Assessing Safety on Dutch Freeways with Data from Infrastructure-Based Intelligent Transportation Systems

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Abstract

Most freeway traffic surveillance technologies deployed around the world remain infrastructure based, with underground loop detectors being the most common among them. A proactive application for traffic surveillance data recently explored for some freeways in the United States is the estimation of real-time crash risk. The application involves establishing relationships between historical crashes and archived traffic data collected before those crashes. In these studies, crash occurrence on freeway sections has been related to temporal—spatial variation in speed and high lane occupancy. Critical modeling questions that remain unanswered relate to transferability of such an approach. This study attempts to address the issues of such transfer through analysis of crash data and corresponding loop detector data from five freeways in the Utrecht region of the Netherlands. Traffic surveillance systems for these freeways include more detectors per kilometer than most U.S. freeways. Their real-time data are also already being used for applications of advanced intelligent transportation systems. The analysis procedure proposed here accounts for these distinctions. In addition to these transferability issues, application is introduced of a new data-mining methodology, Random Forests, for identifying variables significantly associated with the binary target variable (crash versus noncrash). It was found that the average and standard deviations of speed and volume are related to real-time crash likelihood. Subjecting these significantly related variables to multilayer perceptron and normal radial basis function neural networks resulted in classifiers that achieved classification accuracy of approximately 61% for crashes and 79% for noncrashes. The promising classification accuracy indicates that these models can be used for reliable assessment of real-time crash risk on Dutch freeways as well.