Research Notes

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Reducing Red-Light Running Crashes

Background

Red-light running (RLR) is a serious safety hazard at signalized intersections. Crashes involving light-running vehicles are often severe due to the speed and angle of impact in these crashes. Nationally there were 697 deaths caused by RLR crashes in 2013 with an estimated 127,000 injuries.

Sophisticated traffic light controllers have the capacity to identify vehicles likely to run a red light as they approach a signalized intersection. Input from speed sensors located 'upstream' from the intersection can spot cars and trucks that will not clear the intersection before cross traffic is given a green light, creating a high crash risk. Under these conditions, the traffic light controller can delay the green light for the cross traffic to keep them safe until the red-light running vehicle has cleared the intersection. This is known as 'red clearance extension'.

Many of the traffic light controllers used by ODOT and other traffic agencies in Oregon have the capacity to implement red clearance extension, and the City of Portland ran a small trial of red clearance extension systems a decade ago. However, research has been needed to determine the best practices for detecting red-light running vehicles and extending the red clearance interval.

Study Outline

Red clearance extension attempts to mitigate the problem of avoidable or unavoidable RLR, which occurs when a driver cannot decide whether to stop or go at the onset of a circular yellow indication. Dilemma zone protection systems use vehicle detection to reduce driver exposure to the dilemma zone or to offset the impacts of dilemma zone indecision. The goal of a red clearance extension system is to detect a vehicle approaching an intersection near the onset of the circular yellow indication and to predict if the vehicle will safely stop, safely clear the intersection, or be in the intersection at the end of the red clearance interval. If a RLR vehicle is predicted, then a call is placed to the traffic controller to extend the red clearance interval, giving the vehicle time to clear the intersection before releasing opposing traffic.

There are many aspects to consider with regards to vehicle detection for a red clearance extension system, including detector layout, operation, and measurement. Various vehicle detection methods are currently available, each with different characteristics. Detector choice for a red clearance extension system depends on the requirements of the prediction algorithm.

An ODOT sponsored effort lead by Dr. David Hurwitz at Oregon State University developed a field study to investigate factors contributing to red-light running in Oregon. This information was used to calibrate a computer simulation that tested various red clearance interval extension solutions and examined detection and timing strategies.

Study Parameters

The study examined three detection strategies for triggering a red clearance extension:

Downstream Detection operates extensions based on a single loop detector (per lane) located downstream from the stop bar. If the downstream detector is active during the second half of the yellow indication or a normal all-red phase, then a RLE will be triggered.

Simple Upstream Detection operates extensions based on a single loop detector (per lane) located upstream from the stop line. If the upstream detector is active during the second half of the yellow change indication or normal all-red phase, then a RLE will be triggered.

Smart Upstream Speed-Conditional Detection operates extensions based on a pair of loop detectors (per lane) located upstream from the stop line. Logic in the traffic controller differentiates vehicles at higher vs. lower speeds and triggers an extension if a higher speed vehicle is detected during the second half of the yellow change indication or normal all-red phase.

Research Recommendations

- The duration of the yellow change and red clearance intervals have a considerable influence on driver behavior. As such ODOT should consider adopting the kinematic equations recommended in NCHRP Report 731, "Guideline for Timing Yellow and All-Red Intervals at Signalized Intersections".
- Currently ODOT uses the posted speed limit as the approach velocity for the kinematic timing equations. ODOT should consider using an operational speed as recommended in NCHRP Report 731, which could provide more precise estimations for yellow change and red clearance durations.
- The overrepresentation of semi-trucks and light trucks in RLR events observed in the field indicates that more attention should be paid to detection strategies and timing durations which consider vehicle classification.
- Adding upstream detection can enhance the efficiency of RLE systems which could in turn increase the safety of signalized intersections in Oregon.

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To read the full research report go to:

http://www.oregon.gov/ODOT/TD/TP_RES/pages/reportsbyyear.aspx#2016

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