Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Modeling Pedestrian and Bicyclist Crash Exposure with Location-Based Service Data

Research Objectives

The motivation of the research is to enhance pedestrian and bicyclist safety with emerging active travel data. The main objective of the project is to develop a reliable methodology for measuring pedestrian and bicyclist exposure and analyzing associated risks.

Research Benefits

The research will provide immediate results for the study area and a foundational platform to expand to the rest of Nebraska. The research results will include a geodatabase pedestrian crash exposure model and a geodatabase bicyclist crash exposure model. Each model will function independently from the other model. Both models will be geographically constrained to Lincoln, NE. Lincoln was chosen as a testbed for several reasons. It is a midsize city, with an extensive network of multi-use pathways, as well as on-street bicycle facilities.

Principal Investigator

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Background

Biking and walking flows are essential components in safety analysis. Most local governments rely heavily on crash statistics to identify locations prone to pedestrian and bicyclist crashes. However, to effectively diagnose pedestrian and bicycle safety, planners and engineers need to know the relative exposure of the pedestrians and bicyclists to risk. Not having appropriate information about the activity patterns and volume of pedestrians and bicycles at locations, it is challenging to accurately identify and predict risk levels at those locations. A variety of pedestrian and bicycle exposure measures have been suggested and tested in the literature (Alattar, Cottrill, and Beecroft, 2021; Goodspeed et al, 2021; Ryus et al, 2017; Turner et al, 2017), but these measures are inconsistent and limited, and there is no widely accepted single approach. Area-based exposure measures are usually estimated at a macro level. This approach does not adequately capture activities at facility-specific geographic scales (i.e., street segments), since data are aggregated to areawide geographic scales. Another group of measures is based on field observation and extrapolation methods. Actual counts observed at selected locations in short periods of time are extrapolated to generate annual average daily pedestrian and bicyclist traffic estimates. This approach will not adequately display the difference in travel time (e.g., morning, afternoon, or evening), seasonal effects, days of the week, and will not cover the entire street network in a region. One of the main challenges in developing exposure measures is the lack of walking and biking activity data available at a finer spatial resolution, such as street segments, covering the entire road network of a city. The main source of information about area-based exposure measures is survey data (such as ACS or NHTS). The units used in area-based exposure measures vary widely and the geographic scale of available travel data is limiting (only 59 records for Lincoln MSA in the 2017 NHTS). This type of data does not have facility-specific trip information. Some local entities are directly collecting pedestrian and bicyclist count data, but these counts are collected at a very limited number of locations. Therefore, there is a critical need to develop a reliable methodology to analyze pedestrian and bicyclist exposure to risk with emerging data sources.

Conclusion

The rising popularity of non-motorized transportation has brought about safety concerns. The inclusion of accurate traffic volume information is one of the key elements to produce robust outcomes when researching safety. The project investigates and enhances transportation safety for pedestrians and bicyclists, emphasizing the integration of Location-Based Services (LBS) data, particularly StreetLight data, to analyze traffic volume and associated risks. The calibration process the significance of traffic volume as a key variable influencing prediction accuracy across pedestrian, bicyclist, and vehicle models. The crash analysis reveals a strong correlation between crash counts and traffic activity, with noteworthy findings emerging at the facility scale. The safety ranking analysis identifies higher and lower risk areas in the city. The spatial and temporal analysis at the street segment level highlights changes in traffic volumes before and during the COVID-19 period, along with distinct geographic patterns of activities at downtown and recreational locations. The project contributes to the knowledge and methodology surrounding transportation safety for non-motorized road users. By leveraging LBS data, the research provides comprehensive analyses of traffic patterns and safety considerations, aiming to create a safer environment for pedestrians and bicyclists.

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NDOT Recommendations Based Off Research Project – 2025

The research proved that location-based services data can be calibrated with short term field counts to create quality pedestrian and bicycle volumes across a large street network. Calibrated location-based services data can now be confidently utilized in future active transportation modeling and plan development. The crash exposure model identified a strong correlation between pedestrian and bicyclist volumes and non-motorist crashes. This confirms that improved non-motorist count data is needed to shift from reactive, crash focused safety analysis to proactive, non-motorist crash exposure analysis that improves safety before crashes occur. The model and temporal analysis identified specific land use and demographic data as indicators for prioritizing non-motorist safety improvements. The research identified the lack of sidewalk inventory as a gap for integrating facility data into the crash exposure model and any systemic safety improvement processes.

- *As provided by Don Butler, TAC Lead Member*

Research Readiness Level (RRL) Assessment

Level 4: Implementation with Follow-up

RRL 4

Technology Transfer

Transportation Research Board (TRB) papers and Publications

- Aldridge, N., Hawkins, J., and Yunwoo, N. (2024) "Calibrating Multi-Modal Location-Based Service (LBS) Traffic Data using Random Forest Models", Traffic Research Board 103rd Annual Meeting, Washington D.C., January.

This brief summarizes Project SPR-FY23(025)

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