Proactive identification of risk road locations using vehicle fleet data: exploratory study

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INTRODUCTION

Identification of risk locations within road network is the primary task of its safety management. But which indicator to use?

- **Traffic accidents** – only retrospective view, statistically random and rare…
- Alternative indicators, for example **vehicle fleet data** (floating car data, FCD) – proactive safety evaluation and identification of risk locations, based on relationship between road geometry (consistency), speed and safety.

Is it practically feasible to use such data for proactive safety evaluation and identification of risk locations?

- FCD collected by Princip a.s.: sample of 1172 company vehicles, in 8 months (Oct 2014 – May 2015), GPS position 4 times per second
- Selection of rural sections of Czech national road network (speed limit 90 km/h)

Representative sample of vehicles/drivers?

METHOD

What is sufficient number of vehicles vs road network coverage? Intersection influence?

1. GPS data

- road sections and intersections
- GPS points (time, position, speed) in both directions
- at least 100 vehicles in each direction (following *TRB, 2011*)

1416974590.50	49.744991	14.671876	86
1416974590.75	49.745037	14.671925	86
1416974591.00	49.745080	14.671968	85
1416974591.25	49.745123	14.672011	85
1416974591.50	49.745168	14.672053	85
1416974591.75	49.745214	14.672096	84
1416974592.00	49.745260	14.672139	84
1416974592.25	49.745305	14.672182	84
1416974592.50	49.745351	14.672225	84
1416974592.75	49.745396	14.672263	84
1416974593.00	49.745445	14.672300	83
1416974593.25	49.745490	14.672338	83
1416974593.50	49.745536	14.672370	83
1416974593.75	49.745584	14.672408	82
1416974594.00	49.745630	14.672440	82

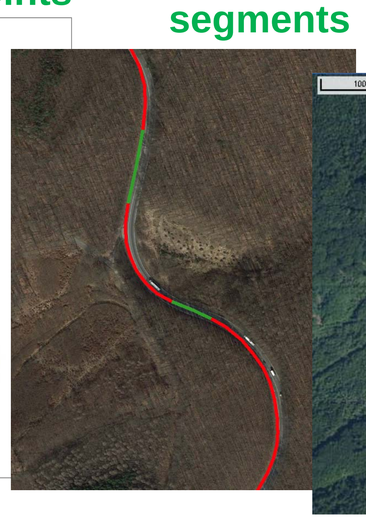
GPS points

Various methods exist... New precise automated method applied here (*Andrášik & Bíl, in review*).

2. Segmentation (classification of point sequence into tangents and curves)

- pre-processing with Douglas-Peucker algorithm for data generalization
- calculation of explanatory variables (angle between three consecutive points, circumscribed circle radius, etc.)
- discriminant analysis
- post-processing: least squares method for radii computation
- selection of segments ≥ 200 m (based on *AASHTO, 2010*)
- in total 509 curves (approx. 200 km)

segments



accidents

In FCD studies, free-flow speed is usually believed to be obtained in off-peak hours.

3. Speed calculation

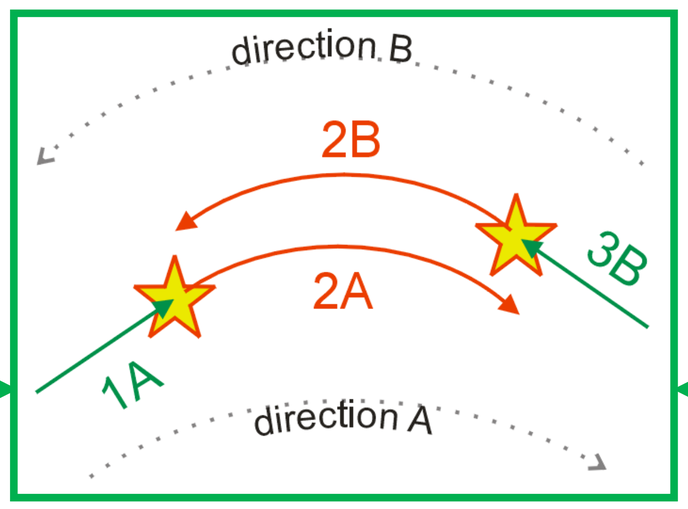
- free-flow („uninfluenced“) speed needed
- speed attached to points with identified geometry
- for each point, speed values were divided into two groups: influenced/uninfluenced (k-means method)
- V_{85} calculated as 85th percentile of uninfluenced speed for each point
- weighted average on segment-level (weight = number of vehicles)

How accurate is the localization?

How to assign multi-vehicle accidents (such as overtaking) to directions?

4. Accident data

- GPS-located by Czech Police
- only single-vehicle accidents, excluding intersections
- all severities, 6 years (2009 – 2014)



5. Validation

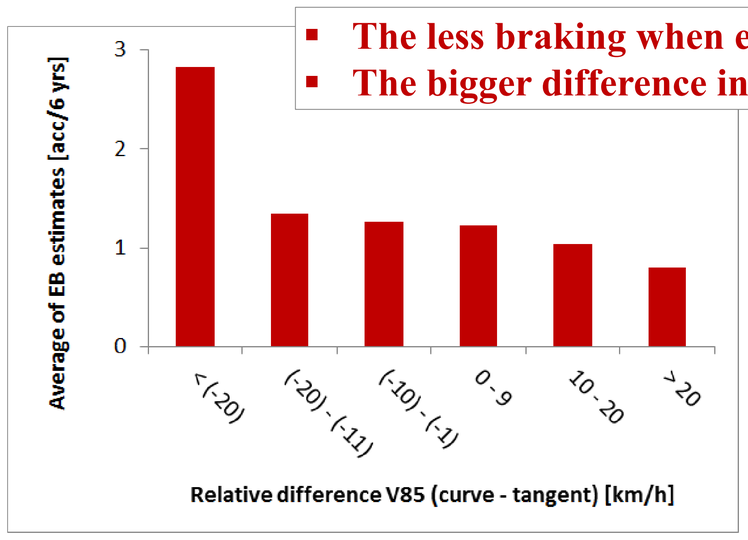
- curve accidents supposed to be caused by speed (or curvature change rate) difference between tangent and curve (*Lamm et al., 1999*)
- to be validated against „objective“ safety in terms of empirical Bayes approach (*Hauer et al., 2002*)
- EB estimated using accident prediction model (explanatory variables: AADT, length, CCR)

How to investigate validity?

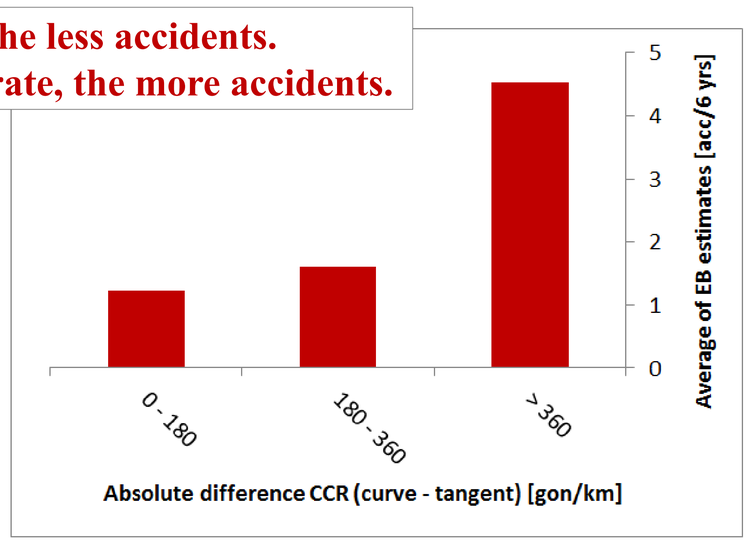
- compare product (correlation)
- compare ranking (consistency)
- compare classification

RESULTS

- **The less braking when entering the curve, the less accidents.**
- **The bigger difference in curvature change rate, the more accidents.**



(thresholds 10 / 20 km/h and 180 / 360 gon/km adapted from *Lamm et al., 1999*)



CONCLUSIONS

- The identification process consists of several steps – each of them involves decisions, which have **influence on quality and precision of results**.
- At the same time **there is no guidance** for most of these decisions, e.g. necessary sample size, free-flow speed collection or segmentation method.
- Both speed consistency and alignment consistency were able to **classify the curves in accordance with objective safety**. However more precise validation approaches, such as comparison of rankings, were not successful. **Revision and improvement of the procedures is in progress…**

Refs.

AASHTO (2010). *Highway Safety Manual.*
Andrášik & Bíl (in review). Efficient Road Geometry Identification from Digital Vector Data. *J Geogr Sys.*
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