ROAD NETWORK CAPACITY: ARE WE THERE YET?
Macroscopic Fundamental Diagram (MFD)
• well defined and reproducible
• network specific
• invariant to small O/D changes
• analytical approximations for simple networks exist
• consistent with traffic physics
• elegant macroscopic control
(Site) Percolation

\[ P_\infty \]

\( p = 0.2 \)
\( p = 0.35 \)
\( p = 0.6 \)
\( p = 0.8 \)


(Site) Percolation

\[ P_\infty \]

\[ p_c = 0.593 \]


soil permeability
ferromagnetism
epidemic spreading
internet
wildfires
polymerization
galaxy structure
superconductors
traffic congestion?
$G$ # clusters

$p_c = 0.593$
Run realistic large-scale simulation

Label congested links

Identify congested clusters

Track traffic performance

Track percolation metrics
Run realistic large-scale simulation

Label congested links

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Track traffic performance

Track percolation metrics
• Calibrated demands from CDR
  • derived in Toole et al. (2015)
  • \(\sim 1\text{km}^2\) & 1h resolution (04:00-11:00)

• OSM derived network
  • road classes residential*-highway
  • lanes, speed limits, traffic signals, priorities

• SUMO mesoscopic model
  • state-dependent queueing model
  • 3 main parameters (2 headways, 1 tls)
  • periodic, stochastic routing

- **Los Angeles** (63'343 lane-km, 240'664 edges)
- **Boston** (42'673 lane-km, 217'180 edges)
- **San Francisco Bay Area** (59'321 lane-km, 230'207 edges)
- **Rio de Janeiro** (28'277 lane-km, 162'754 edges)
- **Lisbon** (39'988 lane-km, 150'548 edges)
1% trips between 09:00 – 10:00
Travel time comparison
- Google API
- 10’000 random OD
- actual travel departure
- trip > 1km
1. Run realistic large-scale simulation
2. Label congested links
3. Identify congested clusters
4a. Track traffic performance
4b. Track percolation metrics
1. Run realistic large-scale simulation
2. Label congested links
3. Identify congested clusters
4a. Track traffic performance
4b. Track percolation metrics

Identify congested clusters
1. Run realistic large-scale simulation
2. Label congested links
3. Identify congested clusters
4a. Track traffic performance
4b. Track percolation metrics
Rio de Janeiro

ROAD NETWORK CAPACITY: ARE WE THERE YET?

- Factors affecting capacity
- Propagation of congestion
- Point of no-return?
Thanks
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