Title: Are the safety benefits of the treatments at pedestrian crossings still valuable in presence of autonomous vehicles?

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Background

One of the main concern when Vulnerable Road Users (VRUs) safety is considered, is the interaction with vehicular traffic. In case of pedestrian it is related to the interaction at the pedestrian crossing, and it mainly depends on design and the control strategy for the crossing itself. Designing pedestrian crossing is a complex problem which must involve the consideration of various factors. The basic criterion deciding the choice of a particular type of pedestrian crossing is road safety. To improve this, typical ‘zebra’ crossings are being reconstructed, usually by implementing refuge median islands or traffic signals. At the same time the introduction of Autonomous Vehicles (AVs) is opening new questions based on the effective of the different type of pedestrian crossing based on different levels of penetration of AVs in traffic flow.

Aim

The introduction of the refuge islands in the pedestrian crossings resulted to be highly effective in providing safety benefits for VRUs. On the other hand, the increasing consideration of AVs is changing the perspective mainly from the VRUs point of view. The safety effects of treatments implemented to solve safety problems can become ineffective or even can worsen the safety conditions in presence of AVs. The main objective of the research study is to evaluate the influence of different levels of penetration of AVs in traffic flow in the safety benefit delivered by the implementation of the refuge island in pedestrian crossing.

Method

To evaluate those safety benefits, a simulation model was built in VISSIM® and calibrated on the basis of research results on observed data about drivers and pedestrians behavior. The vehicles flow was modified considering different levels of penetration of AVs. The AVs behavioral parameters were chosen based on previous research on the topic, and in general considering a less aggressive driver behavior. The comparison between before and after conditions (based on the share of AVs) was based on Surrogate Safety Measure (SSM) such as the conflicts frequency, the Time to Collision (TTC) and Post Encroachment Time (PET). Those parameters were estimated using the Surrogate Safety Assessment Model (SSAM).

Expected results

It is expected that the penetration of AVs in traffic flow can able to considerably increase safety at pedestrian crossing till make the effects of any classical countermeasure negligible. In other terms, it is expected that based on the share of AVs the effects of the treatments change till to become negligible for the higher levels penetration considered, with a sensible reduction of severe conflicts (lower values of TTC).

Conclusions

The different driving approach introduced with the AVs points out new questions about the effects of the classical countermeasures on safety. In the period of transition between a fully automated driving in each vehicle (from 0 to 4 in the Society of Automotive Engineers (SAE) Automation Levels),
but also the traffic mix made up by vehicles with different automation levels, the safety benefit of treatments is function of the penetration level of the AVs which can sensibly get worse or better the safety conditions. That is particularly true when the interaction between vehicles and VRUs is considered. VRUs are generally not connected users this make them vulnerable not only from a physical point of view but also unable to get I2V information and to elaborate them based on their choices. The present research work is a first step in identify safety benefit for refuge island for pedestrian crossing in presence of AVs. The microsimulation model was calibrated on observed behavioral parameters and simulate the observed traffic operation conditions of the real site. Unfortunately, model validation is not possible when even a small share of AVs is considered in traffic flow. More research is needed on the topic before the introduction of AVs in the operating network above all when the interaction with VRUs is considered.