DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

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

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

Right of Way and Land Surveys

JUNE 2021

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

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WHAT WAS THE NEED?

Like other state Departments of Transportation (DOTs), Caltrans faced 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, small Unmanned Aerial Systems (sUAS) were identified as a technology to assist in the effort. Many commercially available sUAS units existed, but the accuracy of digital terrain models and ortho-photos obtained from sUAS flights lacked extensive testing. The problem was specifications developed for different configurations of sUAS vary, such as camera quality, and this strongly correlated to the resultant accuracy of the mapping outputs. Camera quality was one of the many variables in need of specifications before the new technology could be reliably adopted by Caltrans.

WHAT WAS OUR GOAL?

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

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WHAT DID WE DO?

This research project investigated the status of sUAS photogrammetric mapping technology using digital cameras and Light Detection And Ranging (LiDAR), and provided 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 identified the relative strengths and drawbacks of this technology and where it could be effectively used for Caltrans mapping projects.

Furthermore, the research provided specifications for sUAS hardware and ground control requirements for high accuracy mapping. It involved evaluating LiDAR system parameters such as scan frequency, repletion frequency, the number of returns, image intensity return, Global Positioning System, inertial measurement unit accuracy requirements, and other important parameters.

WHAT WAS THE OUTCOME?

The research ended successfully with identified goals being reached. Caltrans intends to incorporate the research conclusions and outputs to improve Caltrans' operations.

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 are the basis for a new chapter in the Caltrans Surveys Manual on the use of sUAS in the surveying workflow and significantly advance Caltrans' ability to create high quality mapping using less resources and in a safer manner.

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https://dot.ca.gov/programs/research-innovation-system-information/research-final-reports

IMAGE

Image 1: DJI Matrice 600 Pro Hexacopter