Research
Report Summary

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Investigating the Effects of Smartphone-based P2V Warning Using Driving Simulator Experiments

The pedestrian-to-vehicle (P2V) technology is expected to reduce pedestrian crashes and improve roadway safety. Utilizing the smartphone as a communication platform could make the P2V more applicable for old car models without having additional retrofits. In UCF's previous work, the effectiveness of a general P2V design has been demonstrated. However, the influence of different P2V designs remains uncertain.

This research focuses on the influence of P2V designs in different scenario conditions and uncovers some insights about potential variations between drivers, for the sake of better informing drivers about potential pedestrian risk situations in the upcoming automation era.

Two aspects of P2V design, i.e., the warning display mode and

warning content, were tested in six pedestrian pre-crash scenarios.

The warning display mode is categorized into a gradually changed warning (test P2V design) and an emergency warning (based P2V design). The warning content is referred to whether having specific distance information as a supplement or not. In total, thirty-six valid participants were included in this study.

The results indicate that in scenarios where the pedestrians are hidden behind other objects (e.g., car, bush), a gradually changed P2V warning design (e.g., warning color changes from "white" to "yellow" and then "red" based on the conflict severity) would smooth drivers' adaptation behaviors (e.g., mean

Example: Driver performance between test and base P2V designs in pedestrian pre-crash scenarios
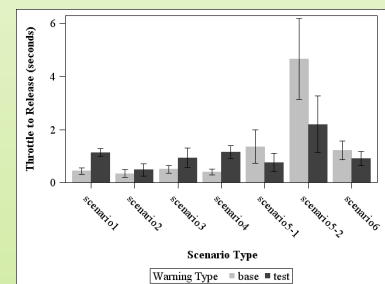
(a) Throttle release time between the base and test P2V designs in each type of scenario
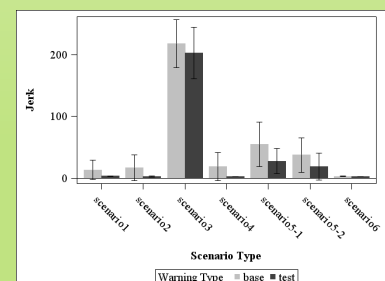
(b) Jerk between the base and test P2V designs in each type of scenario

deceleration, maximum deceleration, and maximum brake), which can improve the driving comfort.

In addition, the results show that in scenarios where the pedestrians can be clearly observed from drivers' view, providing distance information via the smartphone (either the lateral or absolute distance to the pedestrian) would make a driver become more conservative, and thus the safety can be further enhanced.

Finally, it is found that drivers who had been involved in a not-at-fault crash before might benefit more from the test P2V design in scenario 1 ("pedestrian walk from behind adjacent car"), while the drivers had not been involved in a not-at-fault crash before might be benefited from the test P2V design in scenarios 3 ("pedestrian walk from behind the right-turning car") and 5 ("pedestrian walk along curb").

Outcomes

This study focuses on the influence of pedestrian-to-vehicle (P2V) design on drivers' performance & safety and suggests specific P2V designs based on different driving scenarios. In total, six typical pedestrian pre-crash scenarios were analyzed in the study.

The results demonstrate that the gradually changed warning and considering additional information could help a driver better adapt to the critical pedestrian pre-crash scenarios. In addition, the effectiveness of the test P2V design (i.e., gradually changed warning) could be further improved when considering the scenario and the drivers' features.

Impacts

The results of this study indicate that the collision rate of gradually changed P2V design can be 24%-30% lower than the emergency P2V design for the scenarios that pedestrians are obstructed by other objects (e.g., car, bush).

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