INDOT Research

TECHNICAL *Summary*

Technology Transfer and Project Implementation Information

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USING IMAGING TECHNOLOGY TO EVALUATE HIGHWAY SAFETY

Introduction

Crash-based safety analysis is set back by several shortcomings such as randomness and rarity of crash occurrences, lack of timeliness, and inconsistency in crash reporting. Safety analysis based on observable traffic characteristics more frequent than crashes is one promising alternative. Traditional approach to alternative safety analysis relies on the assumption of constant risk across locations. In addition, the current practice of collecting surrogate data often suffers from inherent subjectivity of humans involved in the task. In this research, we proposed a novel statistical approach to safety estimation based on observable traffic characteristics. We evaluated the proposed method by applying to right-angle collisions at signalized intersections. 8-hour traffic movements at selected intersections were recorded using a Purdue University mobile traffic lab. A traffic characteristic so-called post-encroachment time (PET) was observed as a surrogate safety measure to evaluate the risk of collisions. In addition, traditional approach to safety estimation using regression analyses was examined as well. The feasibility of facilitating the measurement of PET with digital video and image processing technology is also examined. Measurement alternatives considered in this study are image detection system 1 (commercial video detection system), image detection system 2 (proprietary developed software), and manual measurement.

Findings

Based upon the results of the measurement evaluation, both image detection systems were not sufficiently accurate for the purpose of our research. However, system 2 was found to perform better than system 1 if all of the following conditions are satisfied: (a) no camera vibration, (b) no obstacles in the field of view, and (c) no more than one through lane per approach. Post-detection of digitized video clips using the manual frame-by-frame analysis was therefore chosen for a collection of the evaluation data.

Poisson and negative binomial regression analyses indicate a significant relationship between PET counts and observed crash counts. A novel safety estimation approach alternative to regression analyses applies the extreme value theory to describe the behavior of PETs. The proposed method allows (a) estimation of risk and crash frequency, (b) model calibration using data from individual location, and (c) model calibration without historical crash data. The evaluation of the proposed method indicates a promising relationship between safety estimates and observed crash counts. The current problem of the proposed approach is a large variance of estimates due to insufficient observation period. A simulation experiment was conducted to examine this issue. It was found that the proposed method requires a few weeks of PET observation to obtain crash frequency estimates with confidence intervals comparable to those being obtained from 3-year observed crash counts. Once a reliable automated measurement method is available in the future, the proposed safety estimation method will immediately offer a new possibility for unprecedented rapid highway safety evaluation. The proposed method can be applied to other types of collisions and locations as well.

Implementation

Based upon the results in this study, a simple method to evaluate the risk of right-angle collisions at signalized intersections was provided. Using a count of short PETs at a studied intersection or individual conflict zone within an intersection, the corresponding annual frequency of right-angle collisions can be estimated. Also given is a guideline to help evaluate whether there is excessive risk of right-angle collisions.

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