PRESERVATION MATTERS: REMOTE SENSING

Small Unmanned Aerial Systems (sUAS)

Topics covered in this brief:

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VISUALIZING DATA

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Since 2015, the use of small unmanned aerial systems (sUAS) has rapidly become one of the primary tools for archeological research, monitoring, and cultural resource management. sUAS, also known as small unmanned aerial vehicles (sUAV), represent an easy and cost-efficient method for acquiring high-resolution imagery.

Different instruments (referred to as payloads) can be mounted to various sUAS. Common payloads are multispectral cameras or LiDAR instruments. They provide enhanced visualizations of archeological features that would otherwise be obscured from the visible light spectrum alone. These high resolution images offer a means for qualitative observations and direct measurement of three-dimensional geometry through photogrammetric techniques, such as structure-from-motion.

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COMPONENTS

There are two main categories of sUAS.

Rotary wing aircraft are commonly designed as quad-, hexa-, or octa-propeller systems, offering the ability to hover above a specific location and maneuver through airspace with obstacles. Fixed wing aircraft are typically able to carry heavier payloads and have longer flight times. Advances in technology now offer vertical take-off and landing (VTOL) for fixed wing systems. Both categories of sUAS are relatively easy to operate. They can be piloted manually or automatically along pre-configured flight plans via an on-board GPS system.

Caution must be taken to ensure operation of an sUAS is within non-restricted airspace (or that proper permissions have been obtained prior to flight). Additionally, ensure that a line of sight from the operator to the sUAS can be maintained throughout the mission, which can be difficult in certain landscapes with dense vegetation or steep topography.

Preparing an sUAS for survey. Note the aircraft in top left corner, and GPS antenna in the right frame. *Credit: Kory Konsoer, Louisiana State University.*

SAFETY

Make sure the flight is authorized, ensure there are adequate crew members to assist with the flight, verify the weather is conducive for sUAS operation, plan the flight mission, and conduct a thorough inspection of all sUAS components.

The U.S. Federal Aviation Administration (FAA) requires one crew member of an sUAS mission to possess a Remote Pilot Certification (Part 107) for all commercial or government operations. This individual must be aware of regulations, airspace classifications, and restrictions above the area of interest. These factors can be determined using aeronautical sectional charts available online (e.g., skyvector.com). As part of the FAA restrictions, operation of an sUAS is not permitted at altitudes higher than 400 ft above ground surface, or higher than 400 ft directly above any local structure.

PREPARATION

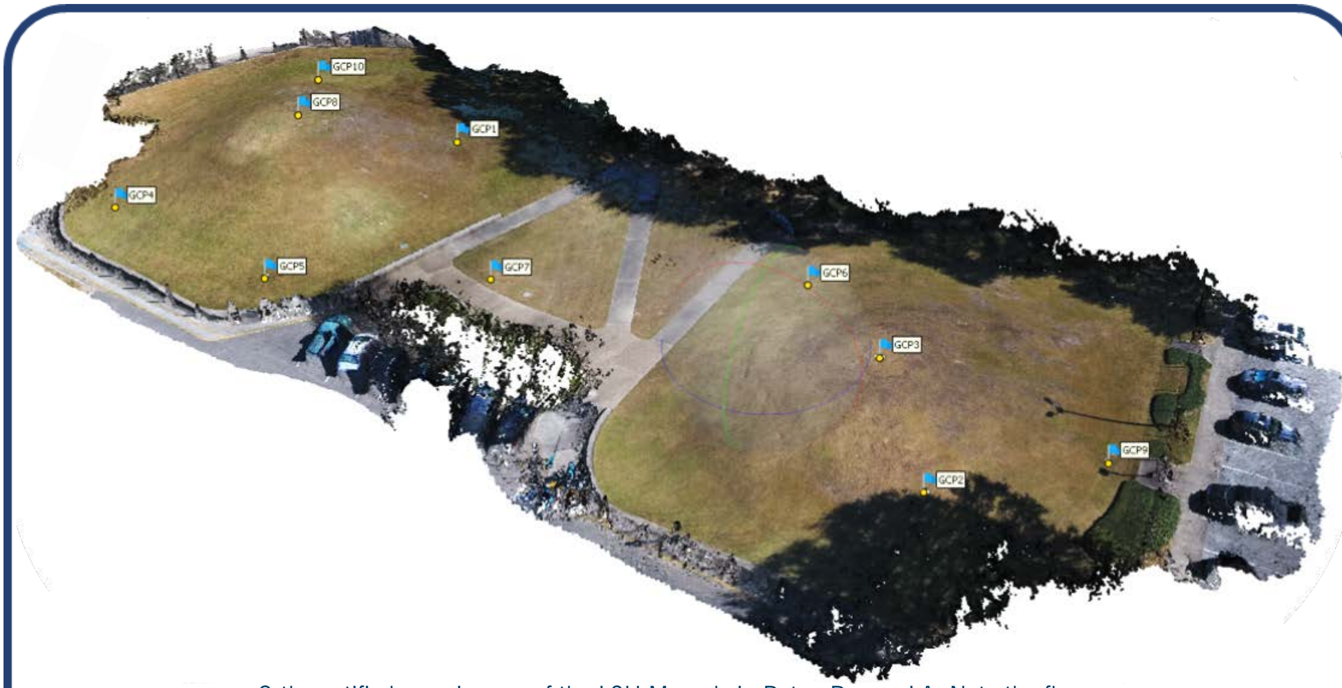
In preparation for an sUAS mission, first consider the flight design. If an automated flight path is preferred, utilize flight plan software. These allow you to select boundaries for your survey area, the altitude at which the sUAS will fly, the amount of overlap between paths, and if the payloads should collect data continuously with video or intermittently with still frames. It is important to make sure the survey area encompassed by the flight plan will not result in collision between the sUAS and tall obstacles, such as trees and buildings. Estimate the flight duration based on the flight plan. These flight times will vary depending on the model of sUAS and the weight of payload.

DATA COLLECTION

sUAS surveys are typically performed using fixed grid spacing, altitude, and instrument orientation, or a manual operation at different altitudes and various oblique camera orientations. Including surficial targets within your survey area that serve as ground control points (GCPs) is important. These GCPs geometrically scale your imagery and data, and tie into real-world coordinates (e.g., Lat/Long) or a local reference system. The coordinates for each target are determined using a highly accurate GPS or total station. To begin the survey, select a take-off and landing zone that is relatively flat, free of debris, and does not have overhead obstacles. If using an automated flight plan, the system will handle all operation from take-off to landing. However, there should still be a remote pilot with controls in-hand and a visual observer as part of the survey crew.

VISUALIZING DATA

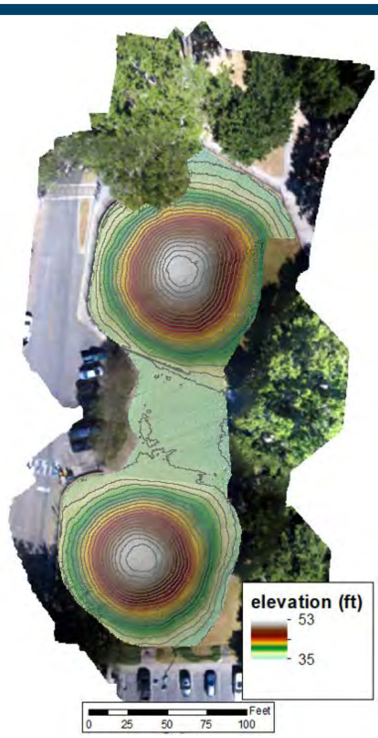
Processing of sUAS data varies from simple visual inspection of photographs and/or video to photogrammetric techniques. Within a photogrammetric software (e.g., Agisoft Metashape), the coordinates for GCPs can be added and manually assigned to corresponding photographs where the GCP is observed. The photogrammetric software then calculates three-dimensional geometry from the overlapping images, a technique called Structure-from-Motion (SfM). Orthorectified mosaicked photographs and digital elevation models (DEMs) can also be produced for use in a GIS for further geospatial analyses. These SfM-derived datasets are useful for measuring dimensions of archaeological sites, identifying relatively subtle morphological features, and monitoring and quantifying change through time from repeat surveys.



Orthorectified mosaic map of the LSU Mounds in Baton Rouge, LA. Note the flags that represent GCPs. *Credit: Kory Konsoer, Louisiana State University.*

CASE STUDY

Orthomosaic of the LSU Mounds in Baton Rouge, LA. *Credit: Kory Konsoer, Louisiana State University.*



DEM of the LSU Mounds produced by sUAS survey. *Credit: Kory Konsoer, Louisiana State University.*

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ABOUT NCPTT

The **National Center for Preservation Technology and Training (NCPTT)** is a research, technology and training center within the National Park Service. NCPTT publishes its Preservation Matters Series to provide easily accessible guidelines for preserving cultural materials.

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Cover Photo: Orthomosaic of the Brookhill Ferry Boat. *Credit: Kory Konsoer, Louisiana State University*