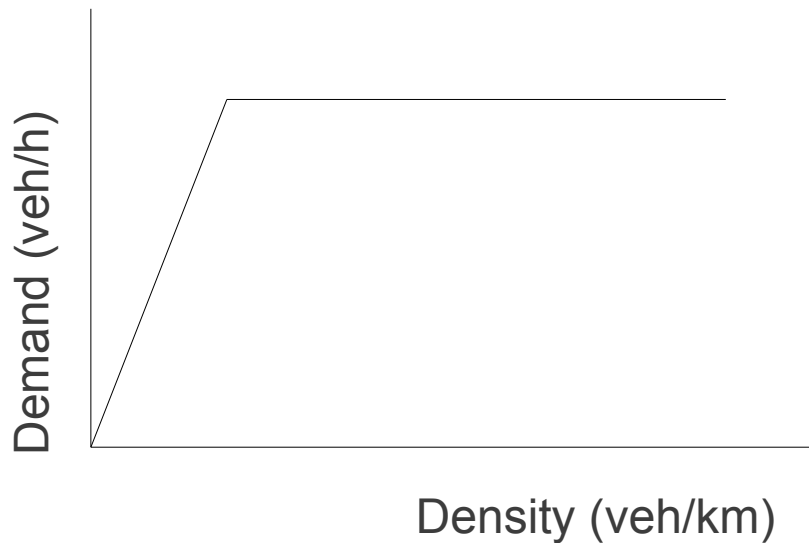
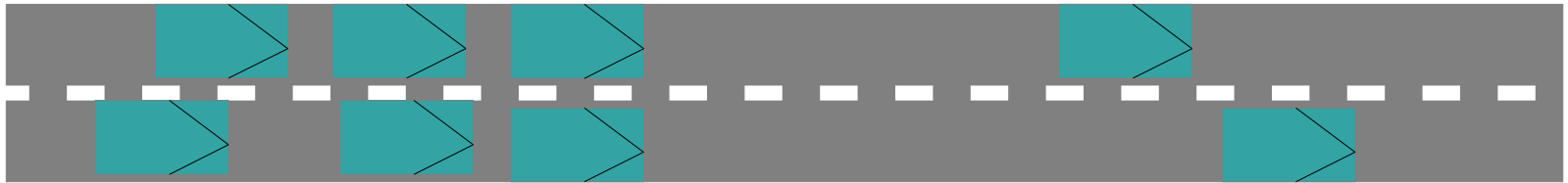
Model flow

3



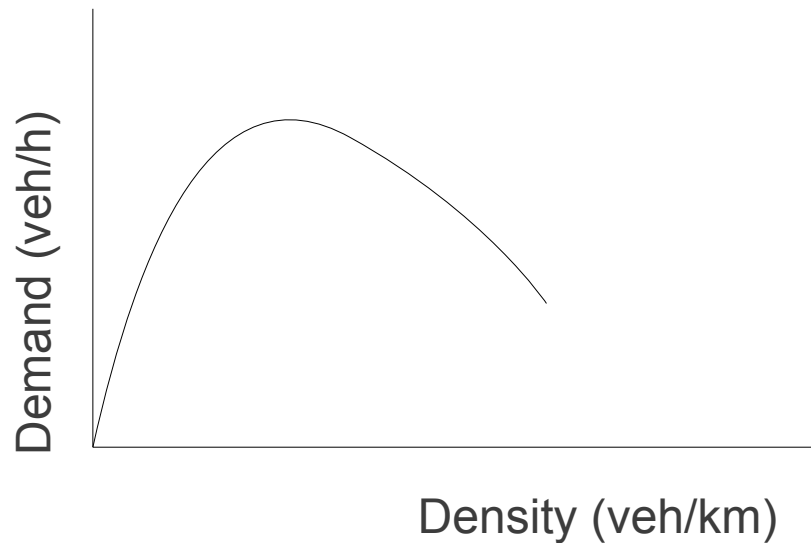
In link flow demand stays constant

- On links with overcritical densities, demand is high



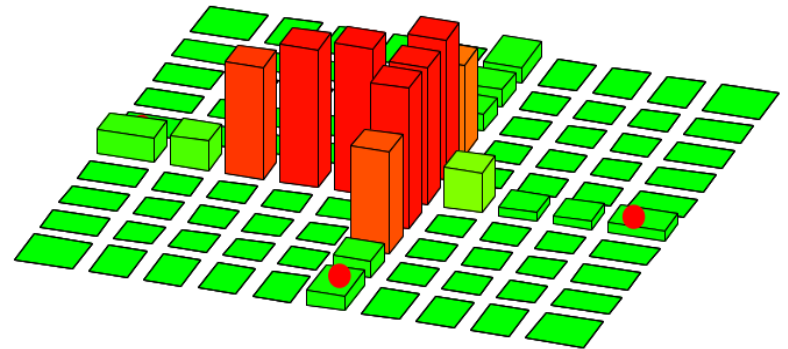
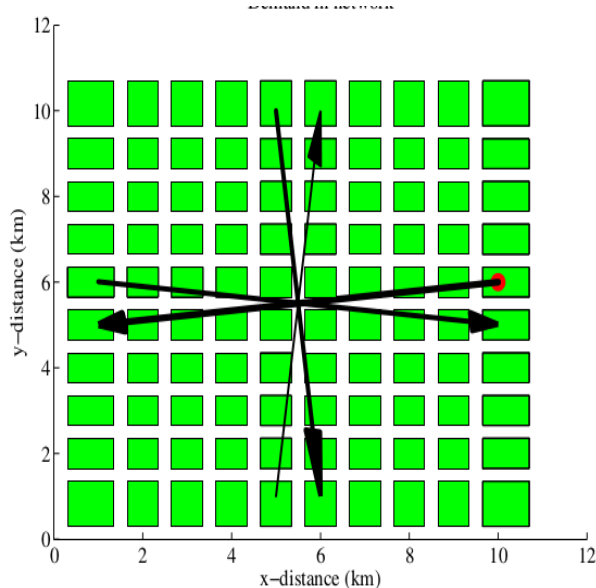
In NFD demand decreases

- In networks, internal spillback limits demand



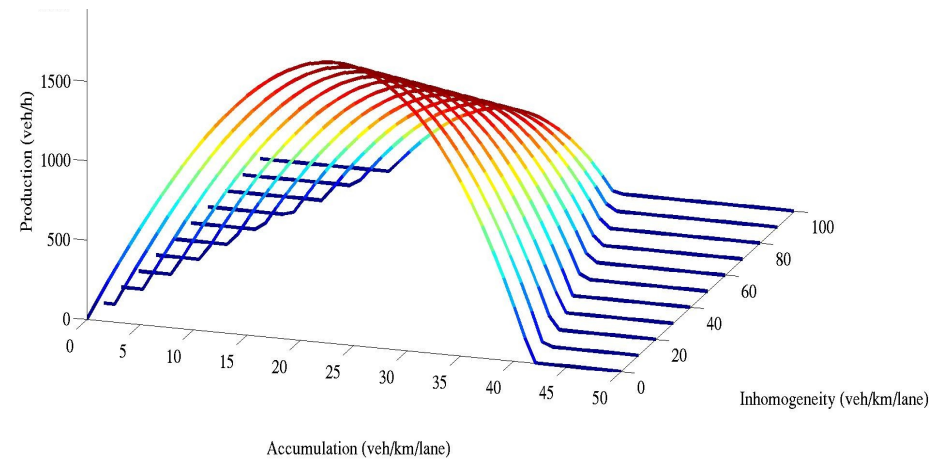
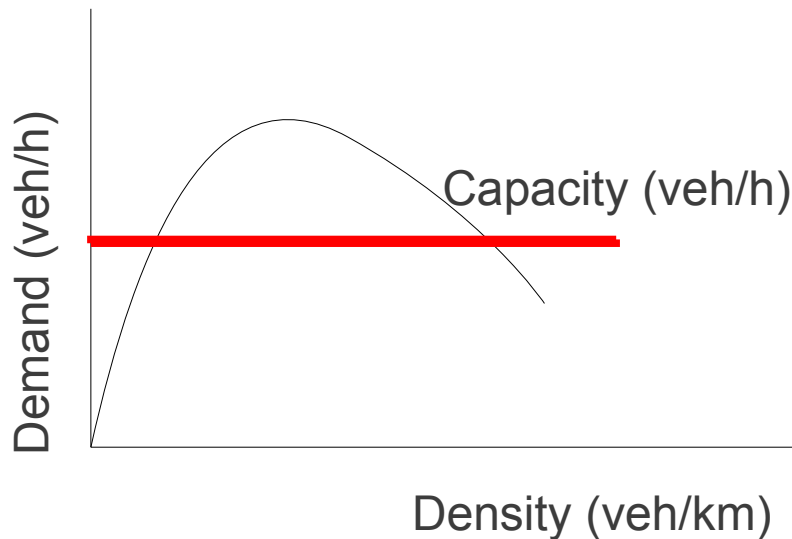
Test case: experimental setup

- Square network, 10x10 times 1x1 km



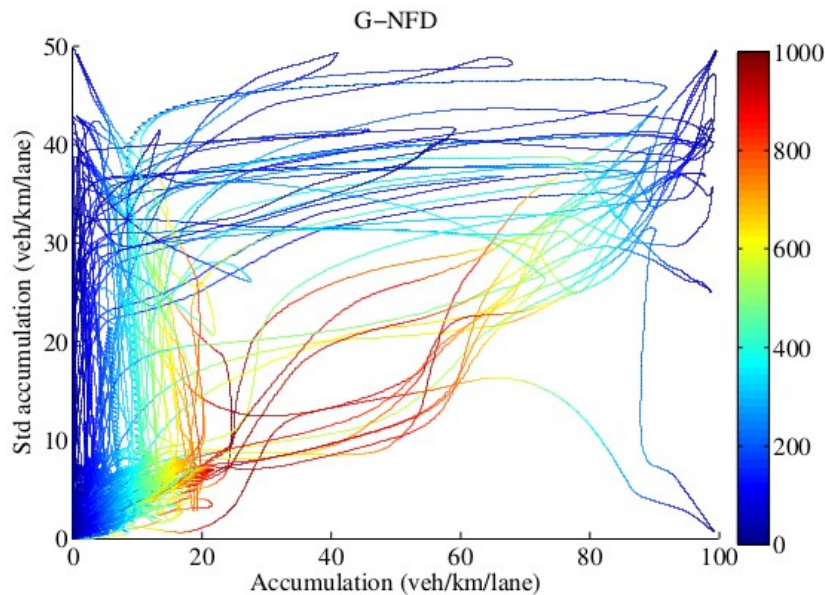
Effect of capacity at edges

- Critical accumulation all to one direction reduces flow
- This leads to inhomogeneity
- Earlier studies (and hysteresis studies):
inhomogeneity=lower flow

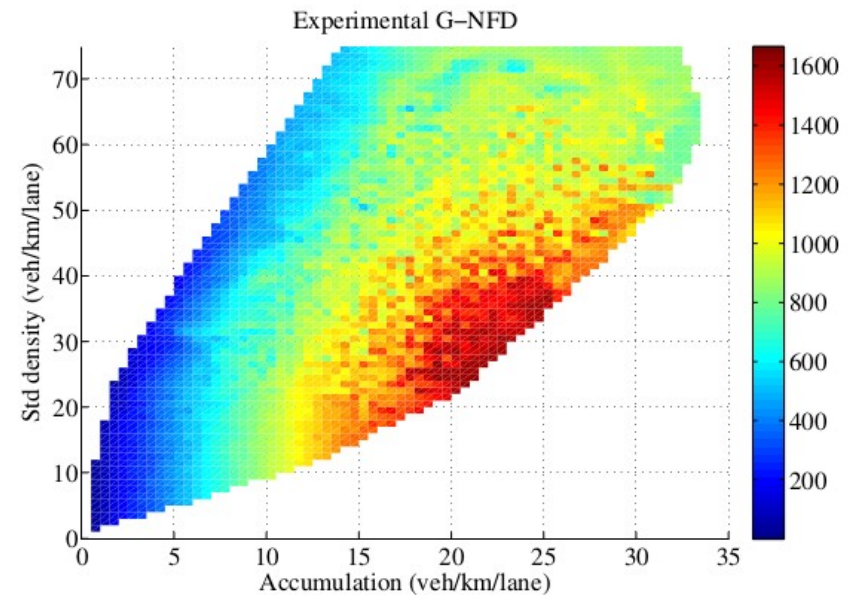


Effect of inhomogeneity

- Effect



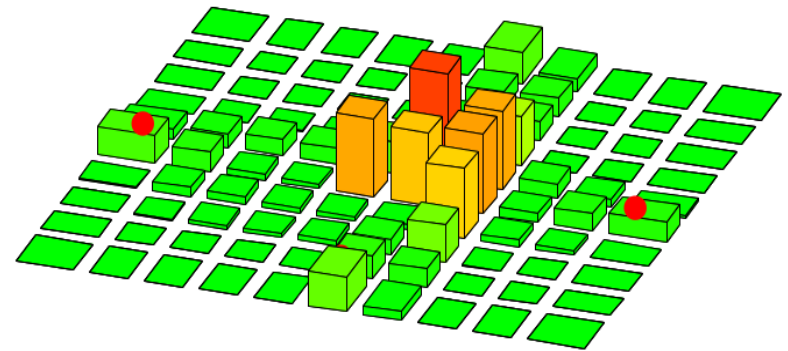
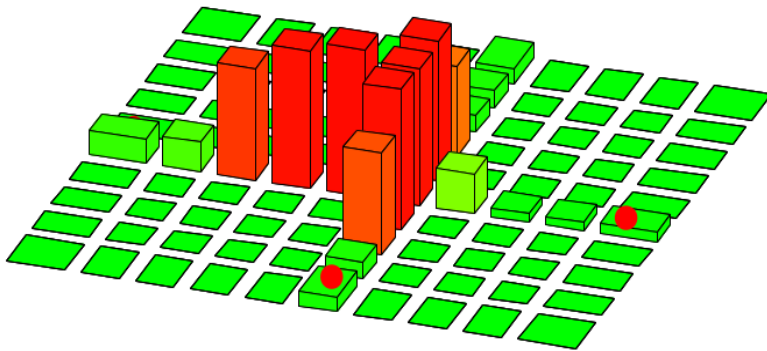
(a) Outcomes of the proposed simulation model



(b) Experimental data from an urban freeway, from (21)

Application: routing, gating

- Traffic improvement by coordination of traffic measures over a large area
- Use this model to calculate the effect of e.g. routing



Conclusions and outlook

- We developed a model describing traffic dynamics based on the network fundamental diagram
- The model can be used for fast calculations of traffic in large areas
- Possibility to use in model predictive control framework
- To do: testing on a real network (first determine NFD's)

