Network Transmission Model: Application to a Real-World City

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Simulation levels

Vehicle Link Zone

Abstract
The Macroscopic Fundamental Diagram (MFD) describes the relation between accumulation and production in a zone. The Network Transmission Model (NTM) exploits that relationship to describe traffic dynamics in a region based on a multi-zone network. This study shows that this model can show qualitatively the location and propagation of congestion. Moreover, it is easy to calibrate by practitioners.

Introduction
- Disturbances (road works, sports events)
- Disrupting large part of the network
- Desire to quickly assess impact of disturbance:
  - Online: no measure, or ATM measure (<30 sec)
  - Offline: best routing or combination of road works
  - Intuitive calibration: impact of disturbance as input
- Quick, rough dynamic model including network effects

Network Transmission Model
- Zone-based, dynamic traffic simulation model
- Flow from one zone to next based on MFD
- Aggregation per zone
- Network-specific routing
- Demand & supply functions based on MFD
- Demand reduces for overcritical accumulation
- Destination-specific partial accumulations
- Routing via destination-specific split-fractions

Inputs
- Estimated static origin-destination matrix (many zones)
- Road network, with speeds and capacities
- Counts and travel times on main routes

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Parameter settings

- Nr of lanes: from road capacities
- Lane length per zone: from map
- Speed: weighted average from map
- Capacity: 60% of weighted capacities (reduction due to traffic lights)
- Routing: en-route update to fastest route

Results

- Initial run:
  - Slight congestion
  - Adapt boundary capacities

- 20 iterations:
  - Congestion and speeds correct
  - Remaining issue: impossible turns

- Face validation:
  - Accident, adapt boundary capacity
  - Congestion propagation and speed realistic

Calibration

- Zones: capacity, \( A_1 \), \( A_2 \), and \( A_j \)
- Boundaries: boundary capacity
- Routes: update fraction, time and spread
- Practitioners can tune parameters to get expected outcome
- If data available: same intuitive adaptation, possibly other values

Conclusions

- MFD-based Network Transmission Model represents urban traffic dynamics correctly
- Initial parameter set gives reasonable traffic states
- Tuning of parameters intuitive