

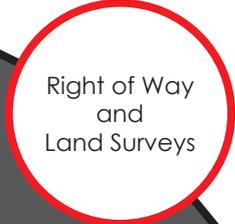


Caltrans Division of Research,
Innovation and System Information

Research



Notes



Right of Way
and
Land Surveys

MARCH 2021

Project Title:
Small Unmanned Aerial Systems for
Right of Way and Land Surveys

Task Number: 3039

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Specifications for Using Small Unmanned Aerial Systems to Generate High Accuracy Mapping

The research delivers a proven set of specifications for using Small Unmanned Aerial Systems (sUAS) to generate high accuracy mapping.

WHAT IS THE NEED?

The California Department of Transportation's (Caltrans) Office of Photogrammetry and Preliminary Investigations is responsible for large-scale photogrammetric mapping along highway corridors in support of the transportation engineering planning and design. Like other state Departments of Transportation (DOTs), Caltrans faces a continuing challenge to maintain current and accurate map data of thousands of miles of transportation corridors spanning the State of California.

Quickly emerging as a safe and cost-effective alternative for mapping, particularly for small-sized mapping projects, small Unmanned Aerial Systems (sUAS) can fulfill some of these needs. Many commercially available sUAS units exist for high accuracy mapping. However, the accuracy of photogrammetry and Light Detection and Ranging (LiDAR) derived digital terrain models and ortho-photos obtained from sUAS flights lack extensive testing.

The problem is specifications developed for different configurations of sUAS vary such as camera quality. Camera quality highly correlates to the resultant accuracy of the mapping products from the sUAS, and this remains one of many variables in need of specifications.



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WHAT ARE WE DOING?

This research project investigates the status of sUAS photogrammetric mapping technology using digital cameras and LiDAR. It provides operational specifications for utilizing sUAS through a comparative analysis of data obtained with a sUAS to data obtained from traditional ground surveying methods. Such a systematic comparative analysis identifies the relative strengths and drawbacks of this technology and where it can be effectively used for Caltrans mapping projects.

Furthermore, the research provides specifications for sUAS hardware and ground control requirements for high accuracy mapping. It involves evaluating LiDAR system parameters such as scan frequency, repetition frequency, the number of returns, image intensity return, Global Positioning System, inertial measurement unit accuracy requirements, and other important parameters. The validation of the standards derived from theoretical analysis is equally important before Caltrans and other industries adopt these standards.

WHAT IS OUR GOAL?

The goal includes delivering to Caltrans a proven set of specifications for sUAS hardware, camera calibration, and ground control requirements. In addition, these new specifications will provide a basis for establishing a new chapter in the Caltrans Surveys Manual on the use of sUAS in the surveying workflow.

WHAT IS THE BENEFIT?

Although Caltrans is the immediate beneficiary, any organization engaged in producing large scale photogrammetric maps and LiDAR derived geospatial products can adopt the resulting standards from the research.

The specifications will represent the basis for a new chapter in the Caltrans Surveys Manual on sUAS use in the surveying workflow.

WHAT IS THE PROGRESS TO DATE?

Unforeseen impacts from the COVID-19 pandemic caused postponements of scheduled test flights and data analysis. With the customers' support, the research team requested a No-Cost Time Extension amendment to the research contract.

The amendment was approved, and research continued, albeit at a slower pace due to continued COVID-19 restrictions. Final test flights have been completed, and data analysis and the final report are done. The research has ended and contract closing efforts are all that remain. No further updates to these research notes are planned.