Summary of Warnings using BSMs in USDOT CV Pilots

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Overview

In the USDOT's Connected Vehicle Pilot, vehicles and roadside infrastructure were configured to broadcast messages to relay safety-related information. The messages generated by vehicles were SAE J2735 BSM messages which include information regarding speed, heading and more.

In order to for BSM messages to warn drivers of potential safety hazards, various applications were defined in the USDOT pilots. These warnings are signaled by processing incoming BSM messages and performing the appropriate calculations on the data to determine if a warning should be signaled. By using these warnings, the BSM data is abstracted and is easier to use.

Warnings used in USDOT CV pilots

The warnings implemented in the USDOT CV Pilots had some variance between individual pilots [1] [2] [3].

In total, the NYCDOT, THEA and WYDOT pilots implemented 14, 11 and 5 CV applications, respectively. Table-1 provides the applications that are the most applicable for simulating in our research.

Criteria for Simulating CV applications

When determining which CV applications to simulate the decision is influenced by the how popularity of a particular application amongst the pilots, and the feasibility of implementing warning in the simulator itself.

Warning Name	NYCDOT	THEA	WYDOT
Forward Collision Warning	x	x	x
Emergency Electronic Brake Light	x	x	
Lane Change Warning/Assist	x		
Blind Spot Warning	x		
Intersection Movement Assist	x	x	
Vehicle Turning Right in Front of Bus Warning	x	x	
Work Zone Warning	x		x
Curve Speed Warning	x	x	
Red Light Violation Warning	x	x	
Oversize Vehicle Compliance	x		
Emergency Communications and Evacuation Information	x		
Pedestrian in Signalized Crosswalk	x	x	
Pedestrian Mobility		x	
Mobile Accessible Pedestrian Signal	x		

Table 1: USDOT CV Applications

Additionally, the CV applications that will be the easiest to implement in the simulated environment would be the warnings that rely only on V2V communication. Applications that utilize V2I communication may require information not contained within a BSM.

Best Candidates for Simulation

A Forward Collision Warning (FCW) is raised if a the vehicle is projected to collide with the vehicle directly ahead. It is a good candidate to simulate as it was used across every CV pilot. This warning should be able to be signaled using only BSM data.

An Emergency Electronic Brake Light (EEBL) is raised when a nearby vehicle applies their brakes above a specified threshold. The warning was used in both urban-based pilots, which matches the simulated environment. This warning should be able to be signaled using only BSM data.

Additionally, the Blind Spot/Lane Change Warning (BSW/LCW) is raised when a driver attempts to change lanes while a vehicle is located in a blind spot zone. The warning is listed as being entirely V2V by the USDOT [4]. While these warnings were only implemented in the NYCDOT pilot, they could be worth implementing.

A Curve Speed Warning (CSW) is raised when a vehicle is approaching a curve above a pre-defined speed. It was implemented in both urban-based pilots, which matches the simulated environment. The warning would require a minimal amount of V2I communication, so it could be feasible to implement.

The Pedestrian in Signalized Crosswalk (PED-X) is raised when a vehicle is approaching a crosswalk with the presence of a pedestrian. It was used in both urban-based pilots, which matches the simulated environment. This would require communication between vehicles and the simulated infrastructure. It would be advantageous to incorporate pedestrian warnings into the simulation, but the difficulty with implementing the warning in LGSVL is to be determined.

References

[1] USDOT, "Connected Vehicle Pilot Deployment Program phase I : comprehensive Pilot Deployment Plan : Tampa Hillsborough Expressway Authority (THEA) : final report.," 01 July 2016. [Online]. Available: https://rosap.ntl.bts.gov/view/dot/31720. [Accessed 30 November 2020].

[2] USDOT, "Connected Vehicle Pilot Deployment Program phase 1 : comprehensive deployment plan : New York City : volume 1 : technical application : part I : technical and management approach.," 1 August 2016. [Online]. Available: https://rosap.ntl.bts.gov/view/dot/31730. [Accessed 30 November 2020].

[3] USDOT, "Connected Vehicle Pilot Deployment Concept Phase 1, Comprehensive Deployment Plan, ICF Wyoming," 11 May 2018. [Online]. Available: https://rosap.ntl.bts.gov/view/dot/31723. [Accessed 30 November 2020].

[4] USDOT, "Connected Vehicle Applications and Supporting Documentation," [Online]. Available: https://www.its.dot.gov/pilots/pilots_v2v.htm. [Accessed 1 December 2020].