

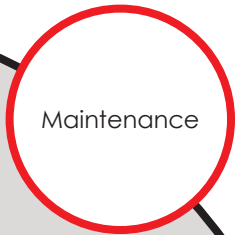


Caltrans Division of Research,  
Innovation and System Information

# Research



# Results



Maintenance

DECEMBER 2021

**Project Title:**

Development of Data Collection Systems for Large Scale Particle Image Velocimetry (LSPIV)

**Task Number:** 3183

**Start Date:**

**Completion Date:** June 30, 2021

**Task Manager:**

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## Development of Data Collection Systems for Large Scale Particle Image Velocimetry (LSPIV)

A new method to measure the discharge, collect flow velocity (magnitude and direction) information, and estimate channel profiles.

### WHAT WAS THE NEED?

Currently, California Department of Transportation (Caltrans) measures river surface flow using an acoustic Doppler sensor mounted on a manned boat. Launching a manned boat in flood conditions is time consuming and often unfeasible due to considerable risk to workers. Caltrans needs a new method to measure the discharge, collect flow velocity (magnitude and direction) information, and estimate channel profiles. The new method needs to provide valid information over a large spatial extent (300 – 500 feet) and be quick to use, safe for Caltrans personnel, and easily deployable.

### WHAT WAS OUR GOAL?

To review Commercial-off-the-shelf (COTS) hardware related to LSPIV, investigate the best practices for Unmanned Aerial Vehicle (UAV)-based LSPIV, and evaluate LSPIV post-processing software of the field testing data.

### WHAT DID WE DO?

The AHMCT researchers have successfully developed the COTS, UAV, and related components of the LSPIV with the thermal imaging camera and the Seafloor Systems PicoMBES (Multibeam Echo Sounder) portable sonar. Sample data have been collected by certified Caltrans personnel who have operated the UAV to collect sample data for aerial image evaluation. The LSPIV software was used to analyze the sampled data of measured surface velocity in streams and rivers.



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The Caltrans customers have also performed evaluations and field testing of the sonar sensing platform using the Seafloor multibeam echo sensor. They have conducted surveys of Napa River Bridge pier data overlaid on a Computer-Aided Design (CAD) model. Based on the inputs from these field tests, improvements have been made by the researchers on the image processing software, which are critical to the successful evaluation of the LSPIV System.

## WHAT WAS THE OUTCOME?

Caltrans utilized the newly integrated bathymetric survey system in several pilot projects to monitor scour, Rock Slop Protection (RSP), and underwater riprap installations. Furthermore, Caltrans divers have used 3D images of piers and surrounding bathymetry to plan their dives. Caltrans has also inspected underwater excavations before RSP installation for Construction.

## WHAT IS THE BENEFIT?

Development of an LSPIV system will allow Caltrans personnel to collect important flow information rapidly and safely during high flow events which can be used to assist hydraulic engineers provide a more accurate evaluation of the existing and new bridges.

With improved evaluations, the design of new construction could be more cost effective and safe for the motoring public. Additionally, eliminating staff from operating a boat in high flows improves worker safety and increases the number of sites that can be monitored in a day during flood conditions.

## LEARN MORE

To view the evaluations:

<https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/ca21-3183-v2-finalreport-all.pdf>

## IMAGES

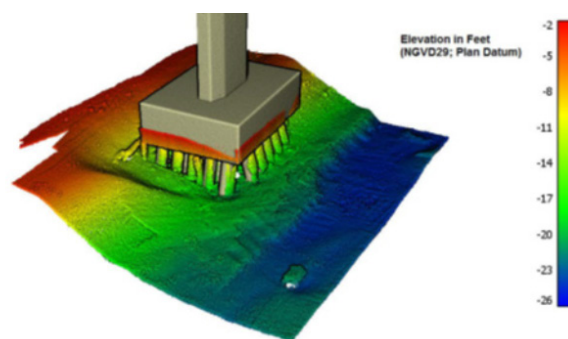


Image 1: PicoMBES 120 survey of Napa River Bridge pier data overlaid on CAD model



Image 2: Point cloud data generated using Phantom 4 Pro UAS images and WebODM software