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# Where and when do drivers speed? A feasibility study of using probe vehicle data for speed enforcement planning

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## INTRODUCTION

- Speed is the most critical road safety factor.
- Speeding contributes to 30–40% fatal crashes.
- Speed management ... enforcing compliance with speed limits

**Where and when do drivers speed? – The answer is useful for enforcement planning. Instead of relying on crashes, we used speed(ing) from probe vehicle data.**

We studied feasibility of using probe data from the perspective of speed enforcement planning.
1. Sample of probe data was validated through comparison with average speed control data.
2. Descriptive analysis was performed, focusing on speeding in individual hour intervals.
3. Statistical models explained which road parameters contribute to speeding.

## DATA

Five road corridors in Prague identified by Traffic Police Directorate as prone to speeding
- Length 1 – 7 km
- Relatively flat terrain
- Mostly 2 lanes in each direction, divided by median (some parts 1+1 lane, without median)
- Speed limits 50, 70, 80 km/h
- AADT 10,000 – 50,000 veh/day

Examples:

2+2 lanes + shoulders
45,000 veh/day
speed limit 80 km/h

1+1 lane (no median)
10,000 veh/day
speed limit 50 km/h

Probe vehicle data (Jan – Dec 2017) obtained from a third party
- Approx. 10,000 company vehicles fleet
- No information on specific vehicles and drivers available
- Estimated 80/20 split between personal and heavy goods vehicles
- Data = GPS positions (1 – 3 per 1 min) + speed

| veh_id | time | lon | lat | speed |
|---|---|---|---|---|
| 54849 | 12:50:14 | 14.417109 | 50.012518 | 42 |
| 54849 | 12:50:22 | 14.417260 | 50.012937 | 4 |
| 54849 | 12:50:34 | 14.417260 | 50.013182 | 30 |
| 54849 | 12:50:44 | 14.417195 | 50.014138 | 31 |
| 43236 | 12:27:40 | 14.416895 | 50.014042 | 31 |
| 43236 | 12:27:50 | 14.417088 | 50.013291 | 2 |
| 43236 | 12:28:10 | 14.417066 | 50.012529 | 43 |
| 43236 | 12:28:27 | 14.415414 | 50.010511 | 53 |
| 43236 | 12:28:44 | 14.415393 | 50.008248 | 52 |


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## ANALYSIS

### 1. SAMPLE VALIDATION

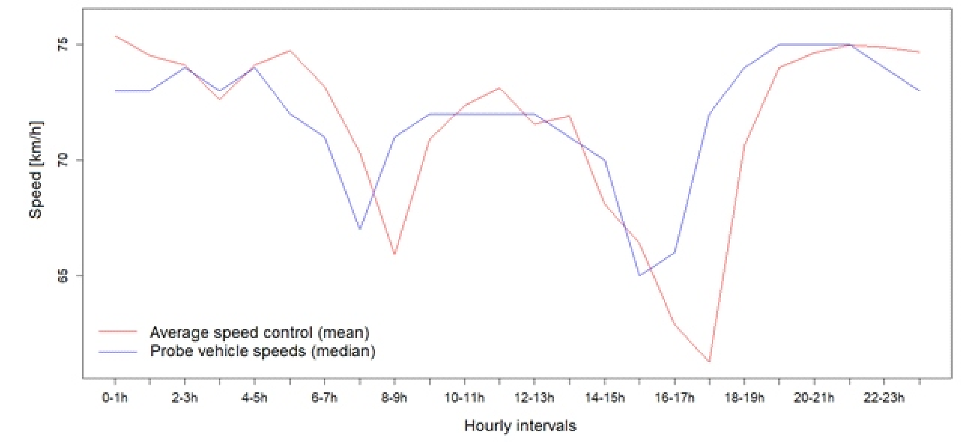
(representativeness of sample of probe vehicle speed data against "ground truth" – average speed control data)

**PROBE VEHICLE DATA**
5 corridors
12 months
**MEDIAN SPEEDS**

**AVERAGE SPEED CONTROL DATA**
4 corridors
2 months
**MEAN SPEEDS**

**statistical comparison in 1-hour intervals**

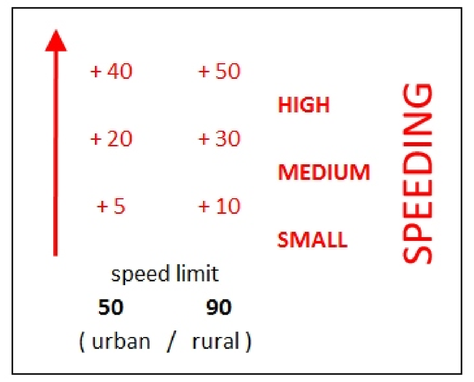
Example:



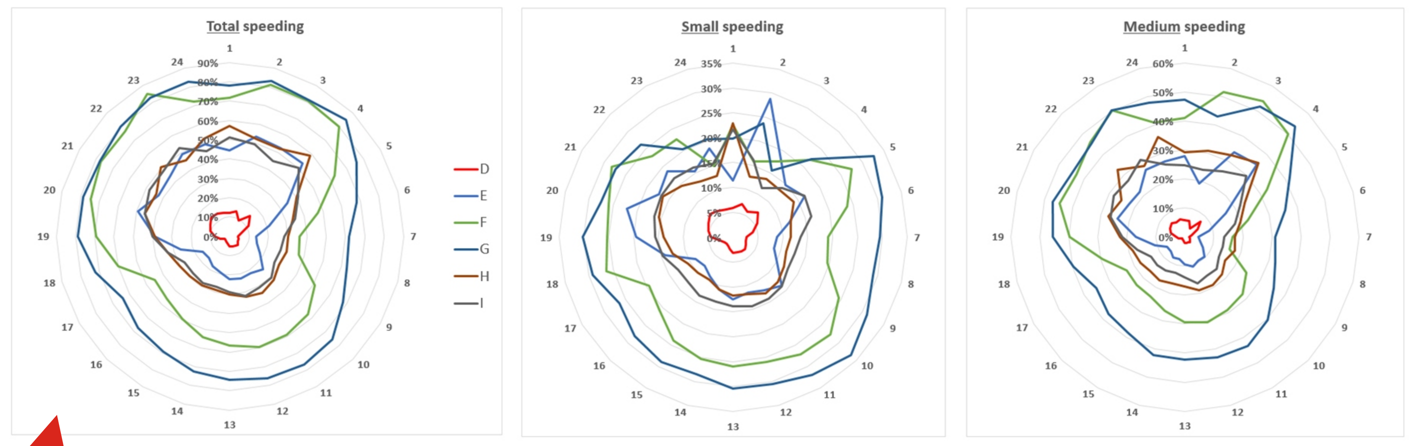

non-parametric statistical tests:
**on sections < 1 km ... differences < 4 km/h**

### 2. DESCRIPTIVE ANALYSIS OF SPEEDING

71 homogeneous segments < 1 km
+ road parameters (cross-section, geometry...)
+ % speeding ( # records / total )




Example:


### 3. EXPLANATORY MODELS OF SPEEDING

Response variable = speeding
Explanatory variables = road parameters

$$(\mathbf{speeding})_i = \beta_0 + \sum_{j=1}^{n} (\beta_j \cdot \boldsymbol{x}_j)$$

| Variables | Categories | *Medium* speeding model $\beta_j$ | *Medium* speeding model *Sig.* | *Total* speeding model $\beta_j$ | *Total* speeding model *Sig.* |
|---|---|---|---|---|---|
| (Intercept $\beta_0$) | | –0.251 | *0.000* | –0.217 | *0.034* |
| AADT | | $3.264 \cdot 10^{-6}$ | ***0.068*** | $6.340 \cdot 10^{-6}$ | *0.019* |
| Speed limit | 50 km/h | 0.287 | *0.000* | 0.399 | *0.000* |
| | 70 or 80 km/h | 0 | | 0 | |
| Number of lanes | 1+1 | 0.100 | *0.010* | 0.183 | *0.005* |
| | 2+2 | 0 | | 0 | |
| Median barrier | cable | 0.112 | ***0.060*** | 0.222 | *0.025* |
| | solid (steel or concrete) | 0.083 | ***0.053*** | 0.189 | *0.010* |
| | none | 0 | | 0 | |
| Roadside activities | none | 0.103 | ***0.061*** | | |
| | buildings | 0.080 | *0.037* | | |
| | buildings and bus stops | 0 | | | |
| Horizontal alignment | curve | 0.129 | *0.001* | 0.209 | *0.002* |
| | tangent | 0 | | 0 | |

*R2* = 0.60    0.51

**WHERE AND WHEN ?**

**Speeding contributors:**

**Lower speed limit**
**Less driving lanes**
**Solid median barrier**
**Less roadside activities**
**Horizontal curves**

## DISCUSSION AND RESULTS

Potential analysis issues:
- Not based on free-flow speeds
- Vehicle fleet representatitiveness ?
- Selection of "ground truth" ?
- Link between speeding and crashes ?
- Some variables less quantitative
- Multicollinear variables ?

**- The feasibility study was successful.**
**- Probe data help answer where and when drivers speed.**
**- Useful for improving effectiveness of planning speed enforcement.**

Future research: free-flow speed estimation, validation, relationship to crashes...

Next steps? optimization of enforcement, revision of speed limits...