0-6030: Guidelines for Best Use of Video Detection for Stop Bar Presence Detection

Background

The Texas Department of Transportation (TxDOT) and other state departments of transportation as well as cities nationwide are using video detection successfully at signalized intersections. However, operational issues with video imaging vehicle detection systems (VIVDS) occur at some locations. The resulting issues are varied but have included camera contrast loss resulting in max-recall operation, vehicles not being detected leading to excessive delay and red-light violations, and degraded detection accuracy during nighttime hours.

This research developed a formalized VIVDS test protocol and a set of performance measures that can be incorporated in future purchase orders and used to uniformly evaluate VIVDS products. It also developed a VIVDS video library and developed conceptual plans for a field laboratory for future projects to deploy a range of VIVDS products at an operational signalized intersection. The research evaluated alternative VIVDS stop line detection designs and evaluated the performance of fixed focal length, variable focal length, and manual focus cameras.

What the Researchers Did

The following goals guided what the research team did:
- develop methods (i.e., test protocols) for evaluating VIVDS products,
- record video for a video library to be used for lab testing of video processing algorithms,
- develop conceptual plans for a field laboratory to support future testing of VIVDS, and
- evaluate alternative VIVDS design and operational strategies and use the information to improve a VIVDS handbook.

The research team developed a test concept consisting of five performance measures for evaluating VIVDS at intersection stop lines. They recorded a variety of video scenes on DVDs for future TxDOT use. They collected data for evaluating stop line detection designs and for camera comparisons. Researchers developed an algorithm to automate the analysis of field data for evaluation of stop line detectors and cameras.

Research Performed by:

Texas Transportation Institute (TTI),
The Texas A&M University System

Research Supervisor:
Dan Middleton, TTI

Researchers:
Jim Bonneson, TTI
Hassan Charara, TTI
Ryan Longmire, TTI

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What They Found

The proposed VIVDS test concept consists of false detections, missed detections, and vehicles detected then dropped, along with two new measures – the activation times of VIVDS when vehicles arrive in a detection zone (i.e., time discrepancy) and the detection of the end of the stop line queue just after the beginning of the green phase. The video library includes scenes that could be difficult to locate in a timely manner – snow, glare, changing light conditions, and camera movement due to wind. The field lab concept could be implemented at a cost between $15,000 and $80,000, depending on availability of components at an existing intersection.

A comparison of VIVDS vehicle detection to an accurate point detector (an inductive loop) indicated that VIVDS detections are stochastic and usually occur after the loop detection and hold the "call" longer than the loop detector as the vehicle passes beyond the detection zone. Camera tests compared the following types of color cameras: fixed focal length, manual focal length, and auto focus. Comparisons indicate that the less expensive fixed focal length camera performed about as well as the other more expensive cameras.

What This Means

Using the proposed test concept will allow TxDOT and other agencies that might use it to push the VIVDS industry toward better performance, since the concept is better tailored to VIVDS than simply comparing vehicle detections (counts) to a more accurate system over some time interval. The video library will be another tool that will allow quick analysis of new products or new software to reduce the need for field data collection. For situations that require field data collection, TxDOT should move ahead with the field lab concept and identify the necessary funding to begin its implementation. The stochastic nature of VIVDS detections and its usually late detection and release of "calls" is a clear indication that its efficiency is compromised.