Quantifying the Safety Impacts of Intelligent Transportation Systems

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(ABSTRACT)

An average of 6.5 million crashes are reported to the police every year in the United States. Safety is significantly important considering the rapid increase on traffic volume on American roads. This thesis describes the development of a safety model whose primary objective is to capture the benefits of Intelligent Transportation Systems (ITS) on safety. The specific ITS component that is examined in more detail is traffic signal coordination. The model was tested in a micro-simulation environment using INTEGRATION traffic simulation model as well as in a field data evaluation.

The General Estimates System (GES) database was chosen as the primary national database to extract accident data. These data were used for the development of the statistical foundation for the safety model. Crash rates were produced using extracted crash frequencies and annual vehicle miles traveled figures from the Highway Statistics (FHWA, 1997). Regression analysis was performed to predict the behavior of several crash types, as they were associated with a variety of variables, for example the facility speed limit and time the crash occurred.

The model was developed in FORTRAN code that estimates the accident risk of a facility based on its free-speed. Two methods were used to test the model: 1. field data from the city of Phoenix, Arizona were used in a GPS (Global Positioning Systems) floating car that tracked the accident risk on a second by second basis. Before and after signal coordination scenarios were tested thus yielding a result that the accident risk is less in the after scenario. 2. the model was then tested in a micro-simulation environment using the INTEGRATION traffic model. A hypothetical network, as well as the Scottsdale/Rural road corridor in Phoenix were used. The sensitivity analysis of before and after signal coordination scenarios indicated that after the signals were coordinated, the crash risk was lower, thus proving that the model could capture the benefits of this ITS component. Reducing the number of crashes is an important aspect of improving safety. Traffic signal coordination smoothens traffic on a facility and reduces its potential accident risk by producing less vehicle-to vehicle interactions. Also, traffic signal control increases the free-speed of a facility. The advantage of this safety model is the fact that it can be used to capture a variety of ITS technologies and not only signal coordination that is examined in more detail in this thesis.

This thesis is dedicated to the memory of
my mother ***Lilia Avgousti***

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