

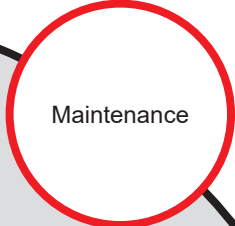


Caltrans Division of Research,
Innovation and System Information

Research



Results



Maintenance

MAY 2019

Project Title:
Field Testing of the Snowplow Driver Assistance System

Task Number: 2990

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Task Manager:
Larry Baumeister
Transportation Engineer (Electrical)
Larry.baumeister@dot.ca.gov

Field Testing of the Snowplow Driver Assistance System

Install a Global Positioning System (GPS)-based Driver Assistance System (DAS) on two snowplows and one snow blower, to help with snow removal operations on the Donner Pass corridor of Interstate 80 (I-80). The system provides a high-accuracy GPS map of the roadway that is displayed on a head-up display (HUD) inside the cab of the vehicle.

WHAT IS THE NEED?

Snow clearing during whiteout storms along I-80 at Donner Pass can be a difficult operation for snowplow operators and directly affects the traveling public. During these conditions, snowplow operators have to navigate slowly and with extreme caution because of low visibility. If snow clearing operations have to be halted during these storms, it can cause major traffic delays for both the travelling public and the commercial traffic that use I-80. To remedy this problem, the DAS was installed on two snowplows and one snow blower under a previous research task. The purpose of this follow-up task was to complete the field testing of the DAS that was not finished under original task (Task 2167).

WHAT WAS OUR GOAL?

The main goal of this research was to evaluate the GPS-based DAS on its ability to increase safety and efficiency during snow removal operations on the Donner Pass section of I-80. Three DASs were installed on two snowplows and one snow blower under a previous research task. During that research task, the DAS encountered radar icing during heavy snowstorms, causing the radar to malfunction. Significant effort and time was spent in the continued development and testing of radar enclosure icing mitigation solutions. A feasible solution was developed and tested towards the end of the task, but additional development and testing was required to confirm suitability. The primary goal of the current research task was to spend one additional winter evaluating the readiness and fitness of the DAS for use in Caltrans winter maintenance operations.



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WHAT DID WE DO?

Caltrans Division of Research, Innovation and Systems Information in partnership with the Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center at UC Davis installed three DAS systems on Caltrans snow removal equipment under a previous task (Task 2167): two on snowplows, and one on a snow blower.

This research task provided support for extended Caltrans district field testing of the DAS. The proposed tasks included:

- Support DAS field testing in District 3, Kingvale maintenance yard. This included operator training for the snowplow DAS and the snow blower DAS.
- Repair DAS hardware as needed based on issues identified in field testing.
- Document DAS changes implemented during the research.

Under the previous task, the DAS encountered radar enclosure icing during heavy snowstorms, causing the radar to malfunction. A feasible solution was developed and tested towards the end of the previous task, but it still needed additional development and testing to confirm suitability. This research task completed the field testing of the DAS that was not finished under the previous task.

During the first field testing of the DAS in December 2015, the heated radar enclosure on one of the snowplows failed due to epoxy adhesive delamination from the aluminum housing and the plastic front cover. This failure, which did not occur under the previous task, hindered the operation of the radar that is used to detect oncoming vehicles. In January 2016, the heated radar enclosure on the second snowplow failed due to the same delamination issue. The research then evolved towards investigating methods to mitigate the

radar icing issue as well as the delamination issue in order to make the system viable for field testing.

A stopgap solution for the delamination issue was to build new enclosures using spare parts that were provided by the manufacturer of the heated enclosure units. The rebuilt radar enclosures were then tested on the Kingvale section of I-80 in April of 2016. The DAS performed the same as in previous testing, which was marginal. It failed to keep the ice off the radar unit during the heaviest snowfall whiteout conditions, when it is needed most.

WHAT WAS THE OUTCOME?

The system which was purchased under Task 2167 and field tested under Task 2990 did not meet Caltrans' needs for a snowplow DAS. The radar is rendered unreliable by the snow and ice buildup. The radar enclosure delamination problem introduced additional system reliability concerns. Without a reliable radar to provide collision warning, no component of the DAS can be used in whiteout conditions. Use of the DAS lane-keeping component without collision warning is not a suitable use of the system and is not recommended.

While the issues noted above make it infeasible to use the DAS in winter storm whiteout conditions, the system is fully capable of supporting driver assistance in other above-freezing, low-visibility environments that are not subject to these same problems. One such application is for tow truck operators working in dense fog—e.g., in the San Francisco Bay Area on the San Francisco–Oakland Bay Bridge. The Bay Area Emergency Response manager has expressed interest in evaluating this technology to assist in clearing accidents on Bay Area bridges. The DAS may reduce the response time to accident sites in dense fog.

WHAT IS THE BENEFIT?

Caltrans is researching new technologies to help provide safer and more efficient snow clearing operations. Even though this research task did not produce an implementable product for use in snow clearing operations, the DAS may have value in above-freezing environments. Caltrans remains committed to investigating these types of new technologies. It is also possible with technological advancements in the next few years that a commercial product similar to the DAS might be available for use.

LEARN MORE

Review the complete report.
<http://ahmct.ucdavis.edu/pdf/UCD-ARR-16-11-23-01.pdf>

IMAGES



FIGURE 1: DAS HUD combiner



FIGURE 2: DAS HUD LCD imager



FIGURE 3: Radar, modem, and GNSS antenna installed on top of a snowplow cab protector



FIGURE 4: DAS computer installed underneath passenger seat

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