

Maintenance

November 2025

Project Title:

Unmanned Topographic and Bathymetric Survey Systems

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Task Manager:

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

LiDAR and Bathymetric Survey Uncrewed Surface Vehicle Integration and Evaluation

This project will provide an evaluation of a bathymetric survey system utilizing an Uncrewed Surface Vehicle (USV) equipped with a Multibeam Echo Sounder (MBES) and a Simultaneous Localization and Mapping (SLAM)-based Light Detection and Ranging (LiDAR) system.

WHAT IS THE NEED?

California Department of Transportation (Caltrans) faces challenges in obtaining high-resolution and accurate bathymetric data for design and construction projects, particularly for bridge and erosion control efforts. Traditional survey methods, which involve surveyors physically entering hazardous environments, are not only time-consuming and inefficient but also expose personnel to considerable safety risks, including slippery slopes, fast currents, and environmental dangers like wildlife. These manual methods are limited in their ability to capture detailed underwater terrain, often leading to incomplete or less accurate data.

As the demand for precise, data-driven decision-making increases, there is an urgent need for advanced technologies that can safely, efficiently, and accurately gather the necessary survey data without compromising the safety of Caltrans workers.

WHAT ARE WE DOING?

The overall strategy of this project is to develop, integrate, and validate a comprehensive survey system that combines MBES technology with SLAM-based LiDAR on a USV platform. The project will begin with a thorough literature review to identify the most suitable technologies, followed by the procurement of the necessary equipment. Initial pilot projects will be conducted to test and evaluate the bathymetry system in real-world conditions. The integration of SLAM-based LiDAR will then enhance the system's capability to capture both underwater and above-water data and

improve positioning performance. Rigorous testing and validation will ensure the system meets Caltrans' operational requirements. The project will culminate in the development of standardized guidelines and workflows, enabling consistent and efficient data collection across various environments. This strategic approach ensures that the final system will provide accurate, reliable, and safe survey capabilities for Caltrans.

WHAT IS OUR GOAL?

The goal of this project is to develop and validate an integrated survey system that combines MBES and SLAM-based LiDAR technologies on a USV platform, capable of delivering high-resolution bathymetric and topographic data with enhanced accuracy and safety.

WHAT IS THE BENEFIT?

The expected benefits include more efficient and accurate data collection, reduced operational costs, and improved decision-making in design and construction projects. Additionally, the standardized guidelines and workflows developed through this project will ensure consistent application of the technology across various Caltrans projects, paving the way for statewide deployment and long-term adoption. By automating and streamlining the data collection process, this system will significantly reduce the need for surveyors to enter hazardous environments, thereby minimizing the risk of injuries.

WHAT IS THE PROGRESS TO DATE?

The contract for this research Task was executed in November 2025 and the kickoff meeting will be held in December 2025. For more information contact the task manager.