Advanced Highway Maintenance and Construction Technology Research Center

Fiscal Year 2021-22
Annual Research Program Highlights
For more information:
AHMCT Research Center
www.ahmct.ucdavis.edu

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Directors’ Message

We are pleased to present the Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center’s Annual Report for the period from July 1, 2021 to June 30, 2022. In this period, the AHMCT Research Center continued its deployment-focused research, while continuing to address the operational challenges of COVID-19. AHMCT diversified its Principal Investigator pool, yielding project area diversification, as illustrated in on-going research below.

The AHMCT Research Center, established in 1991, investigates scientific methods and technologies to improve safety and efficiency of highway construction, maintenance, and operation while addressing infrastructure reliability and environmental impact. Emphasis is on development of innovative human centric technologies and scientific methods using sensors, robotic and automation systems, driver and operator assistance, navigation systems, and pushing such technologies and methods towards deployment in real operations. Center work is leading to digital transformation of operations in project delivery and asset management together with workflows resulting in improved safety of operations.

The AHMCT Research Center deploys prototype machines, devices, systems, software applications, workflows, or methods that can lead to new policies in Caltrans operations. The AHMCT Research Center has developed extensive experience aligning its research and development work towards achieving Caltrans’ mission. Work completed this year addressed improving work zone safety, operational efficiency in pavement management and structures maintenance, new technologies to improve lane closure operations, better understanding of impact of work zone collisions on safety and worker injuries, and decision support for roadside features maintenance. Work also included new technology integration for work zone management in low traffic volume situations, and work on Global Positioning System/Inertial Navigation System integration and other sensing, including full deployment of a driver assistance system for mountain pass road opening. Research included on-site evaluations with successful projects providing significant cost/benefit in areas including Mobile Terrestrial Laser Scanning. Some work used advanced data science and databases to understand work zone collision and injury trends and classification of roadside maintenance activities to yield data-driven decision making in maintenance and construction operations.

On-going research involved application of data science and databases for maintenance task prioritization. AHMCT is collaborating closely with DRISI on a research implementation accelerator project, enabling full implementation of several existing research efforts. On-going research is addressing temporary pavement marking performance, heavy equipment simulators and operator training, guard rail cost-benefit analysis, closed-circuit TV evaluation, sonar scanning, maintenance of bridge structures, and use of hydrogen fuel cell generators for public safety power shutdown mitigation.

Bahram Ravani and Ty Lasky, Co-Directors, AHMCT Research Center
Spotlight on Maintenance Research

Task 3255: Mountain Pass Road Opening Implementation and Training (MPRO)

**Customer:** Division of Maintenance

**Problem:** Due to limited usage and difficulties maintaining mountain passes heavily affected in the snow seasons, Caltrans closes eight such passes over each winter season. In the spring or early summer, Caltrans Maintenance must re-open these passes for the traveling public. In heavy snowfall winters, closed mountain pass highways can build up 30 to 40 feet of snow over a season, making it extremely difficult and hazardous to locate and clear the road.

AHMCT previously developed, tested, and successfully demonstrated a field-ready and deployable Global Navigation Satellite System-based Mountain Pass Road Opening (MPRO) Driver Assistance System (DAS). This system, tested over several seasons on both State Route (SR) 108 (Sonora Pass), and SR 120 (Tioga Pass), is a field-ready and deployable GNSS-based mountain pass road-opening system. The DAS developed is used to guide rotary plow operators to drive and stay over the roadway during road opening operations. Primary system objectives were increased safety and snow-removal efficiency with minimal capital investment and decreased environmental impact and costs associated with infrastructure repair. The system developed is portable and easily installed. In recent testing following a higher than normal snow season, operator feedback was extremely positive.

**Goal:** The primary goal of the current research project was to address implementation of the MPRO design and its utilization in three new areas namely SR 108, SR 4, and SR 120. The secondary goal was to evaluate the system’s performance in these new locations. The key tasks in porting the system to these new locations were physical installation of the hardware and development of a base map to support the GNSS-based location mapping of the vehicle. In the current project, a new approach was developed for location mapping based on the use of Mobile Terrestrial Laser Scanning (MTLS).

**Methodology:** At the request of Caltrans Maintenance and the Division of Research, Innovation and System Information, AHMCT revised the MPRO system for full Caltrans deployment. This included system redesign to current commercial off-the-shelf (COTS) technology, modifications to enhance system portability, and software revisions for compatibility with an up-to-date operating system.
AHMCT produced two of the updated systems for each of the four sites identified by Caltrans. These sites were District 9, SR 108, Sonora Pass eastern slope; District 9, SR 120, Tioga Pass; and District 10, SR 4, Alpine (two sites, each with its own crew). The effort produced eight systems in total. Additionally, AHMCT provided training to selected Caltrans staff for ongoing usage, support, and maintenance of the systems.

The high-level research tasks were:
1. System redesign, build, and validation
2. Porting existing Windows code to the Android platform
3. Operator training
4. Site testing and evaluation

Conclusions: The research results included:
- Development of base maps for three additional Caltrans road opening sites
- Complete redesign of the MPRO system for increased portability, functionality, and ease of installation
- Complete update of the MPRO hardware to current state-of-the-art off-the-shelf components
- Full redesign and reimplementation of the MPRO software to support the modified hardware, including implementation on the Android operating system

AHMCT recommends on-going use of the eight MPRO systems at the four Caltrans road opening sites. In addition, AHMCT recommends Caltrans evaluate whether the MPRO system would be useful for its remaining winter closure sites. Finally, the general MPRO concept should be assessed for application in other highway maintenance and construction operations.

Benefit: By providing drive assistance for experienced and inexperienced operators, the MPRO system allows operators to know they are over the roadway, even when operating over very deep snow (up to 50 feet). The system also provides indication for roadside objects such as small buildings and signs, so the operators can avoid impact and resulting damage to the objects and the snow blower. With this information, the road opening operation is expected to be safer, as well as more efficient, so that the mountain pass roadways are opened to the public sooner.
Task 3685: Review of Equipment and Accessories for Truck-Mounted Attenuator Trucks

**Customer:** Division of Maintenance

**Problem:** Caltrans highway maintenance operations are often conducted in work zones that consist of temporary lane closures that are adjacent to high-speed vehicular traffic. To shield these work zones from errant vehicle impacts, Caltrans routinely deploys shadow trucks especially designed to absorb small- to medium-size vehicle impacts and protect both maintenance workers and the motorist from serious injuries. These shadow trucks are much less effective when impacted by large trucks traveling at highway speeds. In either case, reducing the frequency of impact is the key to increasing highway maintenance operational safety. The research component of this project involved developing updated design concepts to improve operations of such systems.

**Goal:** The objective of this research was to procure and test several commercially available TMA truck accessories to increase the shadow truck operator’s safety. This research conducted a thorough evaluation of the accessories’ performance and developed or updated design concepts that would improve their operations. The systems evaluated included a mobile radar speed signboard, a video monitoring system, an automated work zone reporting system, and a panic button and display. By identifying and evaluating equipment and accessories that can improve the safety of Caltrans workers and the traveling public, Caltrans can procure these technologies based on tangible, demonstrated benefits, leading to a safer highway environment for all and likely reduced overall costs.

**Methodology:** AHMCT procured the four systems to be evaluated in one Level 4 Technology Package. Each system was tested and evaluated individually to determine if it provided the functionality and the level of performance needed by Caltrans. AHMCT worked with the manufacturers of each of the systems when performance or repair issues were identified. The manufacturers provided excellent customer service, and updated the systems to achieve the needed functionality. Two of the systems needing future integration (panic display and video monitoring) were identified and the manufacturers have initiated discussions to address this integration.
Conclusions: This research succeeded in identifying, procuring, testing, customizing, and demonstrating key shadow truck safety equipment technologies that increase highway safety by enhancing motorist responsiveness when encountering temporary highway work zones. The specific technologies included an innovative radar speed feedback display sign capable of displaying the absolute speed of approaching vehicles while the truck and signboard are moving, a video camera system able to continuously record multiple views around the shadow truck, an automated highway work zone reporting system, and a shadow truck driver-activated panic/warning system. These innovative vehicle equipment accessories were combined into a safety Technology Package that can now be commercially purchased for installation on Caltrans TMA shadow trucks to improve safety in highway maintenance work zones.

Benefit: The technologies evaluated are expected to reduce both the frequency and severity of impacts with shadow vehicles used to protect temporary lane closures adjacent to high-speed vehicular traffic. This will improve the safety of the shadow truck operators as well as the traveling public.
Task 3980: Infrared Camera-Based Obstacle Detection for Snowplows and Tow Trucks in Low Visibility Conditions

**Customer:** Division of Maintenance

**Problem:** The Caltrans Division of Maintenance needs to operate tow trucks and snowplows in extreme weather conditions and low visibility to ensure that bridges and roads remain open. As an example, emergency tow trucks are operated in case of collisions e.g., on Bay Area bridges where dense fog is very common. The sensitive nature of such operations necessitates Caltrans’ timely response. However, under low visibility, timely response can be very challenging and even dangerous to both the traveling public and the Caltrans’ crew. This is especially true in the case of collisions under low visibility when pedestrians are more likely to be present on highways. For example, vehicle occupants may exit their vehicle after a collision while waiting for the emergency tow truck. They are often unaware of traffic hazard exposure and may wear low-visibility clothing. Driver assistance and obstacle avoidance technologies have advanced during the past decade. These driver assistance technologies may help improve safety of such maintenance operations.

**Goal:** The goal of this research task was to evaluate the effectiveness of commercially available thermal infrared camera-based obstacle detection in improving safety and efficiency in snowplow operations and Bay Area emergency tow trucks operations. The main objective was to review existing applications of IR cameras for advanced driver assistance and their pros and cons under low visibility conditions, such as dense fog, for potential incorporation into Caltrans operations.

**Methodology:** This project was a Preliminary Investigation (PI) and as such involved reviewing the leading Infrared camera-based obstacle avoidance and driver assistance technologies. The assessment included:

- Conducting a survey of other state DOTs, other knowledgeable individuals, or organizations to determine challenges to support maintenance activities on roads under low visibility conditions and the measures currently adopted to tackle these challenges.
- Identifying and summarizing published literature and performing a review of existing research on the application of infrared cameras for advanced driver assistance and its pros and cons under low visibility conditions, e.g., dense fog.

**Conclusions:** This research PI developed a list of commercially available IR camera-based obstacle detection hardware for driver assistance. Literature review included...
assessment of IR camera technologies (hardware) as well as the software that use such images to automatically detect obstacles and inform the driver of their existence. This PI summarizes the state of suitable technologies and the commercially available hardware/software solutions for obstacle detection in low visibility conditions with emphasis on IR imaging technologies.

**Benefit:** Infrared thermal camera-based obstacle detection has been implemented in modern vehicles to improve drivers’ safety in poor visibility conditions. With the inclusion of Machine Learning technology into the obstacle detection, the system can identify and alert the driver to the presence of pedestrians, animals, bicyclists, and vehicles in poor visibility conditions such as dark rural highways, fog, and snowfall. Using state-of-the-art commercial thermal IR camera-based obstacle detection would enable tow truck drivers to reach a collision site quickly and safely, enhance snowplow operators’ effectiveness, and improve the safety of the traveling public.
Spotlight on Equipment Research

Task 3265: Evaluation of Autonomous TMA Trucks for Use in Caltrans’ Operations

**Customer:** Division of Equipment

**Problem:** Caltrans has begun a research effort seeking to deploy autonomously-driven truck-mounted attenuator (TMA) trucks primarily for moving closure highway maintenance tasks on mainline highways across the state. Reducing the risk of injury to TMA drivers is the main justification of autonomous TMA (ATMA) technology. California regulations currently do not authorize autonomous operation of heavy trucks on highways. Therefore, it was also a goal of this research effort to demonstrate that safe autonomous TMA truck operation is attainable to potentially gain the approvals to begin deploying autonomous TMA trucks on the highway in Caltrans highway maintenance operations.

Caltrans regularly conducts highway maintenance and repair activities in or adjacent to live traffic lanes. To reduce the hazard of direct traffic exposure to maintenance workers in vehicles or on foot, a shadow (trailing) truck equipped with a TMA is deployed as a shield to block errant vehicle impacts to the work zone. The TMA truck driver is subject to much higher likelihood of errant vehicle impact than other maintenance vehicles. TMAs are designed to absorb a collision with cars and small trucks, but large truck collisions exceed design capacity and place TMA drivers in great danger of injury. Autonomous leader/follower driving technology provides a solution to mitigate TMA truck driver safety risk by removing the driver from the TMA truck during live traffic highway maintenance tasks.

**Goal:** The objective of this research project was to identify a commercially available autonomous TMA (ATMA) system suitable for Caltrans use, procure a system, and develop a workflow for the system’s specific safety and performance characteristics relative to Caltrans’ needs. The research sought to determine if the procured ATMA technology fulfills the Caltrans need, and if not, document what is needed to reach that goal. If the research identified a suitable autonomous TMA system that satisfies all the essential Caltrans safety and performance requirements, Caltrans could endeavor to deploy the system for Division of Maintenance use.
Methodology: This research project identified and procured an operational autonomous shadow truck system deemed appropriate for Caltrans use from 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 shadow vehicle. 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 full test results and recommendations of the ATMA evaluation were provided to Caltrans.

Conclusions: The ATMA, after several Kratos upgrades and enhancements, successfully completed all of the safety and performance test scenarios AHMCT could envision while limited to closed test track evaluation. The next logical phase in ATMA evaluation is Caltrans deployment trials to determine how well the ATMA fits into a Caltrans maintenance operations from the perspectives of both functionality and operator training. Such trials are expected to start in Fiscal Year 2023.

Benefit: The ATMA will enable Caltrans to operate the TMA from the relative safety of the protected work truck. The ATMA leader/follower autonomous driving scheme was determined to be the simplest scheme by which to operate a shadow truck autonomously in a lane closure operation. Other popular competing autonomous driving schemes, such as remote control and self-driving autonomous schemes, are complicated, expensive, and less practical. The key opportunity for Caltrans is with field operations during live high-speed traffic on mainline highway moving road closure maintenance operations. These operations expose TMA drivers to the greatest risk of high-energy impacts.
Task 3300: Comparison of New and Existing Caltrans Hopper Body and Tailgate Sanders Phase 1

**Customer:** Division of Equipment

**Problem:** Caltrans has several different types of sand/salt spreaders. Caltrans is motivated to reduce salt and sand usage, and needed quantifiable material distribution results via testing. Caltrans requested testing of the following spreader types:

1. One Henderson V-body FSH14 spreader with Direct Cast (2019 model)
2. One Epoke S4900 with directional casting
3. Two Henderson FRS with Direct Cast (2018 model and 2020 model)

Caltrans continuously seeks new methods and equipment for its winter maintenance operations in order to meet its mission and goals. Winter maintenance operations represent a significant challenge to Caltrans, and by implementing improved methods and equipment, Caltrans can realize operational and safety improvements, cost savings, and reduced environmental impacts. Increasing the efficiency of the sand/salt spreader fleet will reduce the amount of excess sand/salt applied, addressing both environmental and cost concerns; and increase the efficiency of the operation, which will allow the operators to apply sand/salt longer between refills and increase road safety for the motoring public.

**Goal:** The goal of this research was to provide a scientific basis by testing and using a data driven approach for Caltrans’ decision-making process regarding which spreaders to buy in the future in order to achieve its goals. The research also provided test data which may allow Caltrans to revise spreader operations following procurement.

**Methodology:** The research included adapting existing standards and methods for testing and characterizing spreader systems, as well as development of novel methodologies and aggregate measures to analyze the test results. The effort also included developing an engineering understanding of the mechanisms of operation of the spreaders and evaluation of operational efficiency.

Four spreaders tested.
The research methodology used controlled field testing to assess the sand spreading properties of the Henderson and Epoke spreader types. The key deliverables of this project include:

- Updated test procedure: The testing procedure was modified to collect a majority of samples in 2x1-meter increments.
- Sand collection system design: A redesigned vacuum system that supported more rapid collection of samples.
- Sand spreader testing raw data and testing video.

Conclusions: This research project completed the goal of testing spreaders using Ice Slicer and dry sand at application rates ranging from 100 to 1200 lb/Inmi for four lane configurations. The test methodology was based on EU standard CEN/TS 15597-2:2012.1 A detailed display of material spread patterns was achieved by sampling at 1x2-m sections in much of the grid for 2021 testing. The testing provided a detailed understanding of the capabilities and limitations of the modern spreader technology as demonstrated by the Henderson FSH, Henderson FRS and the Epoke designs.

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Summary of Activities in Addition to the Completed Projects

- Delivered a new Decision Support Tool (DST) for snowplow efficiency to the Clear Roads national research consortium. Presented final research webinar featuring overview of the developed DST and the corresponding user's guide to approximately twenty state DOTs.
- Initiated collaborative research to evaluate the Bosch Wrong-Way Driving infrastructure-free alert system.
- Published the results of the research on Wrong Way Driving in a technical paper entitled: “Evaluating Wrong-Way Driving Incidents at Highway Exit Ramps and the Effect of Mitigation” which appeared as a highlighted paper in ASCE Journal of Transportation Engineering, Part A: Systems.
- Performed testing to assess a new method for bridge drain debris cleaning using the Ditch Witch system in District 11 San Diego.
- Deployed eight Mountain Pass Road Opening (MPRO) driver assistance systems developed previously in early April 2022 and provided the needed training for proper operation of the system.
- Added the capability to handle research projects involving applications of Unmanned Aerial Vehicles in highway infrastructure by initiating pilot training for technical staff.
- Demonstrated the newly developed lane-taking maneuver of the Autonomous Truck Mounted Attenuator system at the No Boundaries Transportation Maintenance Innovations Technical Advisory Committee Meeting May 5, 2022.
- Co-Director Ty Lasky presented “Mountain Pass Road Opening (MPRO) Implementation and Training” at the DRISI Research Connection series on May 11, 2022.
- Co-Director Bahram Ravani presented “Research to Develop Performance Measures for Maintenance of Roadside Features” at the DRISI Research Connection series on Mitigating Safety Risks and Environmental Impacts on March 2nd, 2022.
- Co-Director Bahram Ravani presented “Development of a Maintenance Prioritization Assessment and Safety Tool” at the Design Management Board meeting.
- Two workshops were held addressing Implementation of Already Completed Research sponsored by DRISI. In these workshops, 25 completed projects were evaluated and 4 were selected for funding for implementation support.
- The second version of the Responder System was demonstrated to Caltrans by staff engineers Kin Yen and Stephen Donecker. The focus was on illustrating use for Caltrans Structures Maintenance and Investigations (SM&I), with SM&I attendees Patrick Piacentini and Gerald Kracher. Other attendees included Melissa Clark (DRISI Project Manager), Ferdinand Milanes (Chief, Office of Radio Communications Engineering), Prakash Sah (acting Deputy Division Chief, Emergency Operations & Vegetation Management), Lisa Worthington (acting Supervising Landscape Architect, Office of Vegetation & Wildlife Management), and Larry Wooster (Executive Fellow in the Director's Office).
# Active Research Task Summary

For more information on all active projects, see the Research Notes posted at [https://dot.ca.gov/programs/research-innovation-system-information/research-notes](https://dot.ca.gov/programs/research-innovation-system-information/research-notes)

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| 3280    | Development and Testing of an Unmanned Aerial System (UAS) Cellular & Wi-Fi Repeater: Phase 1  
- AHMCT is investigating the possibilities for use of unmanned systems to provide an aerial cellular and Wi-Fi communications repeater to expand Caltrans communications coverage in rural areas. AHMCT is developing and testing unmanned aerial system (UAS) cellular and Wi-Fi repeater concepts. The goal is to evaluate the potential of extending the range of existing wireless communications infrastructure for a variety of remote communications use cases in existing rural maintenance and projects. The system may also act as a general-purpose Wi-Fi hotspot. | 11/30/2022 |
| 3704    | Improved Maintenance Methods for Bridge Drains and Expansion Joints  
- This research is evaluating commercially available systems, including vacuum sweepers and other technologies, for the applicability for bridge drain and deck cleaning and removal of incompressibles located on the bridge deck. The goal is to identify a commercial system or systems that can remove debris from the bridge deck and reduce or ideally eliminate intrusion of incompressibles into bridge drains and joints. AHMCT has been working with District 11 to test effectiveness and deployability of various systems. | 3/31/2023 |
| 3833    | Evaluation of Heavy Equipment Simulator Systems  
- AHMCT has procured two heavy equipment simulators and is evaluating the applicability and benefits for Caltrans' training use. AHMCT has developed training plans (e.g. how much training is needed over what time period for initial training) to evaluate simulators for Caltrans staff. AHMCT is analyzing the mobility of simulators for possible transport to other districts. Finally, traveling training scenarios are being developed and analyzed with regard to feasibility and cost-benefits. | 12/31/2022 |
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| 3836    | Orange Contrasted Temporary Pavement Delineation in Construction Zones  
• This research is assessing the influence of orange pavement delineation in a work zone in Caltrans District 11 in the Interstate 5 (I-5) North Coast Corridor (NCC) Construction Project in San Diego County (about 14 miles one-way).  
Construction Units 1, 2, and 3 of the I-5 NCC Projects are using standard temporary white striping, while Unit 4 is using striping with orange contrast from Palomar Airport Road to State Route 78 (about 4.1 miles in each direction). There are two alternative orange striping patterns for lane lines, right edge line, lane drop, and gores in the southbound and northbound directions. The different units allow the researchers to compare driver behavior and evaluate the effectiveness of the orange temporary delineation compared to standard temporary white striping. | 2/28/2023 |
| 3847    | Development of a Maintenance Prioritization Assessment and Safety Tool  
• AHMCT is developing a tool that will help Caltrans achieve its Priorities and Department Goals by improving the safety and efficiency of its highway maintenance activities via detailed data that can be used to plan lane closures, time duration of operation and consider other factors. The tool will allow planning that would improve the safety of highway workers and traveling public. This work is providing an implementation of the difficulty and collision risk index results of a previous AHCMTC research effort under Task 3289. | 12/31/2023 |
| 3848    | Cost-benefit Analysis for Concrete vs Metal Guardrails and Wood vs Metal Posts for Signs and Guardrails  
• AHMCT is performing research to help provide methods for life cycle cost estimation that can be used in decision-making process for choosing between concrete vs metal beam guardrails. This task is evaluating the use of metal vs wooden posts for signs (considering the lifespan, cost, disposal, and ease of maintenance etc.) and developing guidelines to support the decision for replacement of wooden guardrail posts with metal posts (considering maintenance costs, fire hazards, weed control, crash performance, and improvements to worker safety etc.). AHMCT is also performing research to help identify roadway areas where maintenance workers will have a high-risk in maintaining roadside features. | 11/30/2023 |
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<td>3870</td>
<td>Research and Development of the Caltrans’ Geospatial Technology Proving Ground</td>
<td>9/30/2023</td>
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<td>• Caltrans and AHMCT established a Geospatial Technology Proving Ground (GTPG) facility to support the integration of mobile mapping and Light Detecting and Ranging (LiDAR)-based data collection systems into Caltrans’ business practices. AHMCT is performing research to capitalize on the efficiencies gained through a “collect once, use it many times” best practice. This research is leveraging the existing GTPG facility and the new Caltrans-owned Trimble MX9 and MX50 Mobile Terrestrial Laser Scanning (MTLS) systems, and expanding upon them to provide Caltrans with the needed capabilities.</td>
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<td>3873</td>
<td>Evaluation of Next-Generation CCTV Encoder for ITS Field Elements</td>
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<td>• This task is determining how this equipment performs under real-world Caltrans rural operating conditions including extreme temperatures, low bandwidth, and very remote locations. AHMCT is determining and evaluating which next-generation video encoder equipment will be viable as rural ITS field equipment options as Caltrans adds to and refreshes its ITS assets. Districts will be continuing to evaluate and use the next-generation video encoder equipment during their normal day-to-day operations.</td>
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<td>3919</td>
<td>Targeted Warning Messages to Protect Moving and Stationary Maintenance Lane Closures</td>
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<td>• Caltrans provides static and speed-based warning messages on display signs mounted on the back of truck-mounted attenuator (TMA) vehicles. This research is investigating the effectiveness of targeted warning messages in more efficiently capturing errant motorists’ attention. The research will determine if it is more effective to display targeted warning messages such as “Blue Ford sedan, License xxx 123, Move Over.”</td>
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| 3924 | Integration of Thermal Infrared (IR) Imaging into the Caltrans Inspection Program for Pavements and Bridge Decks  
- The Strategic Highway Research Program recognized the utility of Thermal IR for early identification of shallow-seated deterioration in pavements and bridge decks. Early detection allows repair and rehabilitation ahead of significant degradation, saving time and money on maintenance. Caltrans has installed a thermal infrared (IR) system on its 3D Ground-Penetrating Radar (GPR) vehicle, allowing georeferenced visual and thermal IR imaging of pavement and deck surfaces concurrent with 3D GPR imaging of the subsurface. AHMCT is continuing integration of the technology within Caltrans inspection practices, through identification of commercial software solutions and development of processes and procedures for: acquisition of georeferenced thermal IR data; processing of data to enhance, isolate, and visualize thermal anomalies; and for interpretation and presentation of results. | 1/31/2023 |
| 3926 | Evaluation of Unmanned Surface Vessel-Based Topographic and Bathymetric Survey System in Flood Conditions  
- Caltrans needs a reliable teleoperated system benefitting from semi-automation or automation technologies for topographical and bathymetric surveys that removes the safety concerns and makes scheduling and undertaking of such operations easier. AHMCT is developing a teleoperated unmanned surface vehicle (USV) with semi-automated or automated functionalities and onboard bathymetry capability. The main objective is to make it easier and safer for Caltrans to undertake survey operations on deep as well as shallow waters. | 3/31/2024 |
| 3948 | Mobile Device App for Wrong Way Driver Detection  
- AHMCT is evaluating the commercial Bosch wrong-way driving (WWD) detection system, which uses either an in-vehicle system or a smartphone app. The system uses a roadway map network, mobile position tracking using Global Navigation Satellite Systems (GNSS) such as GPS, and an intelligent algorithm to detect WWD behavior and issue warnings or alerts as appropriate. AHMCT is working with Bosch to evaluate the performance of the system. | 6/30/2023 |
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<td>4008</td>
<td>Responder Study - Interim Phase II - Continued Support for Responder Transition</td>
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<td>- With successful completion of pilot field testing of the Responder System during a previous task (2927), Caltrans needs the prototype to be transitioned to a third-party vendor to reproduce 12+ units and deploy them into the Caltrans Districts. AHMCT is providing on-going technical support for Caltrans’ use of the Responder system until a vendor is contracted. The task will also allow AHMCT to provide in-person training to the selected vendor, and support for the vendor while they establish or modify their software development tool chain, install the Responder code base, and confirm that they are able to build the Responder software system.</td>
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<td>4010</td>
<td>Research Implementation Accelerator: Workshops and Seed Funding Program</td>
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<td>- This research is identifying underutilized research projects and using seed funding to accelerate implementation of such projects by Caltrans. The aim is to work with Caltrans stakeholders to determine the needs and then use the seed funding to work out the workflows necessary for proper integration and adaptation of the research results of such underutilized research projects.</td>
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<td>4025</td>
<td>Public Safety Power Shutdown (PSPS) Hydrogen Fuel Mitigation Pilot</td>
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<td>- AHMCT is procuring, installing, operating, and evaluating new hydrogen fuel cell (HFC) power backup systems in Districts 2 and 3, which have been impacted significantly by Public Safety Power Shutoff (PSPS) events. AHMCT is also evaluating two existing HFC power backup systems in Districts 3 and 11. The goal is to find an alternate source of power that is both reliable and cost effective to solve the PSPS outage issues.</td>
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| 4049    | **TMS Innovative Product Proof of Concept (POC) Support**  
  - AHMCT is performing research for the identification, analysis, and documentation of implementation considerations for the use of new ITS equipment. As new products are sought out by, or brought to the attention of, district staff, AHMCT is generating a specific research and evaluation plan. This includes purchasing or borrowing ITS equipment for installation in a state highway facility or laboratory test environment. The equipment will be evaluated to ensure that it meets current business needs. AHMCT is performing the first specific evaluation is for three specific detectors for pedestrian walk time extension: the AGD326 from AGD Systems Limited, the SmartWalk XM system from MS Sedco, and the TMA-011 from Icoms. | 8/31/2023  |