Spatiotemporal Variation of Risk Preceding Crashes on Freeways

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Authors

Anurag Pande[1], Mohamed Abdel-Aty[1], Liang Hsia[2]

[1]Department of Civil and Environmental Engineering, University of Central Florida, Orlando, FL 32816-2450
[2]Florida Department of Transportation, , 605 Suwannee Street, MS90, Tallahassee, FL 32399-0450

Abstract

Research into the application of freeway loop detector data for traffic safety has gained momentum in recent years. The incompleteness of data from loop detectors has been a common problem in both the development and the implementation of models. The effect of individual crash precursors, obtained one at a time from a series of loop detectors, on relative risk of crash occurrence was examined through withinstratum one-covariate logistic regression models. The hazard ratio (resultant change in log odds of observing a crash by changing the covariate by one unit) was used as the measure of risk. The log of coefficient of variation in speed expressed as percentage, standard deviation of volume, and average occupancy expressed as percentage were found to be the most significant individual covariates affecting the odds of crash occurrence at a crash site. It was also observed that these parameters calculated at a 5-min level (as opposed to a 3-min level) are more significantly associated with crash occurrence. Hazard ratios corresponding to these covariates observed at a series of stations during six 5-min slices were plotted as a contour variable. The location and time of measurements of these parameters with respect to the location and time of the crash were used as ordinate and abscissa, respectively, in the contour plots depicting spatiotemporal variation of crash risk. The chart corresponding to the log of coefficient of variation in speed demonstrated the most clear patterns of increasing risk as the time and location of the crash are approached. On the basis of these spatiotemporal patterns, a methodology with which to identify freeway black spots in real time is proposed. This information could be used by traffic management centers to take preventive measures to avoid crashes or to prepare law enforcement and emergency vehicles for the impending situation.