

## Evaluation of the impact of infrastructure on cyclists accident risk based on GPS, OpenStreetMap and CARTO databases

*Sylwia Pazdan and Mariusz Kiec*

**Keywords:** bike-share, GPS, surrogate safety measure, OpenStreetMap, Carto, infrastructure

### Background:

Because of the high underreporting of crashes involving especially vulnerable road users (including cyclists), the implementation of a proactive approach to road safety is even more urgent. The proactive approach requires determining what surrogate safety measures and what threshold values of these measures can be used to identify a location with an increased risk of an accident. The most popular surrogate measures in vehicle traffic, as well as bicycle traffic analysis, are TTC (Time To Collision) and PET (Post Encroachment Time). However, those measures can be used only for predefined locations. In the analysis of regions, other surrogate measures and methods of their gathering have to be defined. The use of Big data, such as GPS data (eg. from bike-share system or apps) gives new possibilities in safety analysis. The deceleration rate is a surrogate measure, which can be quite easy to obtain from GPS data. GPS data from the bike-share system was used. Preliminary studies have shown, that locations, where vehicle-cyclist accidents are concentrated do not coincide with the locations where hard braking events determined based on GPS data are observed. Therefore, analysis is necessary to determine why these differences occur and which infrastructure factors and their combination have an impact on cyclists' behavior.

### Aim:

The aim of the paper is a comparative analysis of cyclists' behavior in locations where crashes with vehicles and cyclists concentrate (identified based on crash data) and where cyclists' risky behavior is observed (identified based on deceleration rate of bike-share system users). Additionally, infrastructure factors and their combination increases the risk of an accident with cyclist were determined. Moreover, the possibility of combining different sources of data (i.e. OpenStreetMap, GPS data and cycling infrastructure data from the CARTO platform) to cyclists safety analysis were evaluated.

### Method:

Locations of accidents with cyclists were identified based on crash data. Additionally, the potentially risky location was defined as a site with a higher/abnormal concentration of critical events, i.e. hard braking of bike-share system users. Bicycle infrastructure data from the CARTO platform as well as OpenStreetMap data, crash data, and bike-share system GPS data were combined using PostgreSQL to identify infrastructure in critical locations (where accidents with cyclists and risky braking are concentrated).

### Results:

Results of the analysis show which infrastructure factors and their combinations increase the risk of accidents with cyclists and risky cyclists' behavior based on threshold values of surrogate safety measures. Results show why unsafe locations determined based on crash data and GPS data do not coincide, and why both sets of locations should be considered in the cyclist's safety analysis.

### Conclusions:

The results of the study provide the first step in the evaluation of the possibility of GPS, CARTO and OpenStreetMap databases combination in automatic analysis of bicycle traffic safety. This method can be useful especially when Big Data and large areas, such as an entire urban network, as well as to assessment conflicts between vulnerable road users. Methods using GPS data give further insight into cyclists' road safety and should not be overlooked.