The traffic impacts of tunnel closures: Evidence from sensors and Google Traffic Statistics

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- **Södra Länkentunnel** length: 4.7 km
- 2 lanes, 70 km/h speed limit
- 6 entry, 6 exit points
- Designed to serve **60k-70k veh/day**
- Demand: **90k-100k veh/day**
Södra länken traffic management

When speed at critical locations is too low, Trafik Stockholm

1. Send out **warning messages** on signs, radio etc. to inform about queues inside the tunnel

2. If congestion worsens, main tunnel entrances (Sickla-, Talltunneln, in some cases Silvertunneln) **temporarily close** in order to allow for queues to dissipate and ensure safety
Tunnel closure statistics

Tunnel closures per year

Duration of tunnel closure

[Graphs showing frequency of tunnel closures by year and duration of closures.]
Study objectives

Analyze the impacts of tunnel closures
  Do drivers take detours due to closure?
  Impacts on local streets?

Assess the tunnel closure decision making strategy
  Should it be closed and when?
  Is the duration of the closure optimal?

Investigate how combination of Google and sensor data can help
  Predict tunnel closures
  Decrease the number and duration of closures; mitigate the impacts
Data-driven analysis

**Aggregated** speeds and flow metrics available from
- Sensors (MCS system)
- Google Traffic Statistics

MCS coverage

Google data coverage
Raw data

Raw data + privacy preserving noise

Differentially private
Data-driven analysis

Selected data set:
- Morning peak 6 am - 11 am
- Aggregation interval: 5 minutes
- Regular, warning, closure days between April 2014 to November 2014
Impact of closures

On-ramp flow increase: **29%** (Google)

Flow increase: **30%** (sensor)

Silvertunneln: Uninformed drivers wait at the entrance until it re-opens

Flow increase: **14%** (Google)

Flow decrease: **30%**

Sicklatunneln: Closed
Impact of closures - Sensor data

Silvertunneln entrance - 29 April 2014

- Vehicles wait until the tunnel opens
- Large part of the area south of Silvertunneln not covered by VMS

Talltunneln entrance - 1 April 2014

- No queues are formed at the Talltunneln entrance
- Vehicles take alternative paths
Impact of closures

Traffic detours

Sicklatunneln entrance: Closed
Impact of closures

Sicklatunneln and alternative on-ramp (sensor data)

Flow on regular days vs closure day

1 April 2014, Closure 8:30 - 9:00 am
Impact of warnings

Local Network
Flow increase: 22% (Google)

Sicklatunneln entrance
No significant change in flow

Talltunneln entrance
Flow decrease: 14%
Conclusions

**Closures** do not significantly change the flow downstream of the tunnel. Many vehicles use alternative paths to enter the tunnel.

**Warnings** impact flow at some entrances, not all.

**Google data** help evaluate traffic impacts of tunnel warnings/closures.

Where overlapping, flow and speed patterns from Google are **consistent** with sensor data.
Ongoing work

Data-driven prediction of the traffic conditions (speeds) inside and outside of the tunnel

Use simulation to evaluate alternative tunnel management strategies for further deployment and field testing

OD estimation to identify different day-to-day patterns and relation with tunnel closures