International Co-operation on Theories and Concepts in Traffic Safety

Investigation of floating car data characteristics and their implications for speed impact studies

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1. Introduction

Driving speed has been recognized as the most influential risk factor, which makes it a suitable indicator of road traffic safety. This is why it is often used in evaluations, especially when assessing the impacts of speed-related safety measures, such as speed limit signs, road marking or traffic calming.

In principle, speed may be obtained through static or dynamic measurements. While the former uses fixed sensors to provide spot speeds (or section speeds), the latter collects data along the driven trajectory, e.g., using the GPS, to create a speed-distance graph (speed profile) enabling a more comprehensive understanding of driving behaviour.

GPS data collected from vehicle fleets are known as floating car data (FCD). Although FCD have clear benefits (in terms of coverage in time and space), they also have some limiting characteristics:

- Penetration rate, i.e., the proportion of traffic flow represented in FCD, is uncertain and may be low in specific locations and time periods.
- Sample size, which is dictated by the number of drives, length of data collection period, etc.
- Recording frequency (sampling rate).

These characteristics clearly influence the speed representativeness, i.e., how well the FCD-based speed represents the ground truth, based on the fixed sensors. This relationship may be masked also by other factors, which are different between the FCD sample and the total traffic flow. For example, FCD do not allow estimating the free-flow speed, which is commonly taken as a standard speed metric; in addition, vehicle categories are usually unknown in FCD, which prevents distinguishing the speed of personal and goods vehicles. Also, FCD characteristics vary in time: this means that when FCD are to be used, for example, in before-after studies, potential variations need to be controlled so that they do not bias the estimated differences.

The objective of the presented study is to investigate the mentioned characteristics and assess their implications for studies, which attempt to evaluate the impact of speed-related measures.

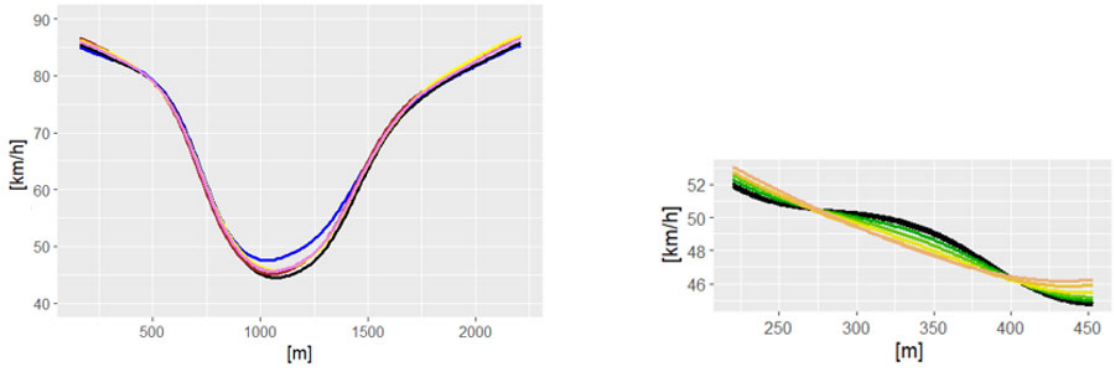
2. Data and methods

To investigate the impacts of various data in changing conditions, long-term FCD samples from Czechia and Italy will be used. They differ in data collection frequency and sample size, as well as fleet composition. Representative segments of motorways, urban and rural roads will be selected. In addition to FCD, data from traditional speed detectors will be used for comparison purposes.

Descriptive statistics will be used for estimating penetration rate and speed representativeness. For analysis of speed profiles and their variations, functional data analysis will be applied.

3. Results

The descriptive, as well as graphical outputs, will be provided. For illustration, Fig. 1 shows some example speed profiles based on data (a) from different seasons and (b) with different sampling rates.



(a) (b)

Fig. 1 Example speed profiles (a) from different seasons and (b) with different sampling rates

4. Discussion and conclusions

The findings will enable answering and discussing the following example questions:

- How representative is the FCD-based speed?
  - Is the penetration rate, sample size and recording frequency sufficient?
  - How do these characteristics influence the obtained speed (or a speed profile)?

- How variable is the FCD-based speed?
  - Which duration is necessary for obtaining an unbiased speed estimate?
  - How should the before- and after-periods be ideally matched?

The answers will provide valuable guidance for planning and conducting cost-effective speed impact studies based on FCD.