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USING THE UCF DRIVING SIMULATOR AS A TEST BED FOR HIGH RISK LOCATIONS

BACKGROUND

The UCF driving simulator has the potential to be used as a traffic safety test bed to identify potential problems with intersection design, explain interaction between drivers and roadway surroundings, and explore effective countermeasures to reduce traffic crash rates.

OBJECTIVES

The goal of this project was to validate the driving simulator from two perspectives, speed and safety. Researchers replicated in the simulator the signalized intersection at Alafaya Trail (SR 434) and E. Colonial Drive (SR 50), which has one of the highest crash frequencies in Central Florida. They then designed eight scenarios to be used in a driving simulator experiment. Test subjects were recruited based on gender classification and five age groups, classified as Very Young (15 to 19 yrs), Young (20 to 24 yrs), Younger Middle-aged (25 to 34 yrs), Middle Middle-aged (35 to 44 yrs) and Older middle-aged (45+ yrs). The experimental measurements based on the subjects' performances in the simulator were compared to those measured in field and police crash report analysis to determine whether drivers in the simulator have the same driving performances and traffic risk patterns as drivers in actual traffic conditions..

FINDINGS AND CONCLUSIONS

Speed data observed in the field were compared to data gathered through the simulator experiments. The comparison showed that both follow normal distributions and have an equal mean for each intersection approach. Furthermore, the simulator experiments resulted in distributions of mean speeds (by driver age and gender) that were very close to the real speed distributions. However, while the speed variances were equal for the two lower operation speed locations, they were unequal for the two higher operation speed locations, in which the speed data from the driving simulator showed greater variability. Overall comparisons of speed between simulation and field data allow one to conclude that the UCF driving simulator is a valid tool for traffic studies related to driving speed behaviors.

The crash report analysis showed two important risk patterns at the intersection: (1) the rear-end crash rate at the Alafaya northbound (434 NB) right-turn lane is much higher than the other approaches, while the Colonial Drive westbound (50 WB) right-turn lane has the lowest rear-end crash rate, and (2) the through traffic at the eastbound approach (50 EB) of Colonial Drive involved the highest rear-end crashes rate and a higher angle crash rate, while the through traffic from 434 NB is less likely to experience rear-end and angle crashes.

Right-turn rear-end risk

Using the driving simulator as a leading right-turn vehicle in the experiment, researchers found the following: (1) the deceleration rate at the 434 NB approach was higher than that at the 50 WB approach; (2) the non-stop rate was greater for the 434 NB approach than that for the 50 WB approach; and (3) the mean speed at the stop line of the 434 NB approach was significantly greater than that of the 50 WB approach.

Using those three variables as key surrogate measures for rear end risk, it appears that the leading vehicles are more likely to contribute to rear-end crashes in the right-turn lane of the 434 NB approach than in the right-turn lane of the 50 WB approach. However, considering driver behavior in right-turn lanes, the following distance at the moment when the leading vehicle starts braking proved to be significantly less along the 434 NB right-turn lane than that along the 50 WB right-turn lane.

Using the following distance as a surrogate measure for safety, the 434 NB right-turn lane showed a higher rear-end crash risk than the 50 WB right turn lane. This conclusion was verified by evidence demonstrating that when the leading vehicle made a sudden stop in front of the subjects, the rear-end crash rate in the right-turn lane of 434 NB (15.25%) was significantly higher than that of 50 WB (3.33%). Consequently, driver performance in the simulator experiment agreed with the risk pattern represented in the police crash report analysis for the intersection.

Through-lane crash risk

Researchers found that the driver's stop/go decision can be considered the most essential behavior at signalized intersections, and is related to both angle and rear-end crashes. Using the no-stop rate during the signal change as a crash surrogate measure in the simulator experiment, researchers found drivers at the 50EB more likely to cross the intersection than drivers at the 434NB (37.1% Vs. 13.3%) in order to beat the red light. Researchers found the mean speed at the 50EB approach to be greater than at the 434NB in both simulator experiment and field studies. This finding implies that the through traffic at the 50EB approach should be expected to have a higher crash rate for both angle crashes and rear-end collisions at this intersection. This conclusion is consistent with the crash trend based on the police crash report analysis for the real intersection.

BENEFITS

In summary, the experiment results validated the UCF driving simulator. It therefore could be employed as a test bed for driving behavior research and traffic safety studies. This capability will provide a useful design tool with the capacity to enhance safety.

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