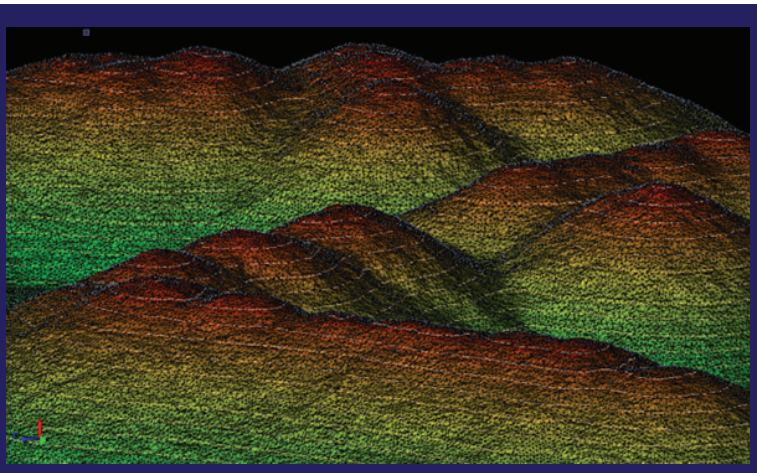
Collecting Data with UAS —Not as Simple as it Seems

Unmanned Aerial Systems (UAS) are a rapidly growing technology. They are appealing and exciting because they can easily capture aerial imagery and can be more affordable than manned aircraft with image or LiDAR sensors. UAS imagery can be used to generate Digital Surface Models (DSM), topographic mapping, planimetric mapping and orthoimagery. Although UAS can be a great tool for some mapping applications, it has its limitations. You must collect and process the data properly; otherwise, you may end up with severely flawed data.

Necessary Tools for UAS Collection

Collection of accurate geospatial data with a UAS requires specific tools and software to refine the data. First, you will need a license to fly UAS for commercial purposes. The following are a few additional key items that you need to make accurate data:

- Good-quality sensor with a global shutter
- Adequate flight planning and acquisition software
- Quality post-processing software
- Data cleaning software
- Data validation measures



Digital Surface Model and 1-foot contours created with a UAS over a material yard.

Sensors Make a Difference

UAS sensors vary in many ways; one important factor is the shutter. A rolling shutter can create image smear and make accurate mapping difficult, whereas a global shutter has a significantly sharper image and is therefore the preferred option for mapping. Planning and acquisition software are necessary to ensure your collection is of the proper accuracy and adequately covers your project area. Post-processing and cleaning software prepare your data for its intended uses, and data validation measures confirm that the data meets accuracy specifications.

UAS Project Design

Proper UAS data collection also requires knowledge of surveying, datums, geodesy, photogrammetry and other geospatial processes, which will enable you to design your project properly. Your project design should include the following:

- Suitable flight plan
- Proper camera calibration
- Connection to a known datum/coordinate system

UAS flight plans need to include accurate and consistent overlap and sidelap. Structure From Motion (SFM) software, which is used in most UAS post-processing software to generate Digital Surface Models (DSMs) will not work properly unless you collect data with a minimum of 75% forward overlap and 60% sidelap. All SFM software performs self-calibration during post-processing, but data processed in this manner can have significant errors that may go undetected. Point-matching errors can be absorbed into these calibration parameters. Understanding of self-calibration and its effect on the final product accuracy is fundamental to making accurate mapping products with a UAS. It is also critical that your data is georeferenced to a known datum or coordinate system. Understanding units, datums and projections is fundamental to a successful UAS mapping project.

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Example UAS Project

In 2018, Surdex conducted flights over a stockpile inventory site using both manned and unmanned flights for comparison. For the manned flight, we acquired imagery using a Leica DMC-1 image sensor mounted in one of our aircraft, and for the unmanned flight we used a DJI Phantom 4 Pro UAS. Using both sets of imagery we performed volumetric calculations and found that the volume calculation derived from the UAS DSM data was within 1% of the calculation generated using the DMC imagery (see table).

1- foot contours and color digital orthophotography of a waste landfill from UAS.

This project offered us the opportunity to assess the quality of the self-calibration of the UAS camera. We found that in this case the self-calibration coefficients solved for in the post-processing resulted in a volume estimate that was 23% below the actual volume of material. The refined camera calibration, constrained to the office calibration, produced the volume figure that was within 1% of the true volume. This field test demonstrates that the understanding of sensor calibration is very important to accurate mapping with a UAS and highlights the extreme importance of proper planning and execution of a UAS project.

Volume Comparisons (DMC imagery versus UAS data)

Sensor	Volume (cubic yards)	Volume Calculation Compared to DMC-Derived Value (cubic yards)	Percent Variance
DMC-1	46,501.8		
UAS - Self-calibration	35,764.0	-10,737.8	-23.0%
UAS - Office calibration	46,830.7	+328.9	+0.6%

Potential UAS Candidates

UAS can offer an economical mapping solution for projects covering areas up to 640 acres. Ideal candidates are inventory sites like quarries, powerplants and material plants. Limitations on flights today are guided by FAA regulations which require line-of-site flights and prohibit flights over people and transportation features.

If you would like to find out if you might be a good candidate for a UAS project or would like to know more about aerial acquisition, please contact us.

Contact Us so We Can Help

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