Specifications for Using Small Unmanned Aerial Systems

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 (Caltrans) Office of Photogrammetry and Preliminary Investigations (OOP/PI) 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 safe and cost-effective alternatives for mapping, particularly for small-sized mapping projects, small Unmanned Aerial Systems (sUAS) can fulfill some of these needs. However, the accuracy of photogrammetry and Light Detection and Ranging (LiDAR) derived digital terrain models and ortho-photos from sUAS flights lack extensive testing.

Many commercially available sUAS units exist for high accuracy mapping. The problem is specifications developed for different configurations of sUAS varies, 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 for specifications.

WHAT ARE WE DOING?

This research project investigates the status of sUAS photogrammetric mapping technology using digital cameras and LiDAR; and provides operational specifications, including minimums, 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 will provide 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 (GPS) and 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 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?

Following the November 16, 2017 project panel meeting and the initiation of processing sUAS flight data, California State University, Fresno (CSUF) researchers started processing data received from Caltrans District 9 Unmanned Aerial Vehicle (UAV) flights. CSUF initiated static and kinematic GPS surveys of control points and conducted digital leveling for them.

Moreover, the research team processed the data collected from the first sUAV test flight on June 25, 2018 and a series of test flights from July 2018 to August 2018 at the San Joaquin Experimental Range (SJER) control field.

Next, the researchers and the OOP/PI representative made a preliminary visit on September 13, 2018 with the California Fire Department to establish a new test site for UAV flights, and are planning to fly UAVs equipped with LiDAR sensors over the SJER site.

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.

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