USC University of Southern California

Using UAS Orthomosaic Imagery in GIS Field-Study Applications

Measuring the accuracy of UAS-acquired imagery

M.S. in Spatial Informatics Program

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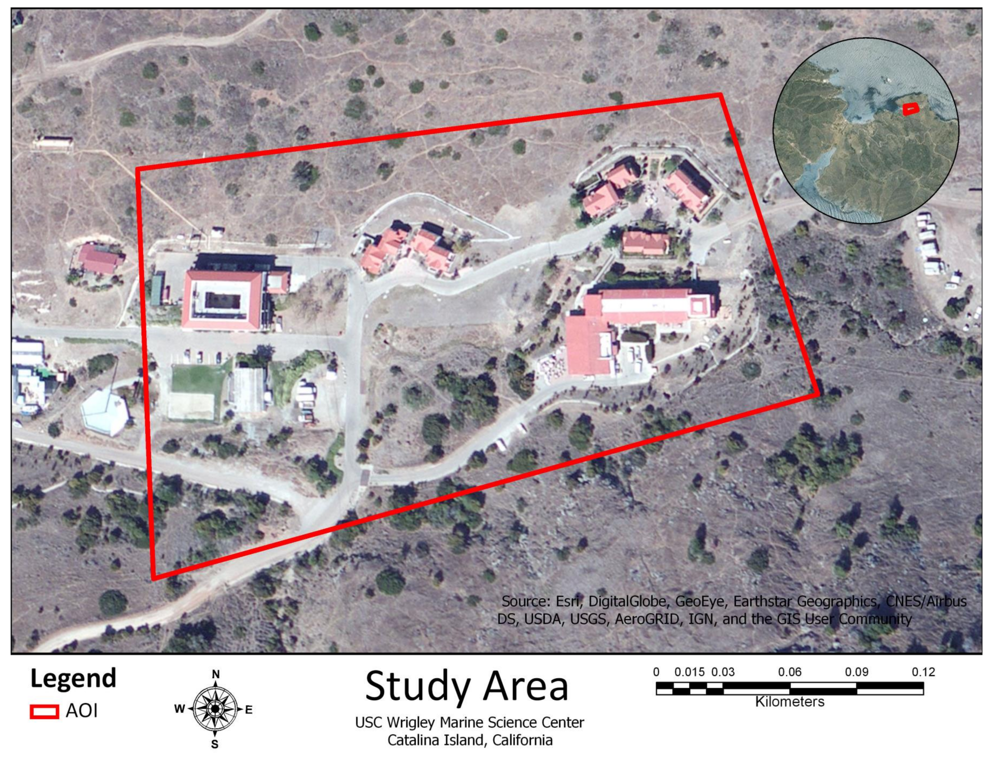
INTRODUCTION

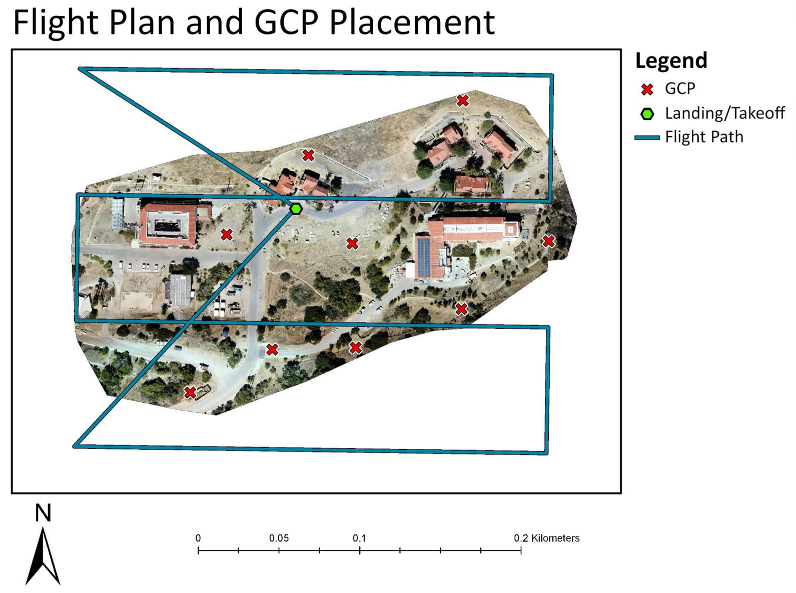
Traditional imagery basemaps are most often derived from satellite or aerial imagery from manned aircraft. While increasing in popularity and availability, Unmanned Aerial Systems (UASs) are still not widely used as a source of high-resolution imagery basemaps. This project aimed to measure the accuracy of orthomosaic imagery acquired from a UAS platform to aide in GIS field research applications. The orthomosaic imagery provides a significantly higher resolution than satellite and aerial imagery, allowing for most non-survey level projects.



METHODOLOGY

1. Created Ground Control Points (GCP) and mapped their location using the Trimble Geoexplorer 6000.

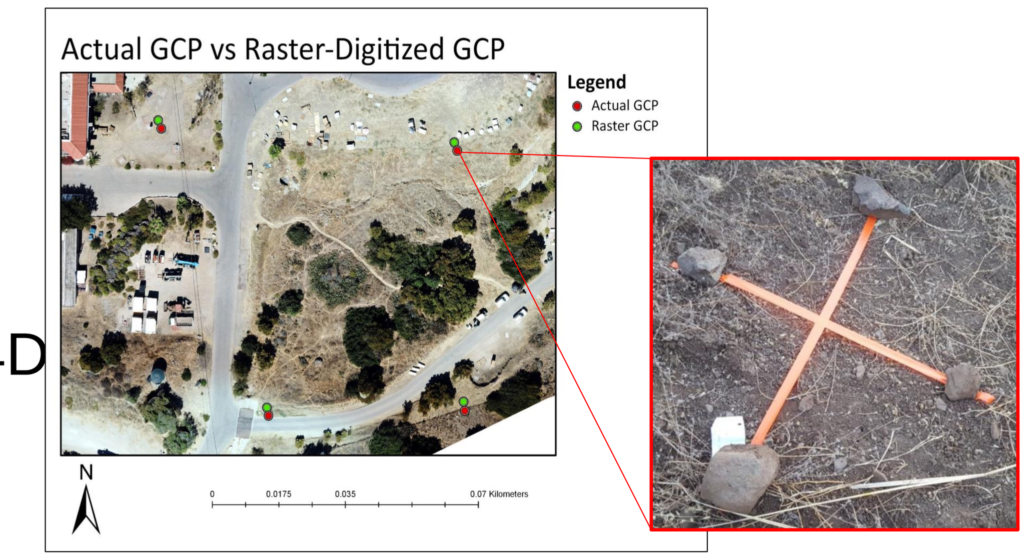
Flight Plan and GCP Placement



2. Used Trimble Juno T41/5 to get ground truthed features and imported features into AtcGis using TerraSync.

3. Executed flight plans with the DJI Mavic Pro.

4. Processed UAV imagery with Pix4D and generate orthomosaic tif.



5. Imported features into GIS, and digitized them from the orthomosaic tif.

6. Used the Near geoprocessing tool in ArcGis to compare the digitized GCP and the actual feature coordinates. The output of the tool produced a distance from the raster GCP to the nearest respective actual GCP. The Root Mean Square (RMS) Error between the GCP datasets was calculated manually.

$$RMS_{error} = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \hat{y})^2}{n}}$$

7. Compared satellite, archived Catalina aerial imagery, UAS orthormosiac archived Catalina aerial imagery.

8. Did a visual comparison of the polygons created from the Juno and orthomosaic, and assessed the accuracy of the Juno in polygon creation.

RESULTS

Comparing Satellite and Aerial imagery to UAS shows UAS imagery has higher resolution. UAS imagery has convincing spatial accuracy on non-building features.

Satellite Aerial UAS

The RMS Error is 2.08m with a maximum distance of 2.33 m and minimum distance of 1.76m.

Polygon Comparisons:

Library	Greenhouse	Administration Center	Dining Hall	House 1	House 2	House 3	House 4	House 5
14	8.6	3.4	4.3	3.5	4.1	7.1	4.6	7.8
7.5	4.3	2.1	3.1	2.6	2.7	4.3	2.6	5
2.1	1.4	1.8	1.6	1.9	1.8	2.4	1.8	2.7
5	5	6	6	7	5	7	6	8
8	8	8	8	7	7	8	8	8
South East (Blocked by two sides of building)	East	North	South (Blocked by 3 sides of building)	East	West (Blocked by House 1)	North	North East	East

Worst Horizontal Average (In meters)	**6.38**
Average Horizontal Average (In meters)	**3.80**
Best Horizontal Average (In meters)	**1.94**
Minimum Satellites Visible Average	**6**
Maximum Satellites Visible Average	**8**

Digitized

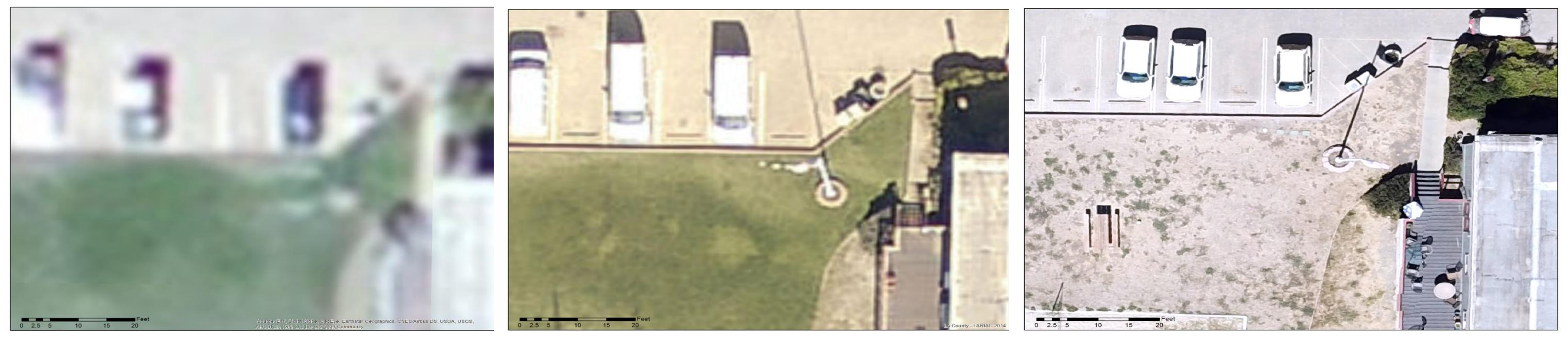
Ground truth

OPPORTUNITY

Potential UAS Imagery Applications:

- Near real-time vehicle counting (vehicle make, model, color, condition…etc)
- Counting humans and/ or animals for traffic analysis

Satellite Aerial UAS



- Remote roof condition inspections
- Building code violation inspections

Satellite Aerial UAS

- Construction site progress inspections
- Environmental regulation enforcement

Satellite Aerial UAS

TAKEAWAYS

- There was significant building distortion with 30% front and side overlap at 3 centimeter ground sample distance (GSD)
- Distortion would be decreased with increased overlap and a lower GSD

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