Analysis of stopping behaviour of cyclists at a traffic light-controlled intersection using trajectory data

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Abstract:

Even if stop lines for vulnerable road users, foot paths and bicycle paths provide clear boundaries for stopping at traffic light-controlled intersections, this is not always the case in reality. In addition to poor infrastructure, such as potholes, puddles or high curbs, the presence of other road users and the further route choice can also affect the stopping point of vulnerable road users. Cyclists get in the way of others if they don't follow the stop line. Cyclists who are riding in the wrong direction also have to stop somewhere at the intersection. The aim of the study is to investigate cyclists' stopping behaviour (e.g., stopping position) at intersections with consideration of the impact of groups, wrong-way riding and road usage. The information can be used to improve models of bicyclist behaviour for example in application in simulations, in which cyclists only stop at clearly definable locations. Furthermore, the results of this study will provide clues in the application field for autonomous vehicles to correctly anticipate bicycle behaviour at intersections.

The traffic observation took place between March 11th and March 17th at the AIM Research Intersection in Brunswick, Germany. This large-scale research facility is part of the Application Platform for Intelligent Mobility (AIM) and records trajectory data with stereo-camera systems. The period from 6:15 a.m. to 6:30 p.m. was analyzed. The corresponding scene videos were recorded in reduced resolution, so that faces and license plates could not be recognized. The position, speed, acceleration and heading of detected and classified bicyclists were used to investigate the stopping behaviour. The AIM Research Intersection has a separate foot path and bicycle path, separate stop lines for foot paths and bicycle paths, and also separate crossings lanes for pedestrians and cyclists. Bicycles without the presence of other bicycles as well as bicycles with at least one other bicycle in the crossing area were analyzed. The stopping position was divided into different areas using previously defined polygons (stop line of foot or cycle path, at the stop line, behind the stop line). In the evaluation, a distinction was made between cyclists who stopped before crossing the intersection and cyclists who crossed through without stopping. For the analysis, single cyclists were considered, as well as several cyclists on one side of the intersection. Around 30%, of 1,411 detected single cyclists stopped on the foot or bicycle path. Around 79% (n=196) of the stopping single cyclists crossed the intersection in the correct direction. 68% of them stopped on the bicycle path. Only 18% stopped at the bicycle stop line. Wrong-way cyclists (n=63) stopped most frequently on the foot path (70%). In addition, it was examined where the intersection was crossed (foot path or bicycle path) and whether stopping beforehand lead to different results. Regardless of whether they stopped before crossing the intersection or not, cyclists used the bicycle path more often when they were in a group of bicyclists. Another subject of investigation was the speed and whether cyclists might drive slower and therefore more carefully if they do not use the cycle path. The speed of cyclists on the footpath is slightly lower.

In overall, it can be stated that stopping behaviour of bicyclists could be successfully modelled based on the conducted traffic observation. Parameter distributions are derived and in a next step ready for implementation for example in the microscopic simulation SUMO (Lopez et al., 2018).
References