DRISI
Caltrans Division of Research,
Innovation and System Information

Research Results

Evaluation of Autonomous TMA Trucks for Use in Caltrans' Operations

This task purchased an Autonomous Truck Mounted Attenuator (ATMA) and tested its ability to provide the same protection as a conventional Truck Mounted Attenuator (TMA) truck.

Maintenance

DECEMBER 2021

Project Title:
Autonomous Maintenance Technologies in Work Zones

Task Number: 3265

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WHAT WAS THE NEED?

Caltrans highway maintenance and repair activities often require a shadow (trailing) truck equipped with a Truck Mounted Attenuator (TMA) to provide impact protection for workers from errant vehicles. The nature of shadow trucks, or TMA trucks, dictates that they will be hit by errant vehicles, so while the TMA truck increases safety for the workers, each collision still compromises the safety and well-being of the shadow truck driver.

There was a need to completely remove Caltrans' shadow truck drivers from the risks associated with errant vehicle impacts. With the advent of autonomous vehicles, it may be possible to eliminate driver exposure by utilizing autonomous TMA (ATMA) trucks. Research was needed to determine if existing ATMA technology can fill this need, and if not, document what is needed to reach that goal.

WHAT WAS OUR GOAL?

The goal of this study was to evaluate an ATMA truck's ability to provide the same protection to Caltrans workers as that of a standard TMA truck, and to document what steps needed to be taken in order to use the ATMA in Caltrans operations.

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WHAT DID WE DO?

Caltrans worked with the Advanced Highway Maintenance Construction Technology (AHMCT) Research Center at the University of California-Davis (UCD) to conduct this research. This project identified and procured an operational ATMA truck that was deemed to be appropriate for Caltrans use from Royal, an accomplished equipment manufacturer. AHMCT created an ATMA test plan designed to evaluate the ability of the system to provide the same level of protection and functionality as a standard Caltrans TMA truck. To provide an additional level of safety, AHMCT operated the ATMA while executing the test plan on closed test tracks with a safety rider stationed in the autonomous vehicle.

The ATMA system that was purchased, consists of two trucks, the leader vehicle (LV) and the follower vehicle (FV), which contains the TMA. The ATMA, has independent global positioning tracking systems for each vehicle, and an inertial navigation system for the FV. It also has an Operator Control Unit (OCU) module for each vehicle, a Graphical User Interface in the LV, and several sets of radio transmitters/receivers which form a line-of-sight communication bridge between the separate vehicles at up to a 1,500-ft gap. The FV includes forward-looking obstacle detection based on a LiDAR sensor. The FV is also ringed with close-range sonar detectors that function solely as a close object detection warning system. A separate wireless Emergency Stop system provides a segregated link that enables the LV operator to shut down the FV independent of OCU control. The FV contains the guidance system, and the LV acts like a command/control platform remotely connected to the guidance system by radio signals. The LV sends a GPS trail of position data points (E-crumbs) via radio signal back to the FV. The guidance controller in the FV compares the current GPS position of the FV to the LV E-crumb path to autonomously drive the FV along the path of the LV.

AHMCT evaluated the ATMA by performing fifteen performance test scenarios and eleven safety test scenarios. The system passed all test scenarios. The results of ATMA system testing indicated that the leader/follower guidance system performance is well within the test measurement resolution, which should satisfy Caltrans highway operational accuracy requirements. The ATMA system operation proved to be simple to operate with a user interface that takes the operator through the necessary steps to engage the automated vehicle guidance system, which also simplifies operator training. During the research, the autonomous technology vendor added the ability of the FV to track the LV with a designated offset, in support of increased safety while taking the lane from a shoulder or median.

Because of the California vehicle code that regulates autonomous vehicles, Caltrans is in discussions with California Department of Motor Vehicles and California Highway Patrol to determine how best to operate the ATMA on a public roadway consistent with the regulations.

WHAT IS THE BENEFIT?

The ATMA removes the driver of the TMA truck, thereby eliminating the injuries associated with TMA trucks being hit by errant drivers. Safety is a priority for Caltrans and the ATMA has the potential to provide a significant safety benefit for TMA truck drivers. There is also the benefit of showing that Caltrans is a leader in its efforts to use autonomous vehicle operations to provide a safer environment for Caltrans workers.

LEARN MORE

Final Report is available at:

http://ahmct.ucdavis.edu/pdf/UCD-ARR-21-03-31-01.pdf

IMAGES

Image 1: Caltrans TMA highway impact

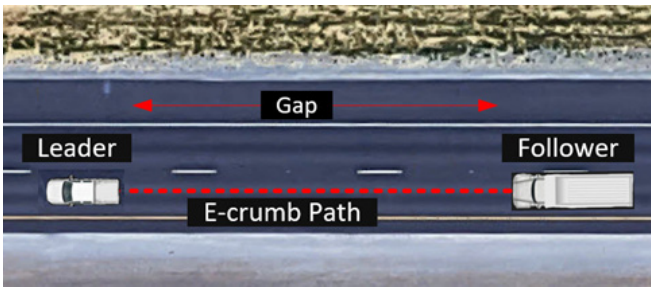

Image 2: Autonomous E-crumb path guidance

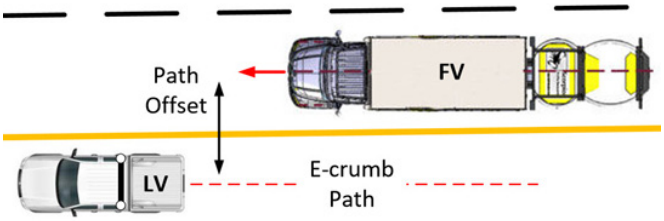

Image 3: E-crumb offset functionality

Image 4: The Caltrans ATMA performance testing system

Image 5: Caltrans Otay Mesa SR 905 overcrossing test site