Use of High-Resolution Signal Controller Data to Identify Red Light Running

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Abstract

Intersection crashes are a safety concern for many transportation agencies, and those related to red-light-running (RLR) vehicles are of particular interest. Many camera-based RLR detection systems are controversial with the public, and there is relatively little published literature on the methodologies. This study proposes a methodology that combines high resolution signal controller data with conventional stop bar loop detection to identify vehicles that enter the intersection after the start of red, when many of the most serious RLR crashes occur. The methodology is validated using on-site video collection at several locations, and the algorithm was refined to reduce the incidence of false RLR indications. One case study demonstrates that an increase in side street green split from 20% to 24% of cycle length is associated with a 34% reduction in daily RLR counts, and a reduction in the likelihood of RLR by a factor of 1.7 – a substantial safety improvement for minimal cost. Additionally, law enforcement and transportation agencies can utilize this technique to more efficiently manage and deploy safety resources, especially in cases where detailed crash histories are unknown or too infrequent.

Red Light Running Key Facts

- 676 annual fatalities from RLR
- 50% killed in RLR crashes are not the violators
- Little preventative research besides RLR cameras
- 93% of drivers view RLR as a major safety threat

Conceptual Overview

Example RLR: US231 & State Street

- (a) Normal green progression, detector zone unoccupied [i]
(b) Detector zone occupied [ii]
(c) Detector zone unoccupied
(d) Start of yellow. Note the vehicle waiting to turn left on southbound US231 [iii]
(e) Start of red
(f) Vehicle [v] flagged as a RLR. Note the near-miss with vehicle [iv]

Refinement of RLR Detection Algorithm

Green Split Increase US31 & Carmel Drive

Significant
Reduction in
Daily RLR

Minor
Reduction in
RLR
Time-in-
Red

Odds Ratio $q = \frac{w_b/v_b}{w_a/v_a}$ w_i = count of RLRs in period i v_i = count of total entering vehicles in period i	Odds Ratio	
	20% Split	24% Split
RLR Odds	0.006	0.003
Odds Ratio		1.672
Upper 99% CI		1.707
Lower 99% CI		1.637

Change in
Likelihood
of RLR on
Phase 8

Phase & Movement	Δ Mean Daily RLR	Δ Variance Daily RLR
Phase 1 – NB Protected Left	1.902*	2.764
Phase 4 – EB Thru	0.168	5.661
Phase 4 – EB Permitted Left	-0.141	-0.349*
Phase 5 – SB Protected Left	-0.231	1.216
Phase 8 – WB Thru	-2.389**	-9.425**
Phase 8 – WB Permitted Left	0.438**	0.295**

* Significant at the 0.05 Confidence Level
** Significant at the 0.01 Confidence Level

RLR
Impacts on
Other
Phases

- Increasing green split on an oversaturated movement significantly reduces total RLRs and RLR rates per 1,000 entering vehicles.
- At US31 & Carmel Drive, a 4-percentage point increase in WB thru green split resulted in drivers 1.7 times less likely to commit a RLR.