DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

Investigation of Multimodal Crashes using Full Bayesian Multivariate Spatial-Temporal Models

Investigation of Main Influential Factors to Multimodal Traffic Safety

Transportation Safety and Mobility

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Project Title:
Investigation of Multimodal Crashes using Full Bayesian Multivariate Spatial-Temporal Models

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WHAT IS THE NEED?

California's Senate Bill-743 signed by the Governor on September 27, 2013 advocated the promotion of active transportation including bicycling and walking. Despite the numerous potential advantages of indulging in such modes of transport, such as elevation of health and environment along with mitigation of congestion, the cyclists and pedestrians are a vulnerable segment of traveling public which is exposed to safety risks. To realize the goal of safer traffic environment, safety of commuters for all modes of transport is of paramount importance. However, insufficient protective infrastructures or deficiency of efficient tools to evaluate the safety and economic impacts of transport facilities on pedestrians and bicyclists is the main deterrent to such active transportation. In response to this issue, there is an urgent need for devising sophisticated crash prediction models which can jointly estimate the crash risk for multiple modes of travel by accommodating the spatial, temporal correlations, and their interactions.

WHAT WAS OUR GOAL?

Develop methods to attain higher accuracy for estimation of crash risk for multimodal traffic at different levels of roadway network. The proposed methods would account for different correlations in crash data to generate more precise results which subsequently lead to informed inferences for devising safety strategies.

WHAT DID WE DO?

This research developed different statistical models for estimation of crash risk by accommodating various structured and

unstructured correlations found in crash data. More importantly, the proposed models were compared with the prevailing techniques to quantify their advantages for accurate prediction of crashes and higher precision of coefficients for explanatory factors. The models were implemented for different spatial levels of roadway network to model multiple modes of crashes. Such case studies allowed us to provide informed inferences from planning and engineering perspectives. The authors would like to thank Southern California Association of Governments (SCAG) for providing covariates, shape files, and geometric centroid distance data of Counties used in this study. This research was also supported by the Highway Safety Information System (HSIS) through the contribution of data.

WHAT WAS THE OUTCOME?

The outcomes of this project highlight the advantages associated with sophisticated modeling approaches. Following are the main conclusions:

- While modeling multimodal crashes, it is suggested to employ mode-varying coefficients as the impact of explanatory factors is variable for different modes of travel.
- The crash data tend to be clustered spatially and temporally, and the model performance for space-time interaction specifications for goodness-of-fit and site ranking indicated their advantages to model crash data.
- The presence of significant correlation between multiple modes demonstrated the importance of joint estimation of multimodal crashes.
- The semi-parametric models were consistently superior to traditional parametric ones. Their improved model performance due to higher flexibility justified their increased computational cost.
- A new approach of mixture components for space-time interaction demonstrated promising implications from different safety perspectives.

WHAT IS THE BENEFIT?

The project benefits Caltrans and the public in many aspects:

- Shed extensive light on the understanding of the impact of various factors to activity transportation and other transportation modes for traffic safety practitioners, which is very important for the proper complete streets design and land use policy development;
- Yield more accurate multimodal crash count models, which help Caltrans direct the limited budget to most needed improvement areas of active-transportation infrastructure;
- Assist Californians in satisfying the goal to enhance active transportation activities while committing to Vision Zero;
- Contribute to the traffic safety community with insightful findings associated with multiple transportation modes which should draw extensive practical and research interests.

LEARN MORE

Review the complete report.

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