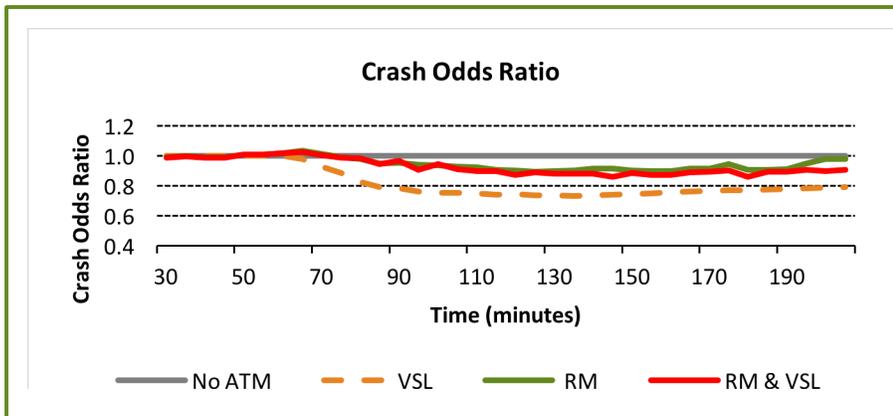


Research Report Summary



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Utilizing Micro Simulation to Evaluate the Safety and Efficiency of the Expressway System



Overview

This project analyzed the safety of three expressways based on average daily traffic, average hourly traffic, and microscopic traffic data at five-minute intervals. The modeling results showed that weaving segments had experienced more crashes than other segment types.

The crash mechanisms of weaving segments were explored using real-time crash analysis. Then, active traffic management (ATM) strategies,

ramp metering (RM) and variable speed limit (VSL), were identified to be potential countermeasures to improve the safety of weaving segments. Subsequently, a well-calibrated and validated microscopic simulation network was built for a congested weaving segment. The simulation results verified that ATM can significantly improve the traffic safety of the studied weaving segments.

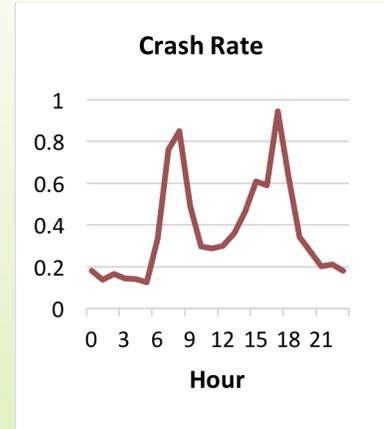


Figure 1. Average crash rate for three studied expressways (crashes per hours per segment)

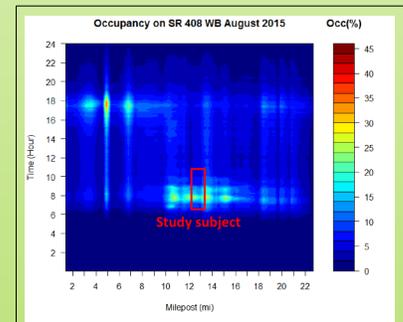


Figure 2. Study subject of VISSIM simulation

Study Tasks

- 1) Identifying the most dangerous expressway segment type based on safety analyses using ADT, AHT, and microscopic traffic data;
- 2) Exploring the crash mechanism of the most dangerous expressway segment type using the real-time safety analysis;
- 3) Building a well-calibrated and validated VISSIM network for an expressway segment that has high crash potential; and
- 4) Testing the impact of ATM on the safety of the expressway segment identified by Task 3.

“Once crash mechanisms have been identified using real-time safety analyses, microscopic simulation can be used to test and verify the impact of active traffic management on the safety of expressway segments.”

Conclusions and Recommendations

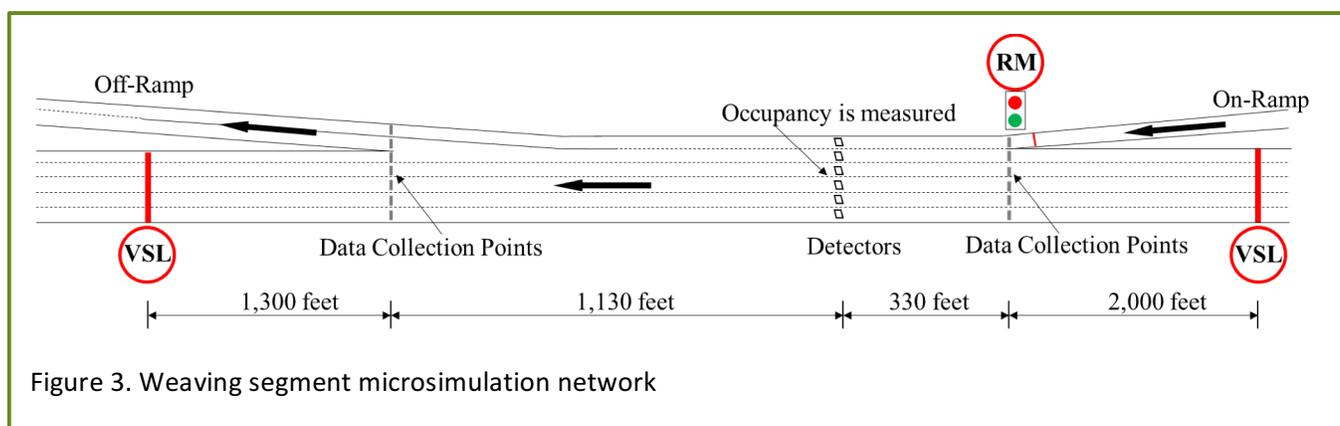


Figure 3. Weaving segment microsimulation network

- 1) In ADT-based, AHT-based, and microscopic-traffic-based safety studies, all results illustrated that the existence of a weaving segment could increase crash potential;
- 2) The microscopic traffic (five-minute intervals) data is the most suitable traffic data if ATM is used to improve the safety of a segment in real time;
- 3) The main crash contributing factors for weaving segments are speed difference between the beginning and end of weaving segments and weaving influence length. Both factors have positive impact on crash risk;
- 4) Through microscopic simulation, ATM strategies improved the safety of a congested weaving segment by reducing crash odds ratio because they reduced the speed difference or weaving influence length or both;
- 5) The proposed new RM, which took both traffic operation and safety into consideration, was better than traditional RM because it provided safer traffic; and
- 6) The integrated strategy (RM-VSL) produced lower conflict numbers than RM alone when on-ramp queue length was controlled.