Research
Report Summary

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Integration of Microscopic Big Traffic Data in Simulation-Based Safety Analysis

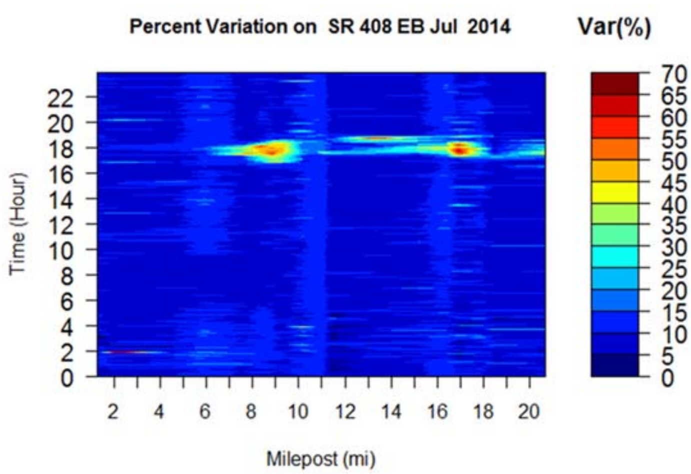

Figure 1. Travel time reliability assessed by weekday percent variation evaluated at 5-min intervals on SR 408 eastbound, July 2014

The Big Traffic Data collected from various ITS traffic detection systems provide insight about the facilities at the microscopic level in real-time. The Big Traffic Data were provided by

▪ Automatic Vehicle Identification (AVI) system,

▪ Microwave Vehicle Detection System (MVDS), and

▪ Video Image Processing (VIP) system.

Efficient integration and utilization of such data for better performance of transportation systems become a critical issue for traffic operators. This project explored these data with a focus on operation efficiency and traffic safety:

▪ evaluation of traffic operation,

▪ real-time safety evaluation,

▪ micro-simulation, and

▪ dilemma zone analysis.

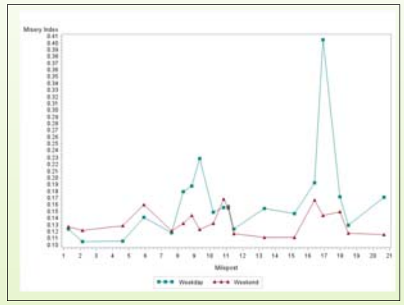

Figure 2. Misery index on SR 408 eastbound, July 2014

Figure 3. VISSIM simulation for the fog condition

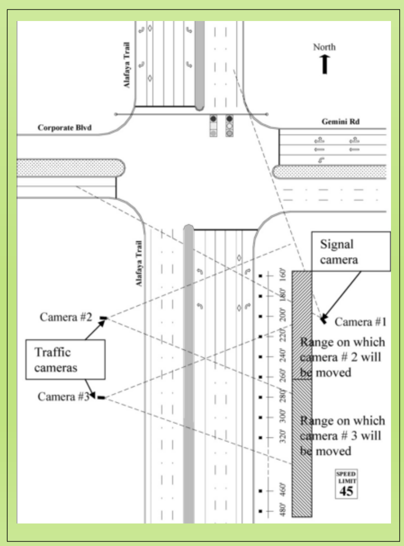

Figure 4. Cellular Automation Model for dilemma zone

Study Tasks

> *"The advent of the Big Data era has transformed the outlook of numerous fields in science and engineering.*
> *The transportation arena expects to integrate microscopic big traffic data in simulation to improve traffic safety."*

1) Evaluate traffic operation from two aspects that use AVI data: congestion measurement and travel time reliability,
2) Conduct real-time crash analyses that use MVDS and weather data for expressway mainlines and ramps,
3) Build a VISSIM simulation network to evaluate safety under fog conditions,
4) Implement a Cellular Automaton Model to simulate the safety conditions in an intersection dilemma zone.

Conclusions and Recommendations

1) Congestion on urban expressways occurred mainly during morning and evening peak hours. The segments experiencing congestion were location-specific. On segments with high traffic demand and near interchanges with other major corridors, congestion was more likely to occur.
2) Statistical range measures, buffer indicators, and tardy trip indicators were all tested for performance in travel time reliability measurements. The conclusions from different measures agreed with each other. Improvement of recurrent congestion can also have positive effects on travel time reliability improvement.
3) Both mainline and ramp real-time crash prediction models achieved good estimation accuracy. Consequently, the automatic traffic detection data showed great potential for the construction of a more proactive traffic safety management system.
4) In fog conditions, a lower speed limit was recommended to ensure that vehicles could slow down in time to avoid potential collisions. If the traffic volume was high, reducing speed limit alone in the face of fog would only have limited effects on traffic flow. In such cases, other countermeasures, such as warning messages, detour strategies, or even closure of roadway facilities, might be needed.
5) The mean speed and the standard deviation played a significant role in rear-end crash risk situations in intersection dilemma zones. The countermeasure of pavement-marking and the auxiliary flashing yellow indication could further reduce rear-end crash risks when the expected mean speed of the leading vehicle is relatively low.

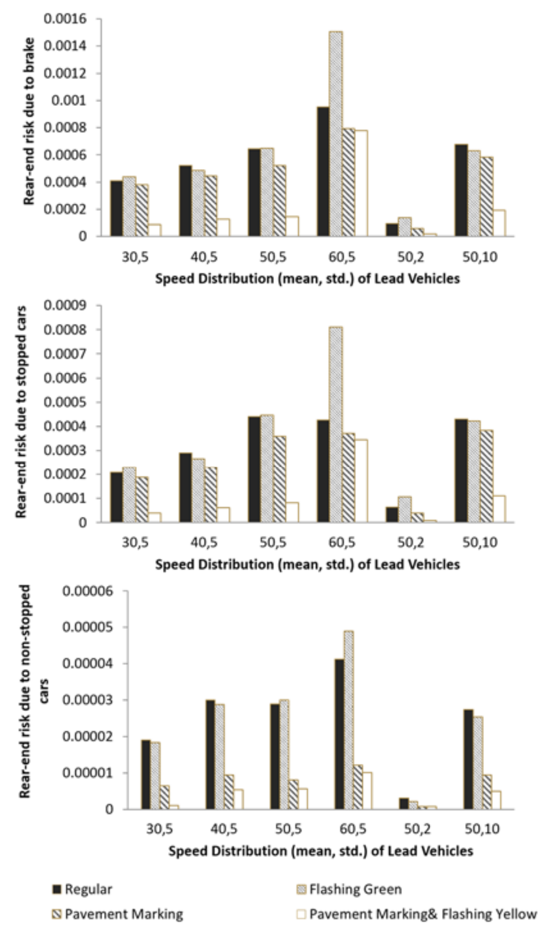

Figure 5. Rear-end risk under different situations