Effects of mobile traffic information on pedestrian traffic efficiency at public transport stations

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ECTRI FEHRL FERSI Road Safety Research

Outline

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1. Introduction

2. Data
   - Flow
   - Calibration data
   - Waiting behavior data

3. Results

Public transport interchange stations

- Efficient stations are important for the traffic system.
- An increasing number of people travel by public transport.
- For efficient and comfortable transfers small stations are needed.

The Problem:

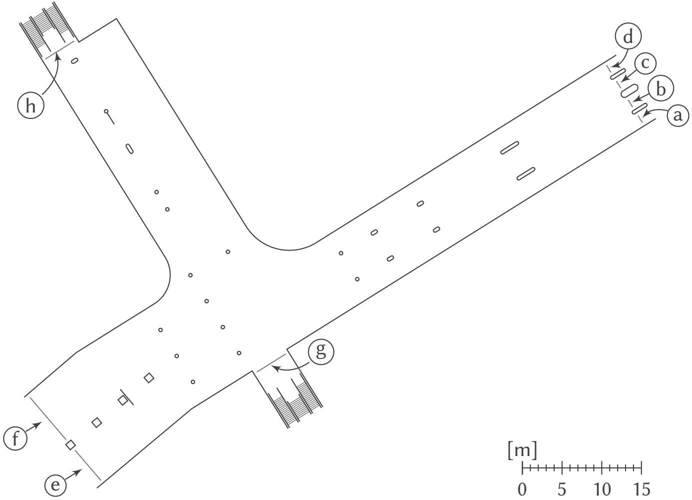
Small station + lots of people ⇒ congestion.

Congestion implies:

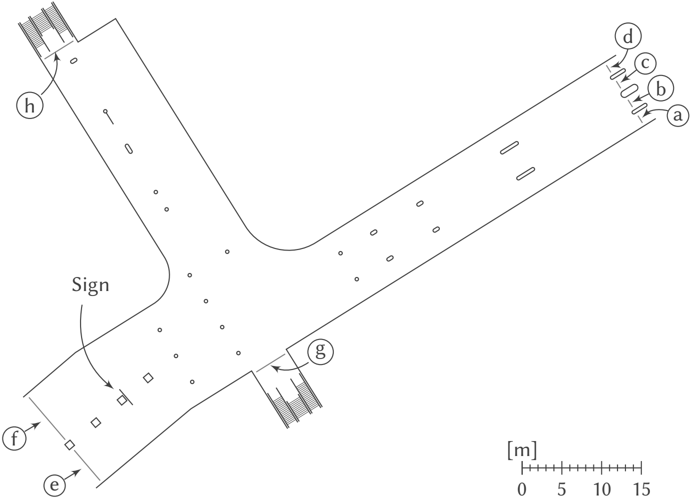
- Delay
- Discomfort

Where? Why? How much? ⇒ Need for accurate models

Case: Lower hall, Stockholm Central Station



Case: Lower hall, Stockholm Central Station



Purpose

"Estimate the efficiency effects on pedestrian traffic of public transport information accessible through smart phones."

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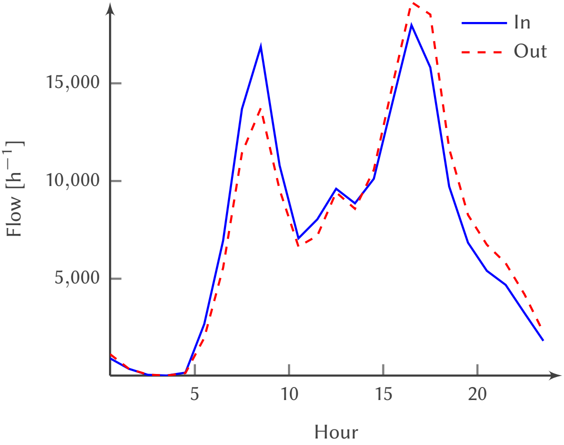
Total flow



OD estimation

Data: Hourly in and out flow at each of the exits.

Assume:

- No flow between:
  - a, b, c, and d,
  - e and f,
  - g and h.
- Flow from an origin is divided among the feasible destinations in proportion to the outflow at the destinations.

Trajectories

- 45 min video,
- main hall during afternoon peak,
- low to medium densities,
- 1870 pedestrians,
- manually extracted trajectories,
- 7 % phone users.

Calibration procedure

For each pedestrian i, solve

$$\min E_i(\tau, F_0, \sigma, T_s, v^p),$$

where

$$E_i = \sum_{t_0 \in \mathcal{T}_0} \int_{t_0}^{t_0+T_{\text{sim}}} \left\| \mathbf{x}_i^{t_0}(t) - \mathbf{X}_i(t) \right\| \, dt, \tag{1}$$

$\mathbf{X}_i(t)$: Observed trajectory,
$\mathbf{x}_i^{t_0}(t)$: Simulated trajectory with $\mathbf{x}_i^{t_0}(t_0) = \mathbf{X}_i(t_0)$.

Parameters

	τ [s]	F_0 [m/s^2]	σ [m]	T_s [s]	v^p [m/s]
No phone	0.54 ± 0.21	0.58 ± 0.24	0.64 ± 0.18	1.2 ± 0.41	1.3 ± 0.30
Phone	0.57 ± 0.21	0.56 ± 0.25	0.62 ± 0.19	1.3 ± 0.46	1.2 ± 0.32
Constraints	[0.1, 1]	[0.1, 1]	[0.3, 1]	[0.5, 2]	[0.4, 2.5]

Number of waiters and waiting time

- 1 h video,
- at the information sign during morning peak,
- manually counted number of waiters at 50 random times, $N \approx 6.8$,
- manually measured waiting times of 50 random waiters, $T \sim \mathrm{Exp}(39\,\mathrm{s})$
- Assuming flow according to automatic counters gives fraction of flow stopping:

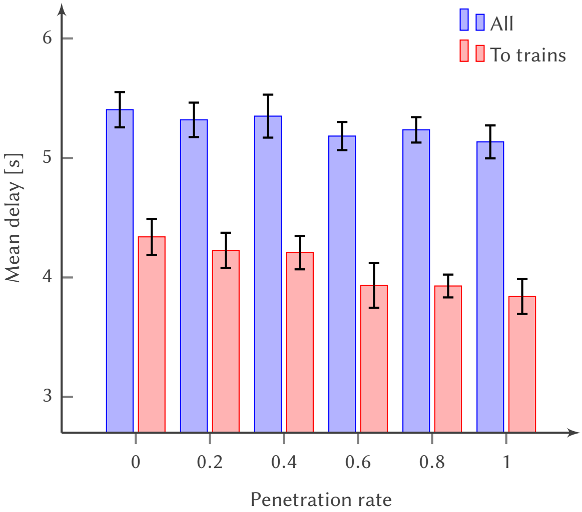
$$p = \frac{n}{qT} \approx 0.24,$$

Waiting behavior

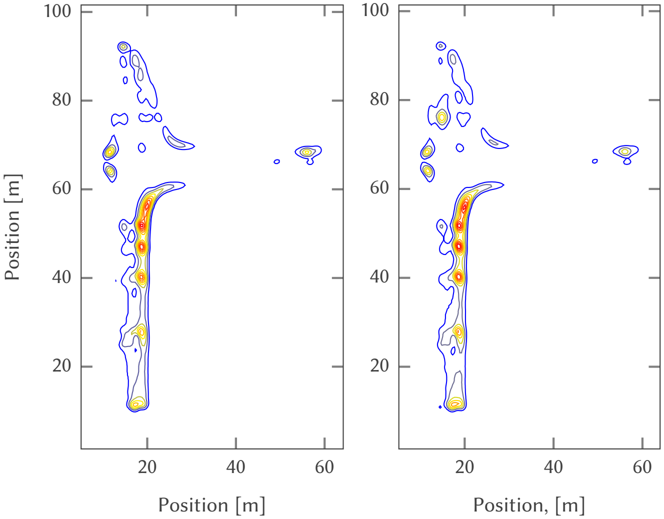
- Observed waiting pedestrians reacted significantly less than walking pedestrians to surrounding pedestrians.
- The reactions of simulated waiting pedestrians were scaled down by a factor of 2.

Outline

Mean delay


All
To trains
6
5
4
3
Mean delay [s]
0
0.2
0.4
0.6
0.8
1
Penetration rate

Delay rate density



Conclusions

- A transition from information sign to mobile information decreases the delay.
- There are significant uncertainties from
  - Automatic counters
  - OD estimation
  - Calibration
  - Scenario simplification

Future research

- Improve and validate OD estimation
- Validate calibration
- Sensitivity analysis with respect to
  - Flow
  - Number of waiters and waiting time
  - Waiting behavior parameter
  - Scenario simplification
- Determine the most important sources of errors

Questions?