Safety Evaluation Report of MOBATSim -AEB

according to ISO 26262, ISO 21448, EuroNcap

Author: Test Author

30-Jun-2021

Table of Contents

Chapter 1. Introduction

This is a safety evaluation report for MOBATSim which according to three standards and generate a case study.

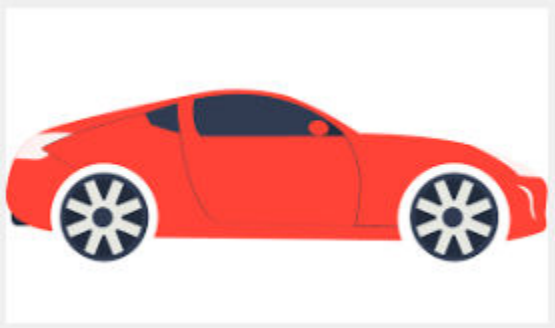

Figure 1.1. Style of the test vehicle.

Chapter 2. HARA

2.1. Scenario definition -laneMerge

The test scenario shows below which contains two traffic paticipants drive on a merged road, the trajectories of two vehicles are distinguished with different color .

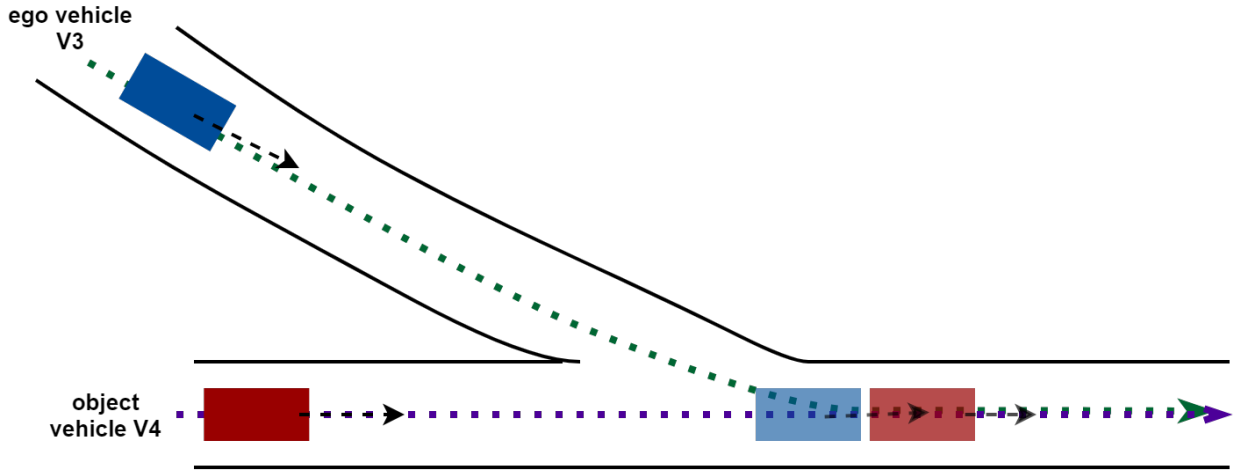

Figure 2.1. Test Scenario in MOBATSim

The road features of the test scenario are listed below:

1. Single lane
2. Road length
3. lane width 3.7m
4. No traffic signal and traffic signal controller

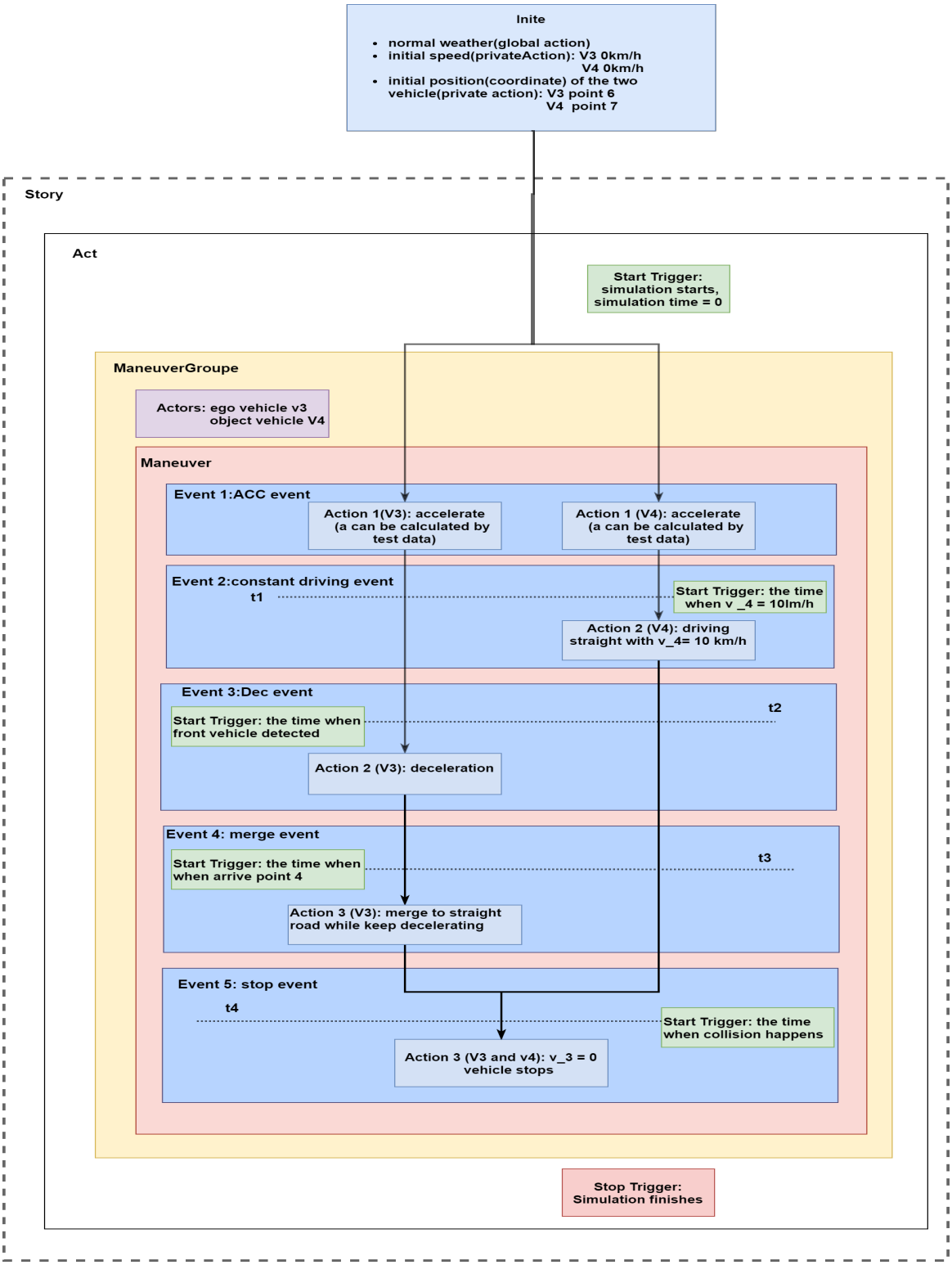

Figure 2.2. Scenario Definition under OpenScenario

2.2. Item Definition -AEB

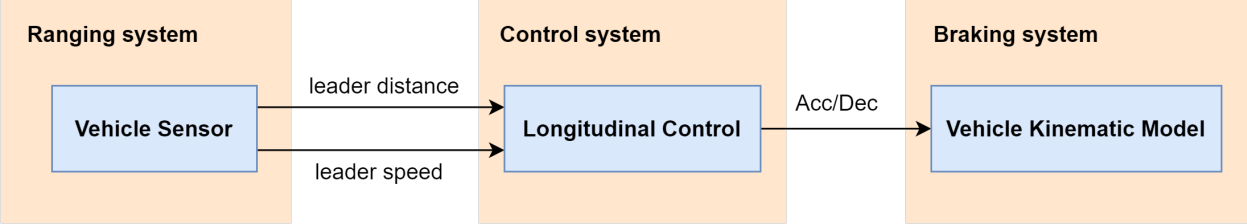

Figure 2.3. System block - Autonomous Emergency Brake (AEB) System in MOBATSim

1. Functionality: AEB detect leading vehicle with ranging system, with the caltulation of the control system, gives the braking command to the braking system.
2. Operational design domain: This AEB function is only appropriate for the MOBATSim platform, in which most of the roads are single lanes and no other vehicles drive alongside the leading vehicle.

2.3. Situation analysis and Hazard identification

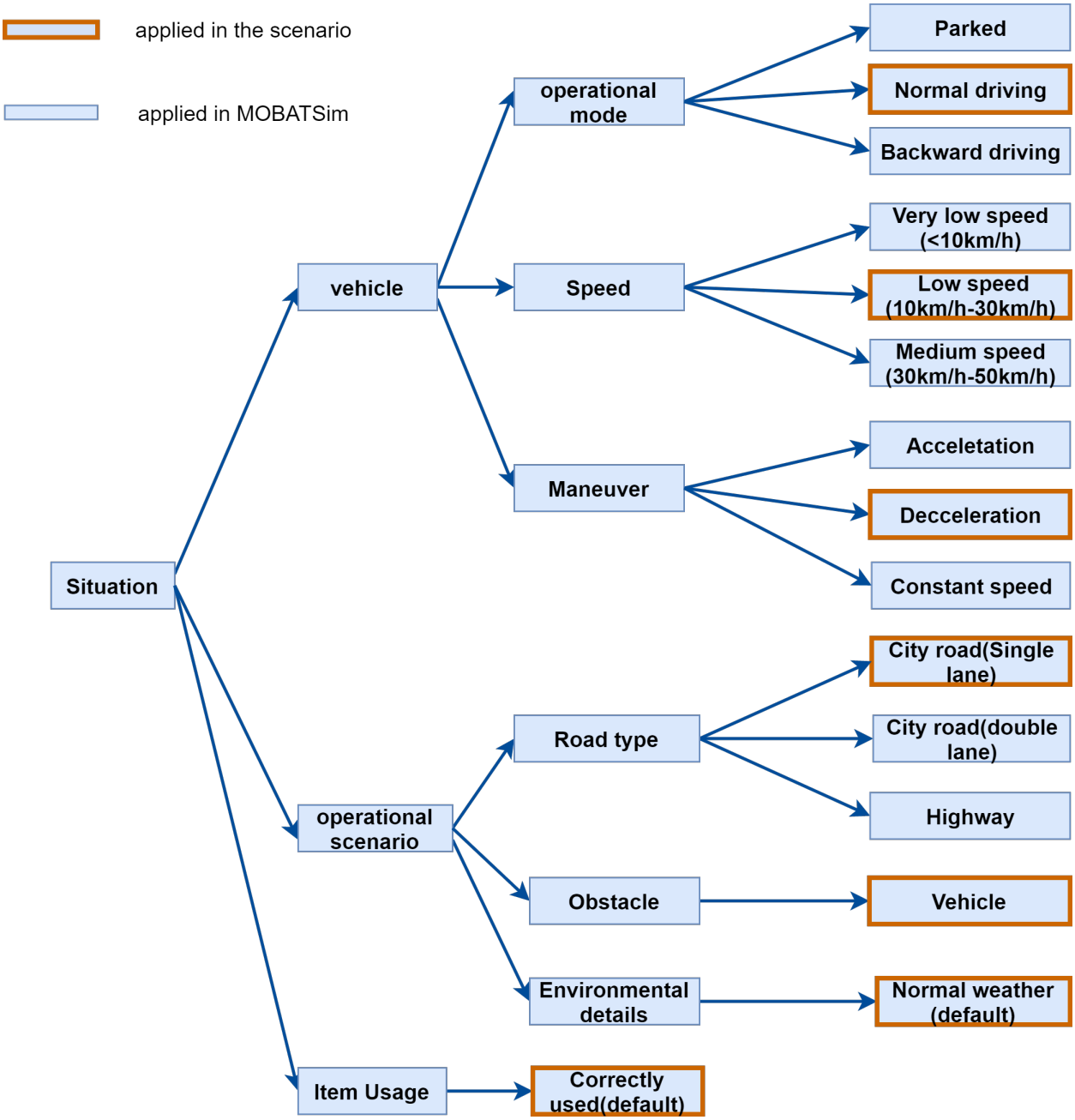

Figure 2.4. The situational analysis for specific scenario in MOBATSim

The situational analysis of the scenario "laneMerge" are listed below:

1. Operational mode: normal driving.
2. Operational scenario: Normal city road with single lane.
3. Environmental details: Normal weather (default)
4. Situational details: low speed (10km/h~30km/h)

5. Item usage: correctly used (default)

The exposure level is 3.

The hazards are caused by electronic malfunctions of target item shown below:

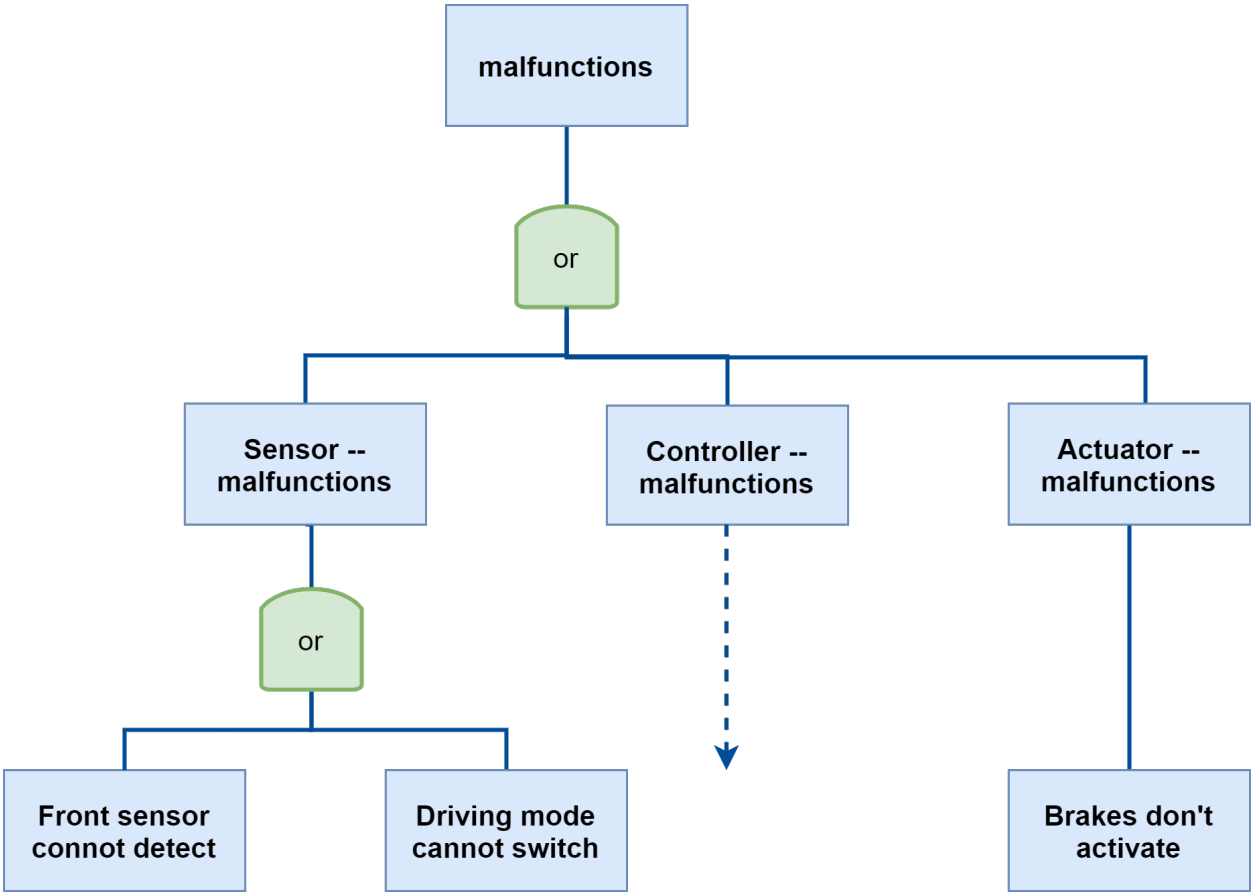

Figure 2.5. The malfunctions which should happends in AEB system in MOBATSim

The example of hazard identification of AEB is shown below:

1. Function: Autonomous Emergency Braking system shall apply a braking to slow down or stop, when there is a potential collision detected.
2. Malfunction: Function not activated. Eg: the sensor does not detected the front vehicle, or there is delay time for switching driving mode.
3. Malfunction details: The sensor of AEB does not detected the front vehicle, so there is no input data for control system, the control system has nosignal for braking system. The AEB function does not apply a braking.
4. Hazardous event: The ego vehicle has a front collision with the leading vehicle.
5. Event details: The unactivated AEB does not apply a braking when the ego vehicle is nearing the leading vehicle, the vehicle remains at the previous speed and has a crash with leading vehicle.

Collision in low speed, the severity level is 2

2.4. Hazardous event classification

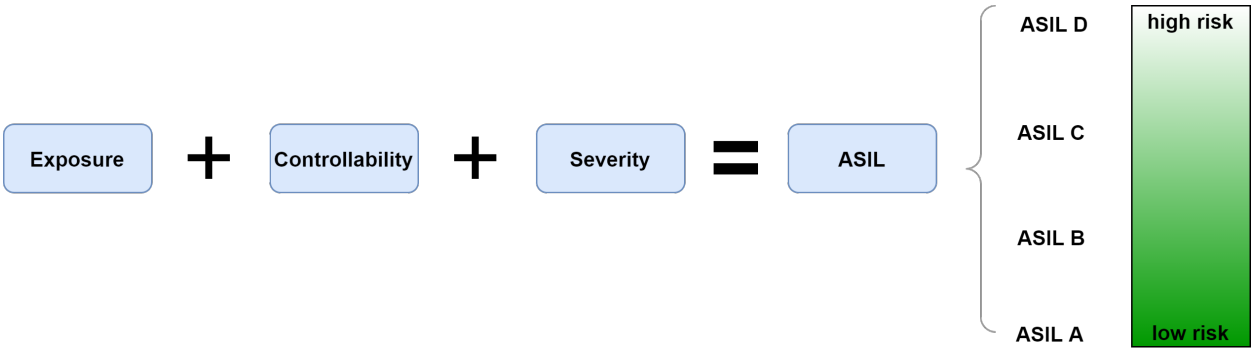

Figure 2.6. Exposure, Severity, and Controllability determin the ASIL level from low risk to high risk

According to above (Controllability level is 3, because the driver is out of the driving loop), the ASIL level of AEB in specific scenario shows below:

The ASIL level is ASIL B.

2.5. Safety goal and functional safety requirement

The Safety goal and functional safety requirements is shown in the list below:

1. Safety goal: The vehicle sensor of the AEB system shall reach the normal sensitivity.
2. Functional safety requirement 1: The AEB system shall ensure the accuracy of the algorithm in ranking system.
3. Malfunction details: The AEB system shall ensure the connection between vehicle model and control system has the proper functioning.

Chapter 3. SOTIF

Chapter 4. Case study

In this chapter, the test results of several cases are presented. For the sake of simplicity, only the data from vehicle_3 is shown here The performance of the AEB is determined by KPIs: minimum TTC, minimum distance, and relative impact speed .

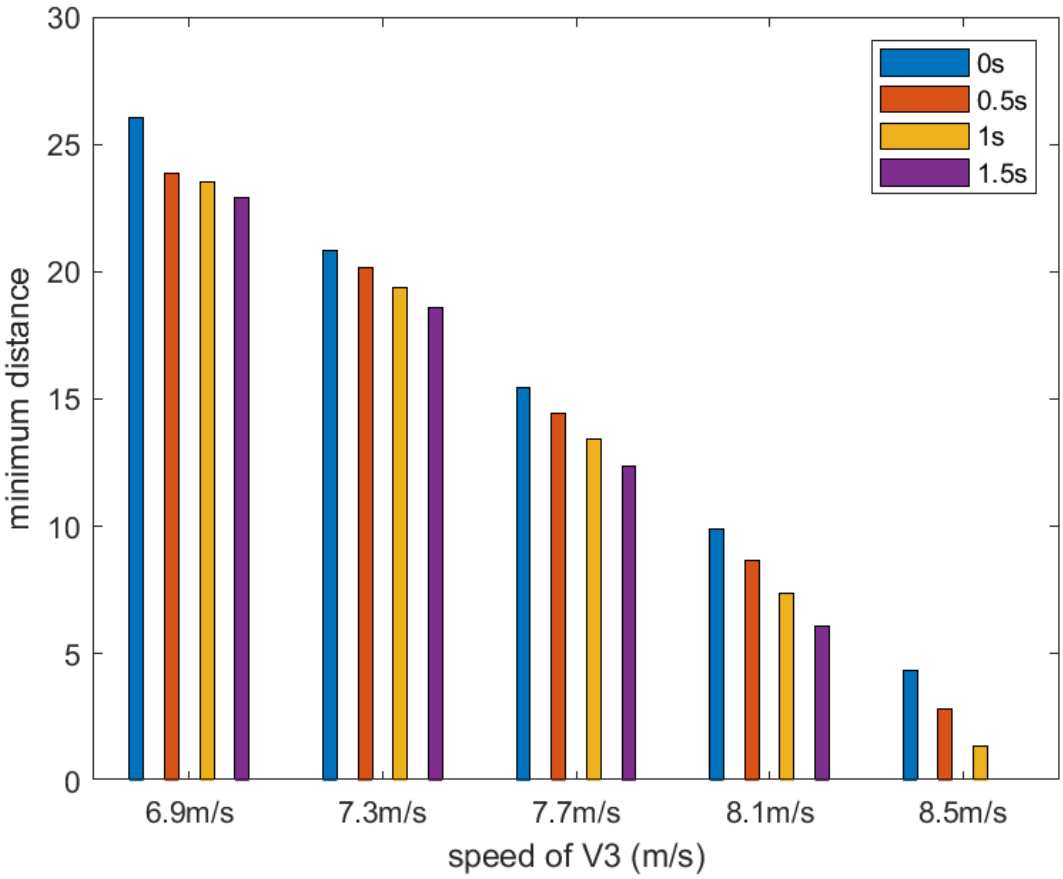

Figure 4.1. The minimum distance between two vehicles under different time delay of vehicle 3.

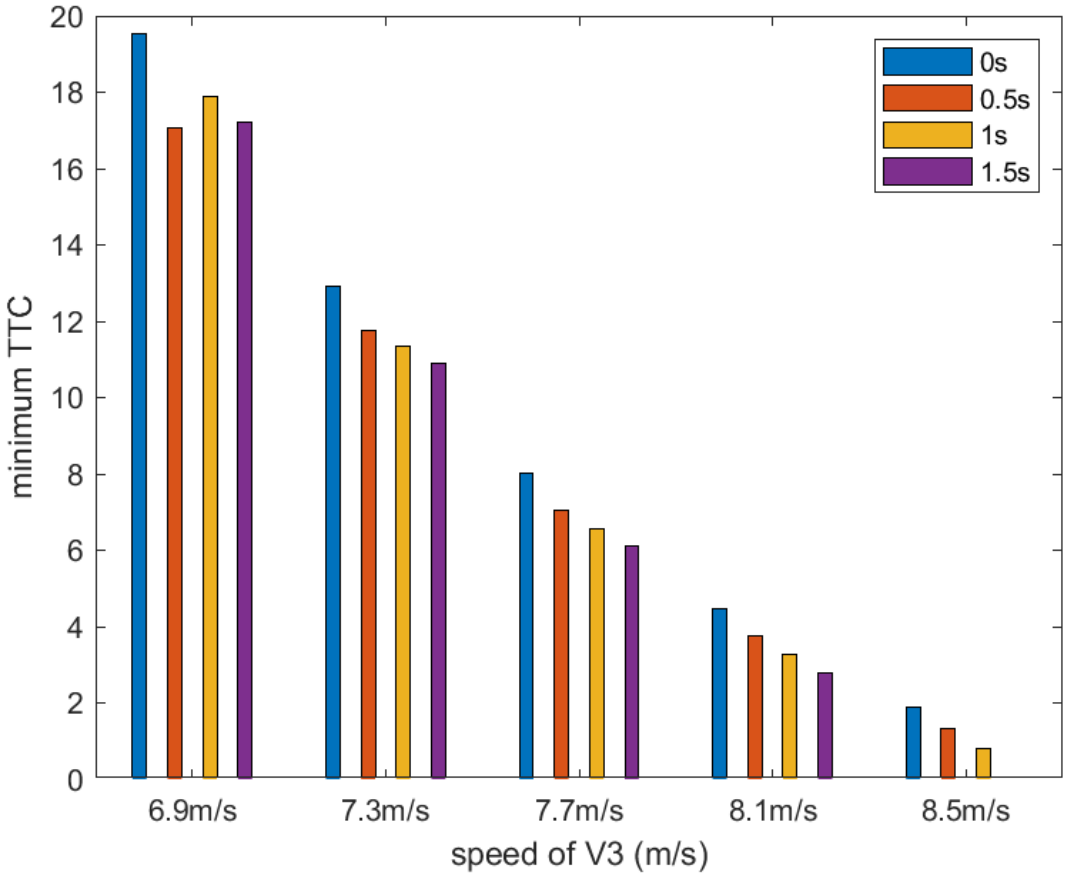

Figure 4.2. The minimum TTC under different time delay of vehicle 3.

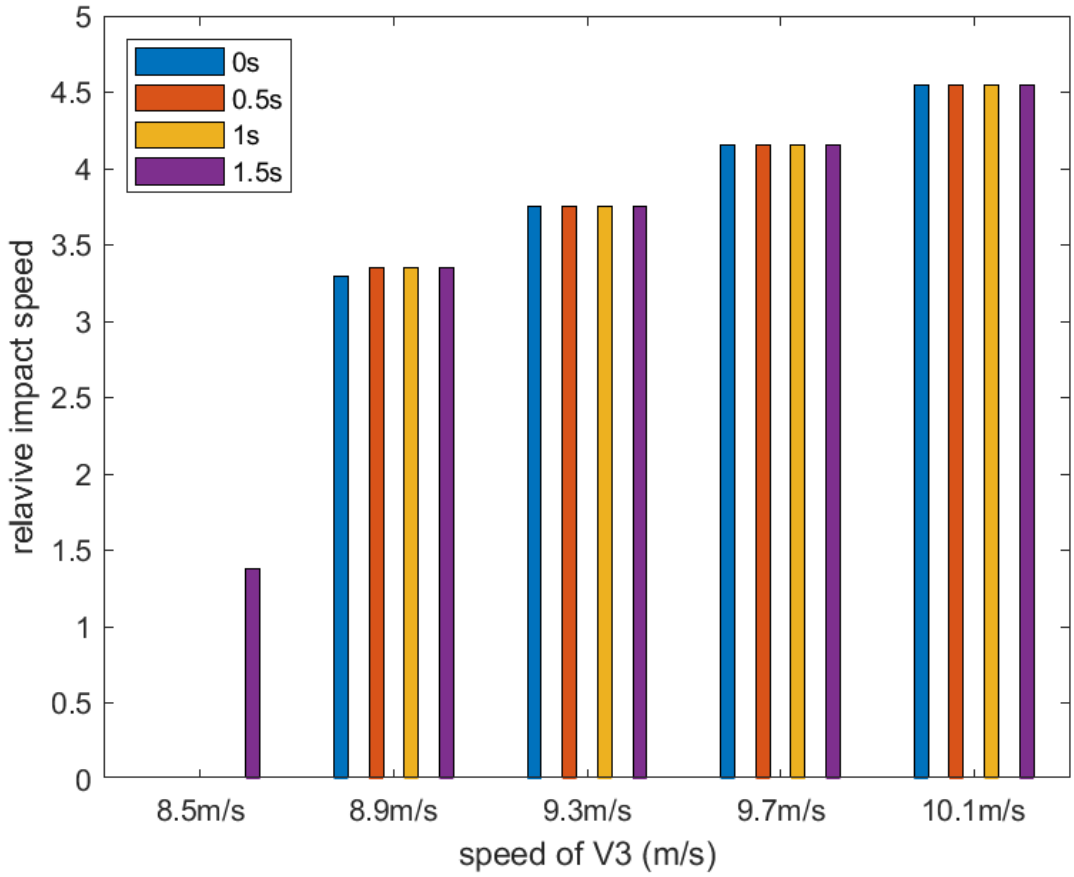

Figure 4.3. The relative impact speed between two vehicles under different time delay of vehicle 3.

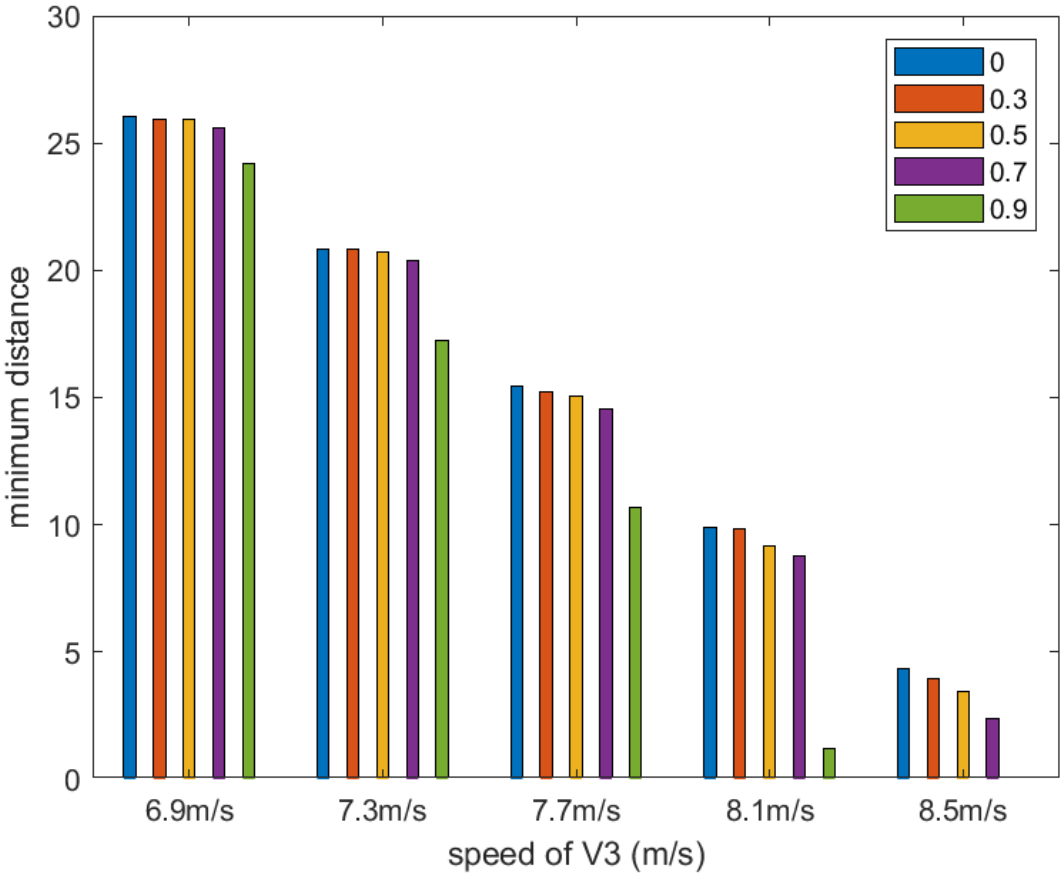

Figure 4.4. The minimum distance between two vehicles under different failure rate of vehicle 3.

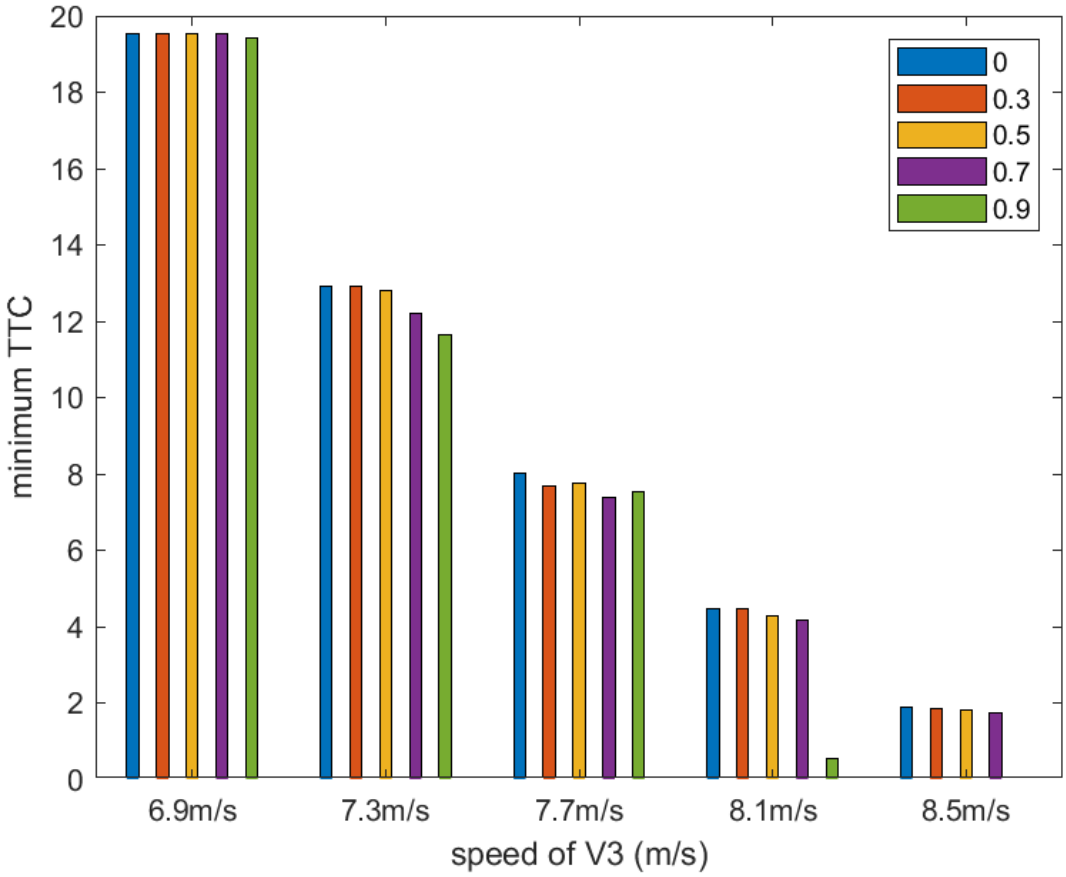

Figure 4.5. The minimum TTC under different failure rate of vehicle 3.

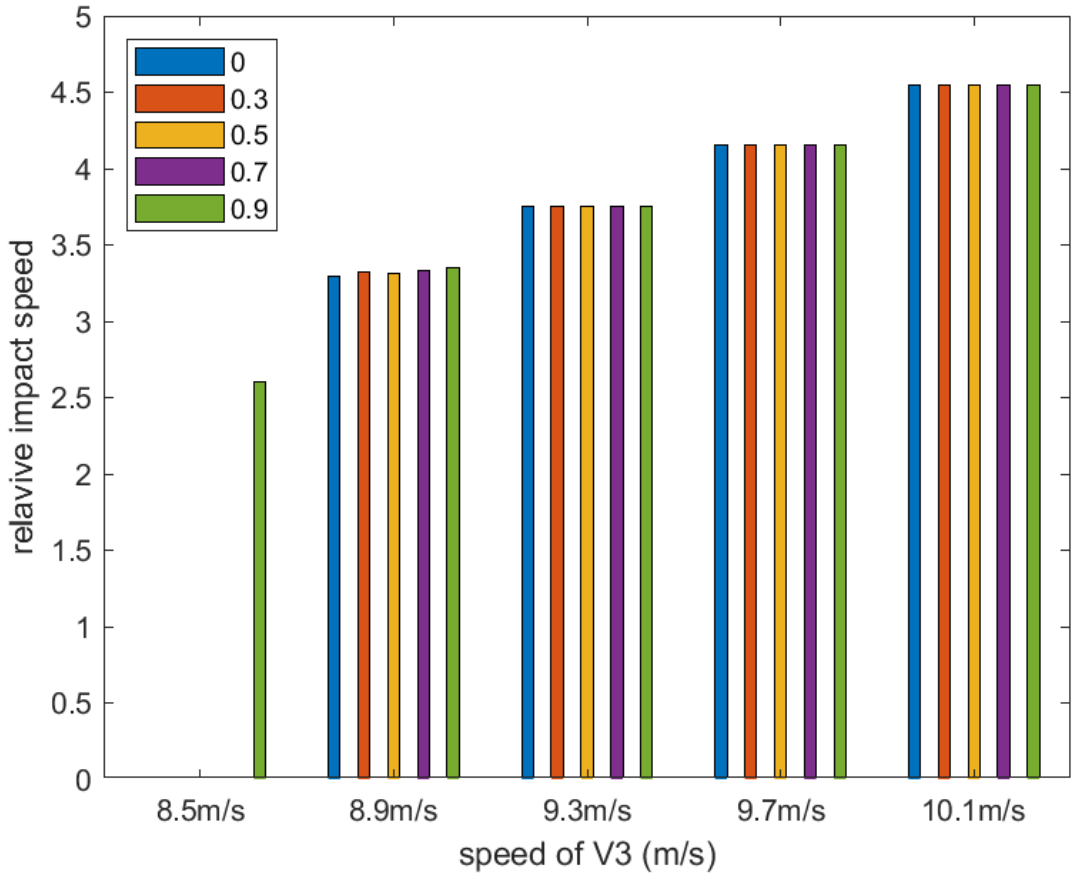

Figure 4.6. The relative impact speed between two vehicles under different time delay of vehicle 3.

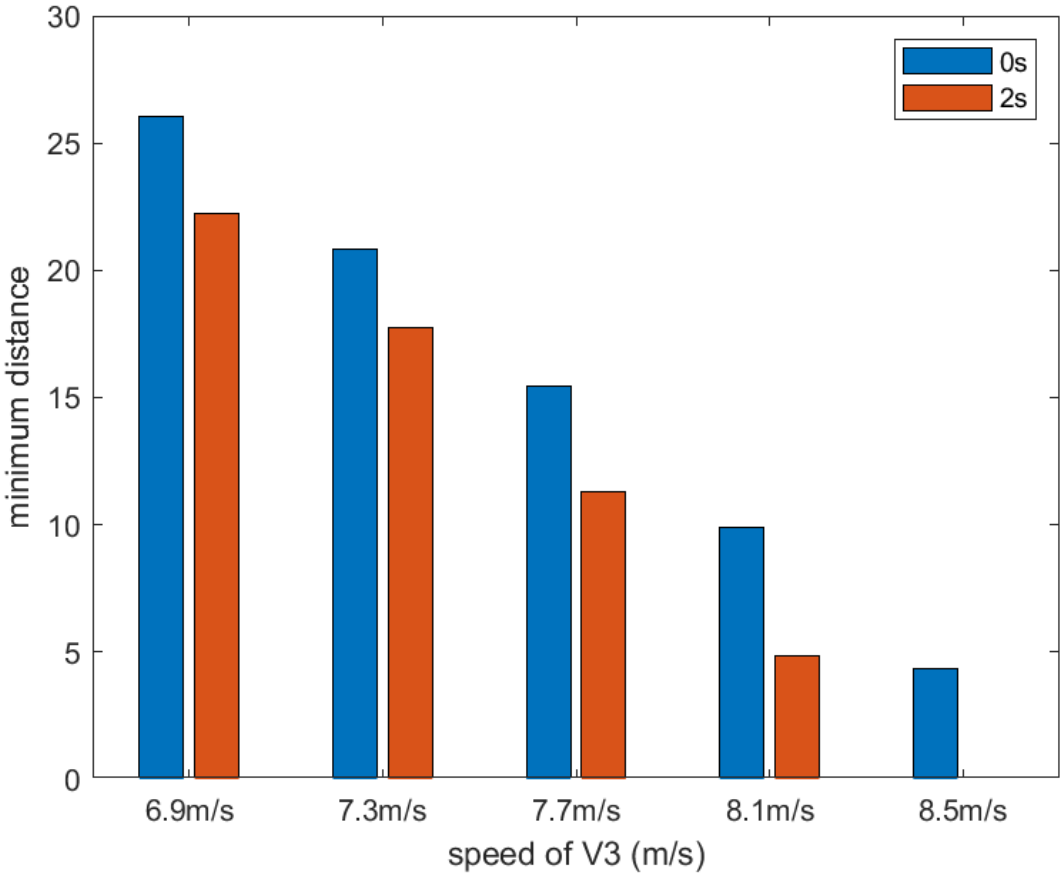

Figure 4.7. The minimum distance between two vehicles under sensor limitation-time delay of 2s.

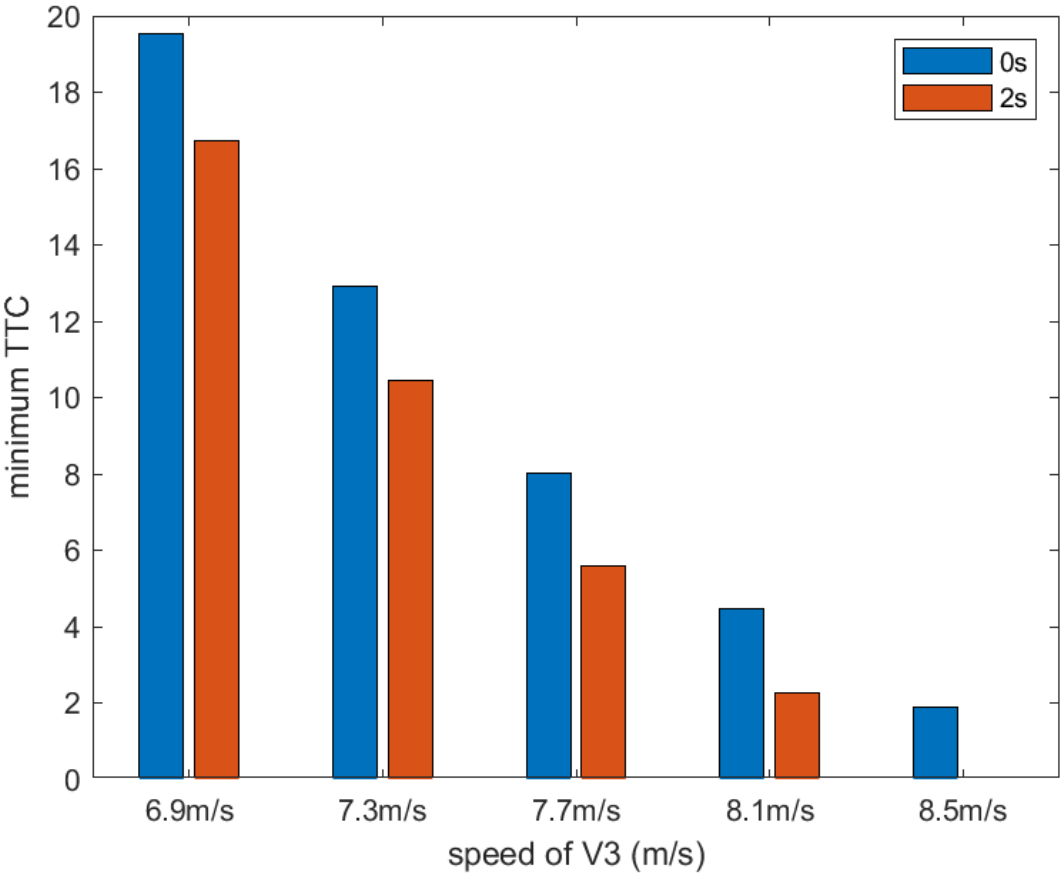

Figure 4.8. The minimum TTC under sensor limitation-time delay of 2s.

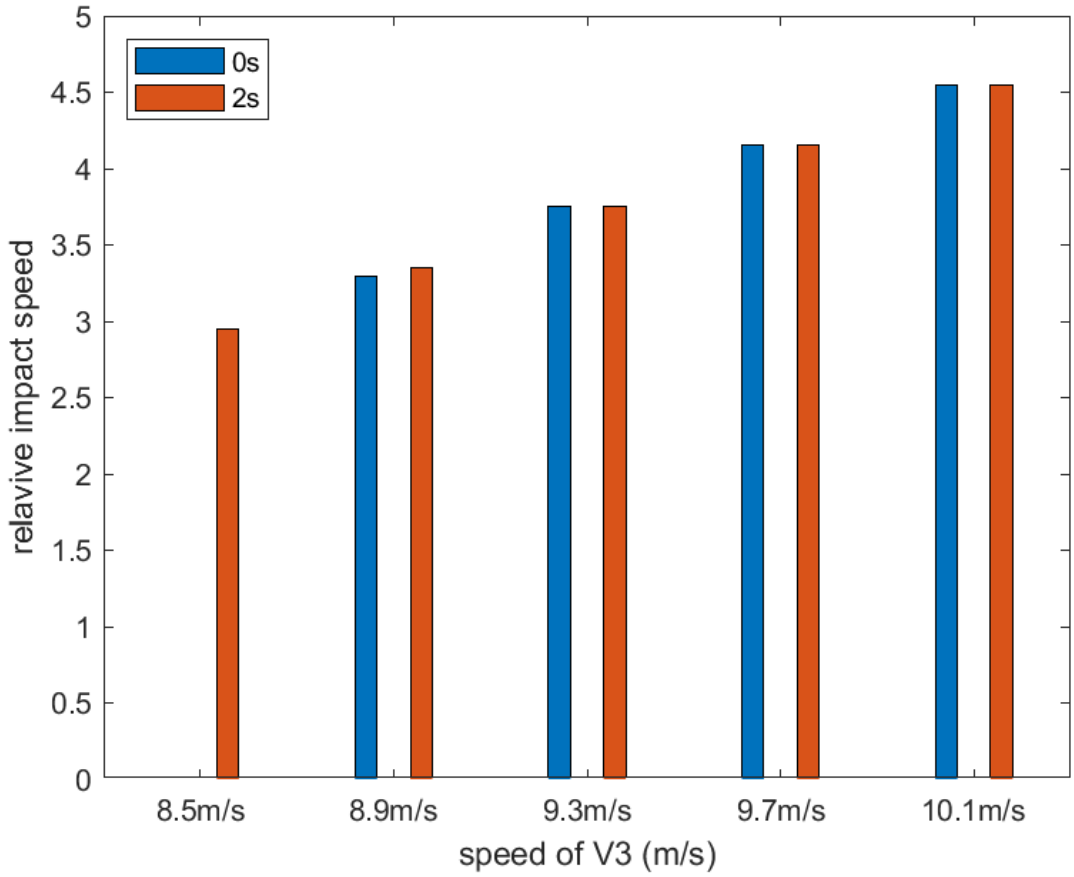

Figure 4.9. The relative impact speed between two vehicles under different time delay of vehicle 3.

Chapter 5. Chapter 5: Summary