Evaluation of Intersection Countermeasures on High Speed Rural Multi-Lane Facilities

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Overview

The primary objective of this study (Phase 1) is the evaluation of the effectiveness of a proposed safety treatment at an intersection in Habersham County, Georgia using surrogate measures of safety. The treatment is expected to improve the safety of opposing left-turn interactions. The surrogate measures considered in this study are speed, acceleration deceleration rate, and Post Encroachment Time (PET). In addition, this study also identifies the challenges and requirements for a surrogate safety data collection system and provides a robust methodology for such a data collection that involves obtaining detailed vehicle profile data from video. A follow up study(Phase 2) was conducted where the use of PET data as a surrogate measure was further explored.

Phase 1

Data Collection

The study area consisted of two high speed intersections in north Georgia (US23/SR 365 and Demorest Mt. Airy Highway (CR387) in Habersham County, Georgia and US23/SR 365 & CR395 (Crane Mill Rd) also in Habersham County, Georgia).

Figure 1 Map showing locations of the two study intersections with reference to the state of Georgia in the inset. (Google n.d.)

Methodology

(i) Video recording is the primary data collection methodology
(ii) Portable data collection station was developed for this purpose. This station consisted of a trailer equipped with solar panels to charge batteries, a PTZ network camera, and a notebook computer to control the camera as well as to store the recorded videos.
(iii) Two cameras with an overlapping area are used to cover 900 ft of intersection approach.

Figure 2 Example data collection station (Photo credit: Guin, A. (2008))

(iv) A custom software was developed as a part of the project, for data processing of the resulting videos.
(v) The software plays videos frame-by-frame, and can synchronize the videos from the two cameras.
(vi) Vehicle trajectories (time-distance) data was recorded from which speed , acceleration deceleration profiles were obtained.

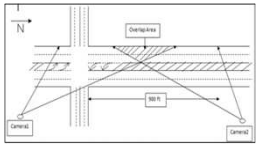

Figure 3 Field placement of the two cameras

Figure 4 Screenshot of the video data processing software

Data Accuracy

To find the accuracy of the collected profile data, GPS probe vehicles were used to provide a ground truth reference. The raw data has granularity, either inherent due to the frame rate of the video or due to human error
Various smoothing algorithms were tested. It was found that 3+5+7 weighted algorithm was the optimal..

Figure 5 I Performance of 3+5+7 smoothing algorithm by comparing raw data, GPS data, and smoothed data

Results

Figure 6 Comparison of before and after treatment surrogate data

No significant difference before and after the application of the treatment which could be because:
(i) the treatment is so subtle or
(ii) the considered surrogates are not effective or
(iii) a combination of both (i) and (ii)..

As a follow up to this study, the use of PET data as a surrogate measure was further explored

Phase 2

Two pairs of intersections considered:
(i) GA 10 with Grayson Pkwy, and GA 10 with Henry Clower Blvd/Oak Rd (Pair 1)
(ii) Roswell Rd with Wieuca Rd, and Buford Hwy with Sugarloaf Pkwy (Pair 2)

Pair 1 has an incident ratio of 6:1, but PET collected at these intersections did not show a significant difference
Pair 2 has an incident ratio of 20:1 and the PET data collected at this pair of intersections showed significant differences
The plots below show the comparison between PET variants of CDF value and # of PETs below a threshold.

Figure 7 Comparison of the two variants of PET as a surrogate

Hypotheses

(i) PET, as a surrogate measure of safety, might be sensitive to the difference in safety between the intersections.
(ii) PET combined with other parameter(s) (e.g. traffic volume, sight distance, grade etc.) gives a better estimate of probability of a crash.
(iii) Between absolute number of PETs below a threshold and CDF value at a threshold, which is a better form of PET as a surrogate measure?

Summary

(i) PET data is likely most suited for use in the before versus after evaluation of safety treatments.
(ii) Data collection of PET is easier, and scalable in comparison to acceleration/deceleration profile.
(iii) Further research and data from more intersections is need to answer the hypotheses and get a better understanding of the effectiveness of PET.

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