ABSTRACT

Li, Wei. PhD, Purdue University, August 2008. Models of Crash Likelihood and Methods of Safety Improvement at Coordinated Signalized Intersections. Major Professor: Andrew P. Tarko.

In this research, the safety impact of arterial signal coordination is investigated. Based on the findings, procedures are proposed to incorporate safety considerations into the design of coordinated signal timing. In addition, software tool is developed to facilitate the utilization of the findings.

Signal coordination, the timing of a string of closely located intersections, has been extensively employed as a tool to optimize an arterial system's mobility performance, common measured by total number of vehicle stops and time of delays. Although vehicle crash at signalized intersections has long been recognized as a major safety threat, past research and treatments have been largely limited locally to non-coordinated signalized.

Disaggregate statistical models are developed to identify the influential factors of likelihood of rear-end and right-angle crashes, the two most frequent type of intersection crashes. To capture the severity factors, the outcome is further classified into property-damage-only (PDO) and injury-fatal (IF) crashes for both rear-end and right-angle. Due to the inherent randomness of traffic, crash likelihoods of each 15-minute interval are used as the response variables of the models. Consequently, values of predictive variables are collected directly or inferred from available data for each 15-minute interval, including the volume, signal timings, and traffic patterns. In particular, a method to characterize the traffic is proposed to represent each 15-minute interval's arrival pattern for every approach.

Various discrete outcome econometric models are used and compared, including multinomial logit model (MNL), multinomial probit model (MNP), conditional logit model (CL), ordered logit model (OL) , and nested logit model (NL). A mixture of MNL and NL is proposed as the prediction framework for different purposes.

Some of findings regarding the inducing factors of crash are listed as follows. First, signal coordination significantly affects crash likelihood. Certain traffic arrival patterns, characterized by the method proposed in this research, are associated with significantly lower crash likelihoods. However, no adequate evidence is found to establish correlation between crash risk and the traditional coordination quality measures, such as arrival type and platoon ratio. Second, dilemma zone, a widely perceived risk caused by short yellow signal, contributes insignificantly to the crash likelihoods. Third, volumes adjusted based on models presented, rather than the total volumes, are found to be better predictors of crash likelihoods. It suggests that only a part of all vehicles are highly susceptible to the two types of crashes.