INFLUENCE OF THE SAFETY ZONE ON THE RISK OF ACCIDENTS WITH AUTONOMOUS VEHICLES

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Objectives

The improvements in control systems is enabling the development of autonomous vehicles (AV). These systems are aimed to replace driving activities performed by humans safely and efficiently. However, at their current stage, AVs cannot handle all possible traffic scenarios, which can result in accidents. Simple protection approaches, such as the creation of protected areas around the vehicle, can contribute to reduce the safety risks without impacting traffic flow efficiency. The objective of this study is to assess the impact of the dimension of a Safety Zone (SZ) - virtual region around the vehicle to expand its dimensions to create a bigger safety margin for the control system – on the risk of collision in a single lane crossing traffic scenario.

Methods and Procedures

This work uses a computational modeling and simulation environment, developed by GAS/EPUSP to study the behavior of AVs in traffic scenarios from the safety perspective [1]. A traffic crossing scenario was adopted, as shown in Fig.1.

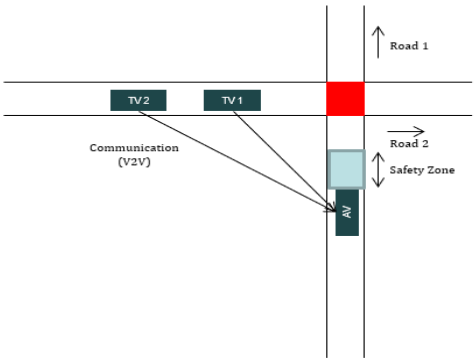

Fig.1 – Simulated crossing scenario in the study

A control algorithm was embedded in the AV, which travels on Road 1, being responsible for its safe navigation through the intersection. The algorithm manages the appropriate space-time slot to perform a crossing without colliding with the other vehicles on Road 2, which travel at 15 m/s. For doing it, the control obtains situational awareness through vehicle-to-vehicle communication (V2V) and considers a fixed size of SZ in the AV's frontal region. For V2V communication, a 10Hz frequency rate (F) and a 1 second end-to-end latency (L) were considered. The SZ impact was evaluated by the accident rate (collisions, C) observed at the intersection. The experimental design considered 3 values of maximum speed (MS) for the AV and 5 values of the SZ, which results in 15 combinations (scenarios). Fifty executions were performed for each scenario (a total of 750 executions for this study). In each execution, the AV performed a crossing, which could result in a collision or not, allowing the calculation of C.

Results

Figure 2 shows the distinct AV's MSs considered in the experiments (13, 13.5 and 14 m/s). For MSs of 13 and 13.5 m/s, a SZ value greater than or equal to 3 meters demonstrated the effect of reducing the number of collisions. However, the experiments considering MS equals to 14 m/s resulted into no collisions for any length of the SZ.

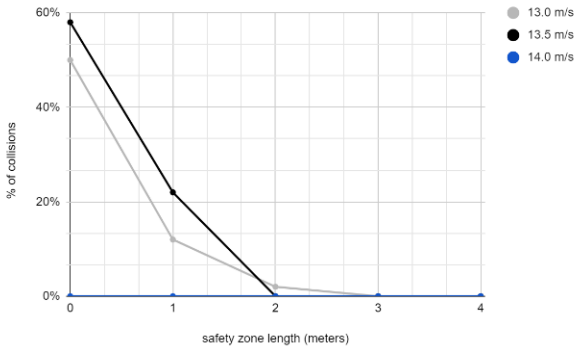

Fig.2 – Impact of ZS (m) on C (%)

Conclusions

The experimental results were coherent to the hypothesis of lower accident risks could be expected for higher values of ZS. In a future study, the reason why the increase in the AV's MS resulted into lower risk of accidents will be investigated.

Bibliographic References

[1] L. F. Vismari et al., "A simulation-based safety analysis framework for autonomous vehicles – assessing impacts on Road Transport Systems safety and efficiency," in Safety and Reliability – Safe Societies in a Changing World: Proceedings of ESREL 2018, June 17-21, 2018, Trondheim, Norway, 2018, pp. 2067--2075.