

INTRODUCTION

Overview

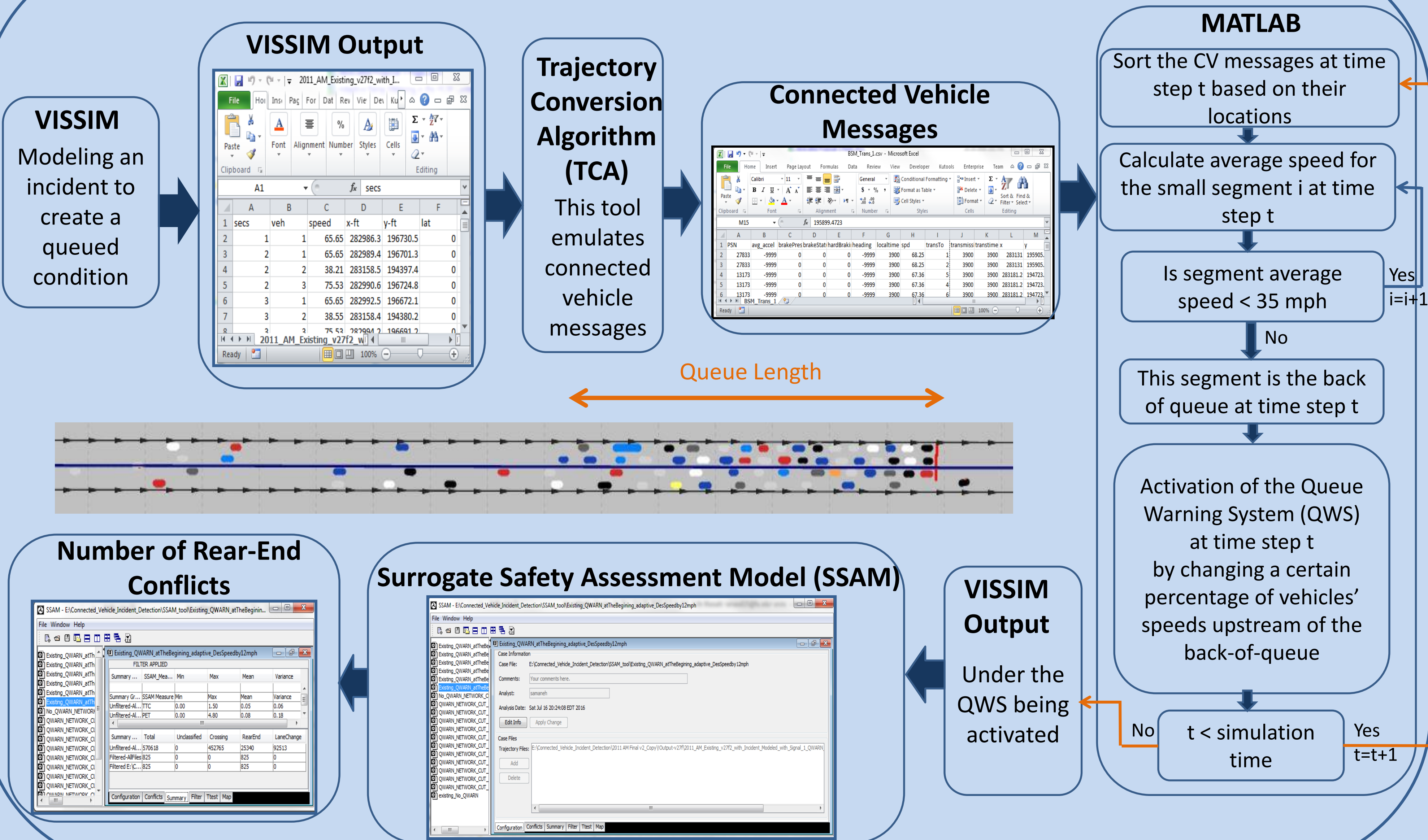
- Rear-end collisions are one of the main safety concerns on freeways generally caused by slow or stopped traffic.
- Queue Warning Systems (QWSs) are designed to inform drivers about the queued traffic ahead so that they can react in a timely manner.
- Based on Daimler-Benz study, 60% of the rear-end collision can be prevented if the drivers had an extra half a second to react to slow traffic ahead.
- Existing QWS rely on fixed traffic sensors to detect the back of queue. Thus, the location of back of queue cannot be detected accurately.
- It is expected that if the transmitted messages from the connected vehicles (CV) are utilized for this purpose, the detection can be faster and more accurate.

Objectives

- Investigating the accuracy of queue length estimation using connected vehicle data versus point-detector data
- Evaluating the safety benefits of the QWS under different market penetrations of CV in future years based on safety surrogate measures (number of rear-end collisions)

METHODOLOGY

Freeway Back-of-Queue (BOQ) Estimation & Queue Warning System Based on CV data

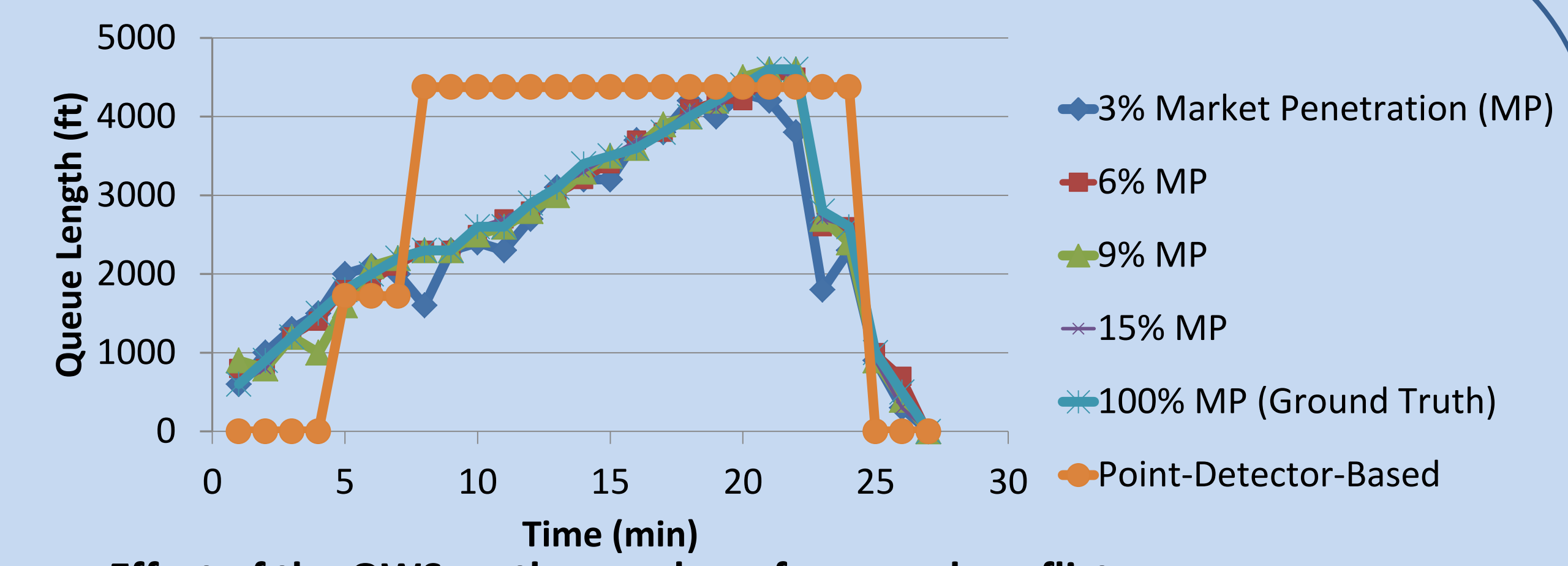


CASE STUDY

- A well calibrated network in VISSIM micro-simulation was used to test the back of queue estimation algorithms and the queue warning system.
- The network is a 20-mile segment of the I-95 southbound corridor in Broward County, Florida.
- A one-lane blockage incident was introduced into the traffic stream to generate a bottleneck location for the purpose of this study.
- To test the methods presented in this study, a total of 40 scenarios with different CV penetrations were conducted.

RESULTS

Estimated queue lengths: connected vehicle-based vs. detector-based



Effect of the QWS on the number of rear-end conflicts

Compliance with the queue warning system (percentage of drivers changing their speed in response to the Queue Warning Messages)	Reduction in number of rear-end collisions due to Queue Warning System activation(%)
2%	0.10
5%	3.56
10%	3.89
15%	5.31
20%	5.37
30%	5.47
50%	7.47
70%	7.50

CONCLUSIONS

- Having 6% connected vehicles in the traffic stream allows the estimation of the back-of-queue location with less than 4% error on average.
- Further, it is concluded that the QWS improved the safety conditions of the network by reducing the number of rear-end conflicts.
- The safety impacts of the queue warning system become significant when the compliance with the queue warning messages is more than 15%.