DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

Evaluation of Signalized Intersection Safety Using Centracs System

Develop a model that can predict drivers' decisions to stop or drive through intersections by interpreting real-time data collected from stop bar and advanced inductive loop detectors

Transportation Safety and Mobility

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Project Title:
Evaluation of Signalized Intersection Safety Using Centracs System

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WHAT IS THE NEED?

Intersection safety has long been a national concern. Approximately 40 percent of the collisions that occurred in the United States in 2008 were intersection related. Most intersection-related collisions occur due to careless or reckless driving behavior such as red light running, resulting in a substantial number of fatalities and severe injuries as well as significant property damage. Despite improved intersection designs and more sophisticated applications of traffic engineering measures, the annual toll of human loss due to collisions of motor vehicles in intersections has not substantially changed in the past ten years.

WHAT WAS OUR GOAL?

This study aimed to make quantifiable predictions about the safety performance of signalized intersections by identifying emerging and impending hazardous situations. The goal of this research was to develop a model that can predict drivers' decisions to stop or drive through intersections by interpreting real-time data collected from stop bar and advanced inductive loop detectors. The system was intended to perform two major functions: estimate potential traffic conflicts based on real-time traffic conditions and predict red-light-running violations.

WHAT DID WE DO?

The researchers first collected event-based data provided by the SMART-SIGNAL (Systematic Monitoring of Arterial Road Traffic and SIGNAL) system developed at the University of Minnesota. The SMART-SIGNAL system has been installed at six intersections along Highway 55 approximately 6 miles west

of Minneapolis. They also collected second-by-second traffic signal data provided by an Econolite controller equipped with their Centracs system at the intersection of Harbor Blvd. and Manchester Avenue in Anaheim. They devised a method of converting between the two data formats. The collected data included individual actuations of stop bar and advanced loops as well as the current signal phase.

The researchers then devised an algorithm that uses the collected data to identify individual vehicles that run a yellow signal, run a red signal, and the first vehicle to stop after the green phase terminates. The algorithm could identify these behavior cases with an average accuracy rate of 87%. Using the parameters developed to identify these behavior cases, the researchers developed another algorithm to predict whether a specific detected vehicle will run a red signal and thus identify it as a potential cause of either a rear-end or intersection-crossing collision.

Several months of data were input into the algorithm, and it generated a predicted number of rear-end collisions for each month. The researchers extrapolated the monthly predictions to rear-end collisions per year and compared the figures to six years of historical rear-end collision records from the Minnesota Department of Public Safety database. The number of rear end-collisions per year, as predicted by the algorithm, correlated across three intersections with the actual historical records

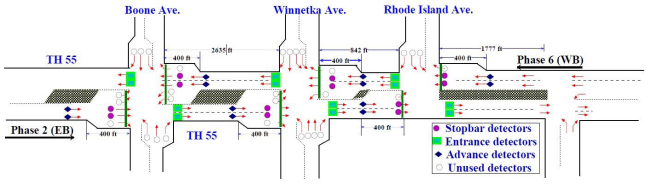
WHAT WAS THE OUTCOME?

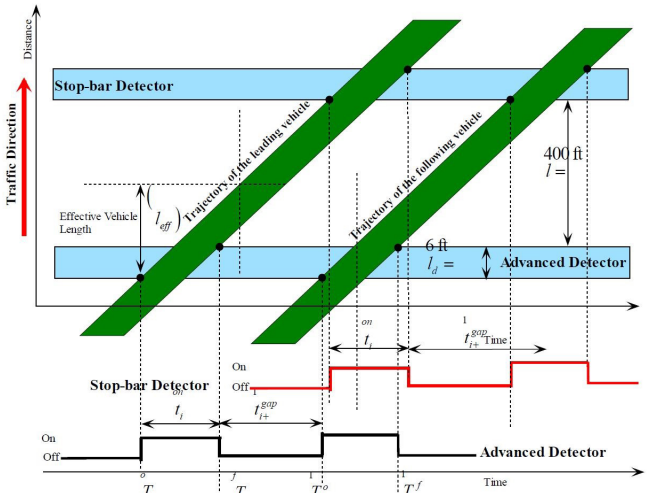
The researchers used collected data to predict whether individually detected vehicles would stop or drive through an intersection with an accuracy rate of 87%. They also predicted specifically if a vehicle would run a red light with an accuracy rate of 65% - 75%, but there was a relatively high false alarm rate. However, they were able to extrapolate predicted rear-end collisions for three intersections and show a strong correlation with historical records (see the table on the next page).

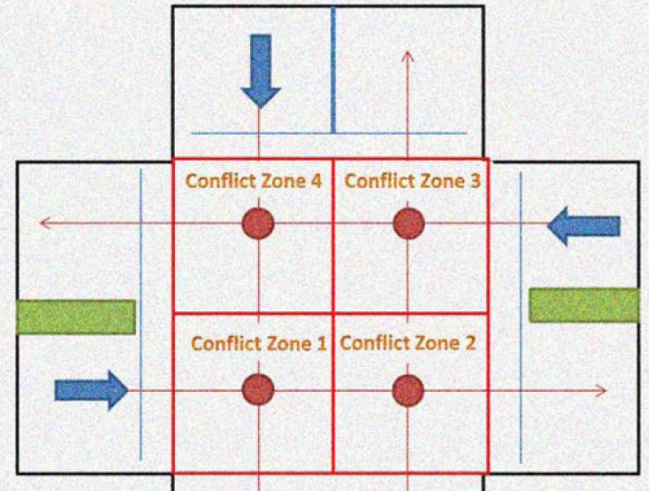
WHAT IS THE BENEFIT?

This research provides Caltrans with the first statewide estimates of pedestrian exposure, which will allow Caltrans to improve the quality of their pedestrian safety analyses by evaluating risk. In addition, the identification of a pedestrian crash typology allows alternative crash frequency-based HCCL identification methods to be applied which can evaluate the statistical significance of the presence/absence of specific crash types.

IMAGES







Intersection Name	Estimated Rear-end Collisions			Actual Number of Rear-end Collisions (2006-2011)
	Estimated Conflicts per hour	Estimated Crashes per year	Estimated Crashes in 6 years	
Boone	8.60	2.52	15	11
Winnetka	9.61	2.95	18	15
Rhode	4.48	1.00	6	2