JOINT TRANSPORTATION RESEARCH PROGRAM

Principal Investigator: Andrew P. Tarko, Purdue University, tarko@purdue.edu, 765.494.5027

Program Office: jtrp@purdue.edu, 765.494.6508, www.purdue.edu/jtrp

Sponsor: Indiana Department of Transportation, 765.463.1521

SPR-4302 2021

Using Emerging and Extraordinary Data Sources to Improve Traffic Safety

Introduction

In the current practice of traffic safety analysis, counts of crashes aggregated over several years, typically 3 to 5 years, are analyzed with count data models to estimate the effects of traffic volume and major design elements on roadway safety performance. This method of analysis takes advantage of data aggregation to address the rarity of crash occurrence, but it fails to reflect the diversity of operational conditions in short periods, which may be critical in identifying crash causality and effective safety counter measures. In the time of big data, emerging data sources provide various opportunities to perform novel safety analysis and, as a result, they call for the evolution of traditional safety management procedures. Among the emerging data, the most promising is high-resolution, time-dependent data including hourly traffic volumes, speed, and weather conditions. Thanks to their low aggregation level, the factors of crash probability and severity in short intervals, such as one hour, can be analyzed and estimated.

This pilot study investigated the feasibility of using emerging data sources to improve traffic safety. The research consisted of three components: (1) evaluation of the usability and reliability of emerging data sources; (2) example analysis of hourly crash probability and severity for two cases—rural freeways and signalized intersections using static and temporal data (geometry, traffic, weather, other); and (3) identification of the potential limitations and challenges of future implementation to safety management practice.

Findings

The data sources maintained by INDOT and FHWA are reliable and easy to access, while data sources offered by commercial companies may be less reliable and may involve considerable costs. The preliminary analysis of the obtained sample data showed the possibility of linking various time-dependent data, volume, speed features, and weather conditions to traffic safety. Nevertheless, restructuring, standardizing, and linking data from various sources is complex and time-consuming. Several analysis examples of time-dependent data were conducted and the key findings are listed as follows:

1. Hourly traffic volumes were forecasted using probe density, time indicators, AADT, travel speed characteristics, and weather conditions. The hourly volume estimation/prediction model explained 90% of the sample variability. This indicates its good performance.
2. Time-dependent variables were found to be significant in estimating crash risk and severity. The most pertinent determinants were travel speed variation, decreasing operating speed, congestion level, scattered rain, and freezing temperatures.

Partially signalized intersection with raised crosswalk.

Fischer, E. (2015, May 24). *Partially signalized intersection with raised crosswalk* [Photograph]. Flickr. https://www.flickr.com/photos/24431382@N03/18467909131

3. Some of the detailed roadway features, such as barriers, street lighting, and road curves, were found to significantly affect the probability of a crash and the severity of its outcome. Some of the effects of intersection design elements were found to be counterintuitive due to the lack of turning volumes among the variables used in the models.
4. The limited size of the interaction sample precluded confirming the significance of a few roadway design elements and temporal traffic conditions that were expected to be safety factors.
5. The obtained models revealed safety-critical conditions such as potentially slippery pavement from near freezing temperatures combined with large speed variation on approaches to signalized intersections. Identification of critical combinations of adverse conditions helps understand crash causality.

Implementation

The revealed limitations of emerging data sources pointed out the following data needs: traffic volumes and speeds on local roads, turning volumes at road intersections, and high-resolution road geometric data. The two studied cases showed the potential for identifying safety-critical operational conditions. Time-dependent data may help traffic safety engineers identify these conditions, their frequency, and their overall contribution to crash occurrence and severity, while also devising effective safety countermeasures and estimate their safety benefit and cost effectiveness. Practical and efficient methods of scanning selected types of roads over time to identify the high-risk conditions are under development in the follow-up SPR-4540 project.

Recommended Citation for Report

Tarko, A. P., Guo, Q., & Pineda-Mendez, R. (2021). *Using emerging and extraordinary data sources to improve traffic safety* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2021/04). West Lafayette, IN: Purdue University. https://doi.org/10.5703/1288284317283

View the full text of this technical report here: https://doi.org/10.5703/1288284317283

Published reports of the Joint Transportation Research Program are available at http://docs.lib.purdue.edu/jtrp/.

Unsignalized leg of partially signalized intersection.

Fischer, E. (2015, May 27). *Unsignalized leg of partially signalized intersection* [Photograph]. Flickr. https://www.flickr.com/photos/24431382@N03/18810884261

JOINT TRANSPORTATION RESEARCH PROGRAM
Discovery with Delivery
Since 1937
JTRP

PURDUE UNIVERSITY

INDIANA DEPARTMENT OF TRANSPORTATION
INDOT