

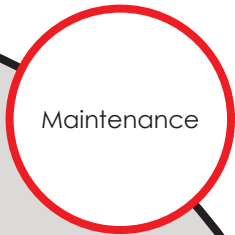


Caltrans Division of Research,
Innovation and System Information

Research



Results



Maintenance

OCTOBER 2015

Project Title:

Driver Assistance for Winter
Maintenance Using GPS

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Task Manager:

Larry Baumeister
Transportation Engineer (Electrical)
Larry.Baumeister@dot.ca.gov

Evaluation of GPS-based Mountain Pass Opening for Tioga Pass

Develop a Global Positioning System (GPS) based system that will provide a highly accurate GPS display map that will help operators clear the mountain pass at State Route (SR) 120 Tioga at the end of the winter snow season.

WHAT WAS THE NEED?

The California Department of Transportation (Caltrans) has eight mountain passes that are closed at the beginning of the snow season and open at the end of the snow season. Opening these passes is a difficult and dangerous job as the road can be buried at times under 25-30 feet of snow, with few visual indicators or landmarks to guide equipment operators. Existing techniques for finding the road include probing the snow pack with poles, path staking, and active embedded cable systems, which all have associated drawbacks. This system will help to provide a safe and efficient operation for equipment operators during the mountain pass opening at Tioga Pass.

WHAT WAS OUR GOAL?

The main goal of this research was to develop one Mountain Pass Road Opening (MPRO) system for use on Tioga Pass for the purposes of evaluation.

WHAT DID WE DO?

Caltrans Division of Research, Innovation and Systems Information (DRISI) in partnership with the Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center at UC Davis developed one MPRO system for use on Tioga Pass. AHMCT under a previous research project with DRISI, developed an MPRO system for use on SR 108 at Sonora Pass. This research task developed the MPRO so that it could also be used on the Tioga Pass on SR 120.



DRISI provides solutions and
knowledge that improves
California's transportation system

One of the first things that was done in this research task was to develop a high-accuracy Geographic Information System (GIS) map of the Tioga Pass. A Caltrans survey group used a mobile terrestrial laser scanner, while driving the Tioga Pass, to provide the information necessary to develop the highly accurate GIS map. This map includes buildings, road signs, and guardrail. After this was done AHMCT incorporated this map with the software that was developed for the previous MPRO that was used for Sonora Pass.

The MPRO system allows the equipment operator to safely and efficiently find the road that is sometimes buried under the snow. The MPRO works by providing an accurate mapping of the roadway that is displayed on a computer screen. The display includes a detailed map of the roadway, heading of the vehicle, mile post information, and vehicle height above the roadway. The display is shown on Image 1 on page 3. The system includes the following:

- A GPS receiver (Image 2) along with a satellite subscription that provides digital corrections for the GPS signal that is essential for highly accurate positioning.
- A dual-antenna vector GPS unit (Image 2) that directly provides accurate heading data.
- A high-accuracy GIS database representation of the roadway.
- An in-vehicle display (Image 1) to provide the bird's-eye view of the vehicle location and heading vs. the roadway, along with landmark information to provide a sense of overall position along the route.
- The required embedded computing, real-time software, and power systems to support this mountain pass road opening driver assistance system (Image 3).
- Watchdog feature that provides status indicators for all sensing systems.

WHAT WAS THE OUTCOME?

The MPRO system was tested on SR 120 at Tioga Pass in both April 2014 and April 2015. The system overall provided accurate mapping for the majority of the Tioga Pass section of SR 120. There were two small areas where the GPS signal was not accurate enough to provide valid data, it would be during this type of situation where the watchdog feature of the MPRO would notify the operator that the MPRO cannot be relied upon.

Even though snow levels during the field-testing period were very low due to the drought that California has been experiencing in recent years, Caltrans maintenance staff saw the benefit that the MPRO would provide during heavy snow seasons.

WHAT IS THE BENEFIT?

The MPRO system is a benefit to mountain pass opening operations when there is significant snow on top of the roadway, which can sometimes be 25-30 feet deep. The system will keep the operator in the cab of the snow removal vehicle and provide the operator with accurate location information for a safe and effective pass opening.

LEARN MORE

The final report documenting this research is available through the AHMCT Research Center website:

<http://ahmct.ucdavis.edu/pdf/UCD-ARR-15-07-31-01.pdf>

IMAGES

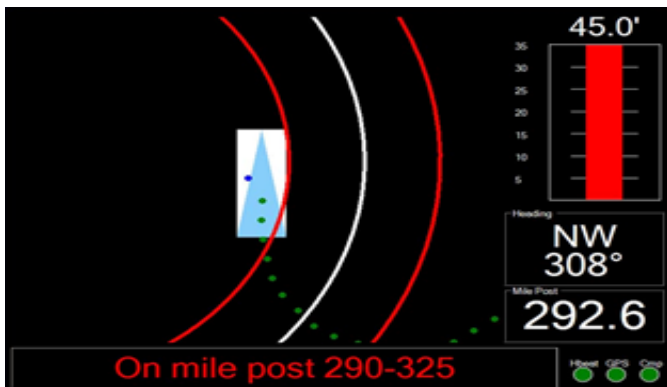


Image 1: Computer display of MPRO

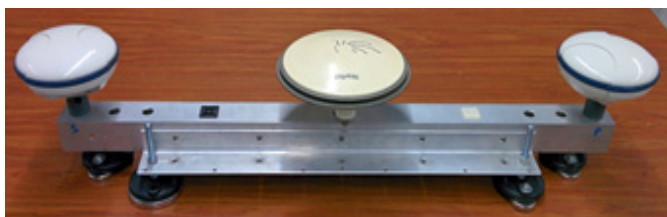


Image 2: GPS receiver and dual GPS Vector unit



Image 3: MPRO computer and display

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