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Spatial-temporal effects of speed transition on accidents likelihood

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박사학위 논문요지

Spatial-temporal effects of speed transition on accidents likelihood

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Traffic accidents happen as a result of the interaction among human factors, vehicle factors and road or environment factors. Many researchers have studied accident prediction models (APMs), which formulate the relationship between the factors and accidents likelihood, focusing on road or environment factors. They found that annually average daily traffic (AADT), geometric design of roads, speed limit, etc. could have effects on accidents likelihood. These factors are hard to be changed during short period. To put it differently, previous studies developed APMs with aggregating data more than one hour.

As we enter the era of big data, researchers get an opportunity to develop APMs with aggregating data less than one hour. According to the analysis for big data collected from Gangbyeon-bukro and Olympic-daero, which are the main arterial roads of Seoul, it is found that 56% of all accidents occurred on those roads during 2017 is due to the traffic congestion and speed transition of traffic flow. This result suggests that traffic congestion and speed transition have much to do with accidents likelihood.

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The purpose of this research is to develop an accident prediction model using five-minute aggregating speed and accident data. To analyze the spatial-temporal effects of speed transition on accidents likelihood, 'speed transition diagrams' (STDs) are made. STDs are defined as the two dimensional space with a time axis and a space axis and show the speed transition pattern of free flow and the hot-spot of traffic accidents.

This research carries out two analysis using STDs. First of all, the inference to compare the mean speeds of two populations is performed. More specifically, it is examined how the forming or disappearing speed and the types of queues could affect the accidents likelihood. To look into this effects, in the case of existence of queues, the forming or disappearing speed of queues with accidents is compared to the forming or disappearing speed of queues without accidents. As a result of the test, the speed of forming or disappearing speed of queues with accidents is faster than that of forming or disappearing speed of queues without accidents.

In addition, the binary logistic regression model is developed to formulate the relationship between the speed transition of traffic flow and accidents likelihood. The independent variables to estimate that model are used to consider various relationships among the speed of the analyzed link and those of adjacent links. The model using the independent variables which are not treated as moving window method (MWM) are revealed not statistically significant. However, it is demonstrated that the independent variables which are treated as MWM could improve the goodness of fit of the binary logistics regression model. MWM makes the speed transition among links smoother and tempers the randomness of accidents. According to the model

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estimation, it is showed that the speed transition during 20 minutes before an accident occurrence has to do with accidents likelihood. Also, it is revealed that the speed transition between the analyzed link and two upstream and two downstream links could increase the accidents likelihood.

The outcome of this research could contribute to the groundwork of forecasting traffic accidents. In the accidents forecast based on the hot-spot, it is difficult to consider the time-dependent variables, which are the main focus of this research. So the nondiscriminatory information related to the accidents which happened on a certain link in the past is provided to all drivers passing that link. If it is possible to distinguish the likelihood of accidents on hot-spot by time, drivers will be provided with discriminatory information such as the temporal frequency of traffic accidents. Besides, the outcome of this research will be used to identify another cause of accidents and prevent them from happening. The speed transition of traffic flow cause accidents. This means that the management of traffic flow speed could reduce the likelihood of accidents.

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