Proactive Assessment of Accident Risk to Improve Safety on a System of Freeways

Anurag Pande, Ph.D., Cornelius Nuworsoo, Ph.D., and Cameron Shew

MTI Project 1006

May 2012

As traffic safety on freeways continues to be a growing concern, much progress has been made in shifting from reactive (incident detection) to proactive (real-time crash risk assessment) traffic strategies. Reliable models that can take in real-time loop detector information and discern normal flow from crash-prone conditions are a key to implementing crash preventive measures.

> *Classification models can help assess the relative risk of a freeway crash based on real-time traffic conditions... the classification model estimated from a freeway can even be used on similar nearby freeways.*

Study Methods

This study analyzes crash data for a 16-month period on the US-101 and I-880 freeways in San Jose, California. Crash risk assessment models were developed based on a binary classification approach, with traffic parameters measured at surrounding vehicle detection station (VDS) locations as the independent variables. Both logistic regression and classification tree (data mining) models were developed from the US-101 NB crash data.

SAS software was used to fit a logistic regression model for each combination of one, two, and three vehicle detection stations (1-VDS, 2-VDS, etc.) upstream and downstream from the crash, as well as at three different time slices before the crash: 5 to 10 minutes ("TS 2"), 10 to 15 minutes ("TS 3"), and 15 to 20 minutes ("TS 4"). The best logistic regression models (those capturing the most crashes in the first three deciles of posterior probability) were identified. Classification tree models were also developed for the different time slices and the number of VDS combinations.
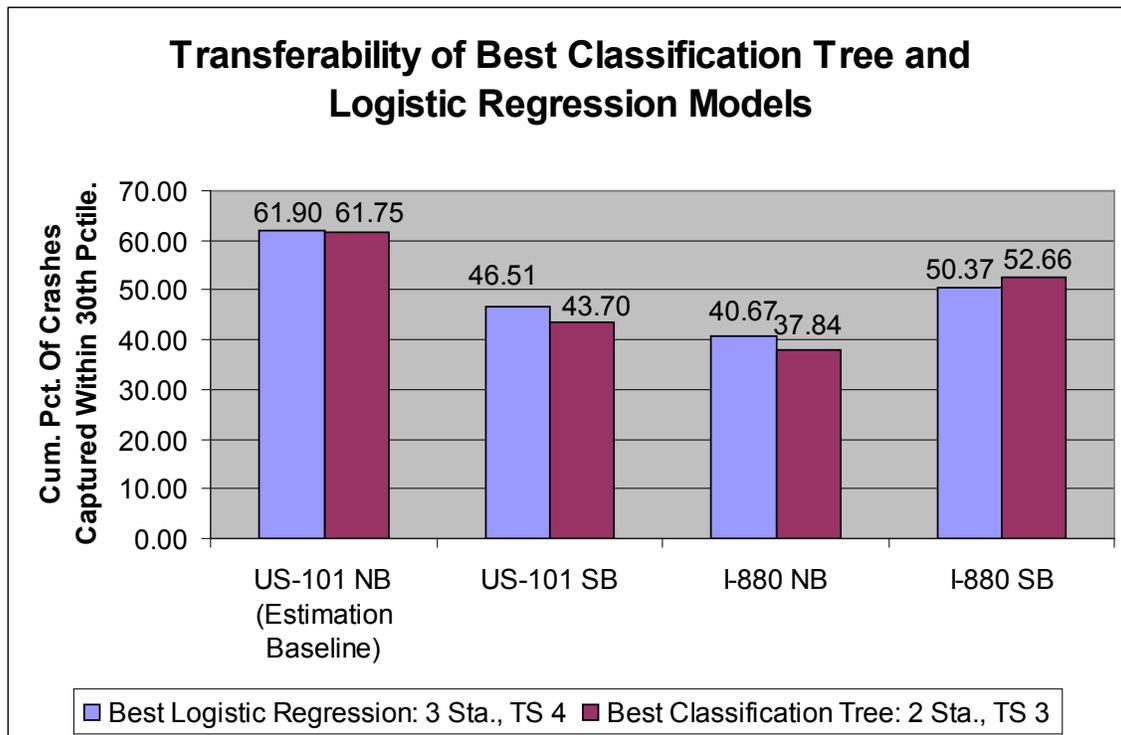
After the predictive models were evaluated for classification performance on US-101 NB (the same freeway from which they were developed), the best models were applied to the crash data of nearby freeways to assess transferability.

Findings

- Continuous output of the models (posterior probability) can be related to real-time crash risk.
- Both logistic regression and classification tree models can be transferred to nearby roadways, although performance is not as good.
- 3-VDS regression models offer the best classification performance on the same roadway, although 1- and 2-VDS models have superior transferability and are more suitable for real-time application.

- Classification tree models offer comparable performance to logistic regression models.
- There is no appreciable difference between models that consider only daytime crashes and those that consider all crashes.

Transferability of Best Classification Tree and Logistic Regression Models

Cum. Pct. Of Crashes Captured Within 30th Pctile.

Location	Best Logistic Regression: 3 Sta., TS 4	Best Classification Tree: 2 Sta., TS 3
US-101 NB (Estimation Baseline)	61.90	61.75
US-101 SB	46.51	43.70
I-880 NB	40.67	37.84
I-880 SB	50.37	52.66

☐ Best Logistic Regression: 3 Sta., TS 4 ☐ Best Classification Tree: 2 Sta., TS 3

Policy Recommendations

The authors have proposed a real-time implementation framework for instantaneous assessment of crash risk, but they recommend further study about issuing warnings and drivers' subsequent reactions. These models could also be applied for developing and testing variable speed limits (VSL) and ramp metering strategies that proactively attempt to reduce crash risk.

About the Authors

Anurag Pande, Ph.D., is assistant professor of civil engineering at California Polytechnic State University, San Luis Obispo. Cornelius Nuworsoo, Ph.D., is associate professor of transportation planning at the California Polytechnic State University, San Luis Obispo. Cameron Shew is an M.S. degree candidate in civil and environmental engineering at California Polytechnic State University, San Luis Obispo.

To Learn More

For more details about the study, download the full report at *transweb.sjsu.edu/project/1006.html*