

ACCURACY OF UAV PHOTOGRAMMETRY COMPARED WITH NETWORK RTK GPS

P. Barry, R. Coakley



Overview:

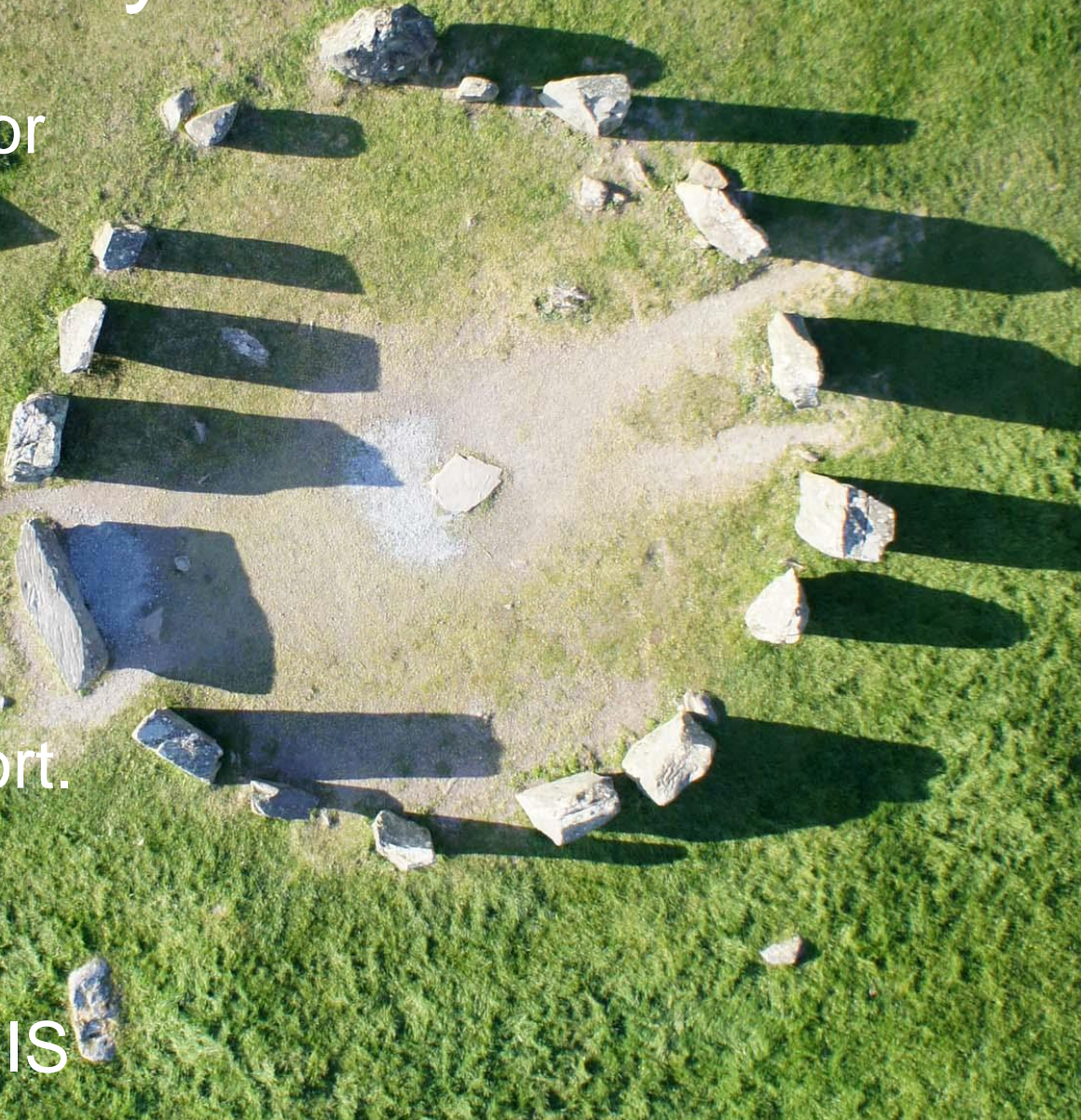
- We compared the accuracy of geospatial data derived from a RPAS and an RTK GPS
- Aim: To understand the mapping applications RPAS can deployed for
- Objective: By the end of this presentation the audience will be able to list the horizontal and vertical accuracies achieved by a RPAS

Content

- Baseline History
- Motivation
- RPAS Accuracy Test
- Results
- Discussion

Baseline History

- Engineering Surveyor for tunnels, roads and bridges.
- 2,500 Topographic Surveys.
- Over 20 years of experience.
- Legal Mapping Export.
- Early adapter of Survey Technology
- Higher Diploma in GIS



UAV History

- Commercial active with UAV's since 2012
- Active with UAV's since 2011
- IAA approved to fly both fix wing and multicopter UAS
- UVS International Committee Member

Motivation

- Viability of UAS for carrying out GPS mapping tasks
- Need to measure UAS accuracy limitations
- Results obtained in Sub Optimal conditions

Reasons for Proving UAV Accuracy

- Mapping applications are accuracy sensitive
- Cadastral or Boundary mapping 1:1000
- Topographic Mapping 1:500
- As Built Survey 1:100
- Where can UAVs be used?

- 2 HA Site
- 10 Ground Control Points
- 45 Check Points
- Network RTK GPS accurate to +/- 20mm
- Bramor C-Astral UAS
- Accuracy: 41mm Horizontal and 68mm Vertical

Flight Plan

- Evenly distributed control points
- 80% overlap and sidelap
- 30mm lens
- 24MP RGB Sensor
- Ground Sample Distance 1cm
- Flight +90m AGL
- Design ground speed 16m/s

Equipment

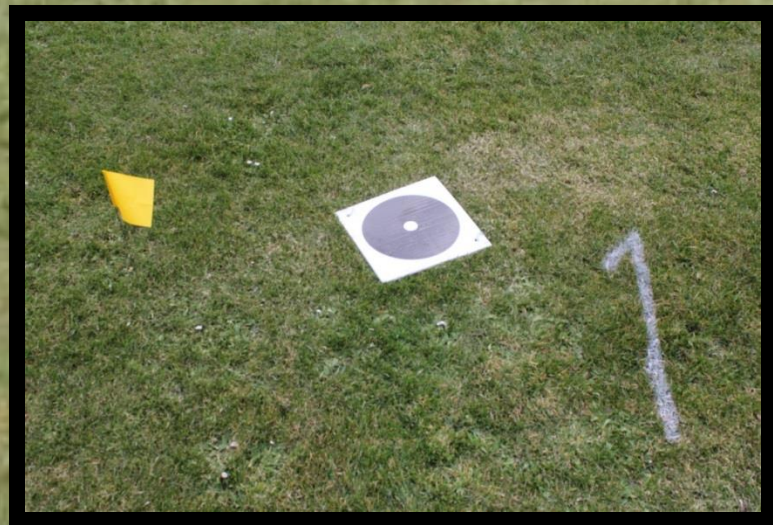
Trimble GEO XR – Network RTK GPS

C-Astral Bramor UAS

- Lockheed Martin Autopilot
- Stable platform
- 24MP Camera

Ground control markers

Trimble GoeXR Network RTK GPS



C-astral BRAMOR - geo

Lockheed Martin Autopilot
Sony NEX-7 24MP Sensor
180 Minute Endurance
30mm Lens
Stable Platform
12m/s wind tolerance



Site Conditions

- Cloudy
- 7m/s winds
- 20 degree
windspeed
divergance

Data Processing

- 1601 photos taken
- 728 photos aligned
- 168 photos modelled
- 10 control points
- 1cm Ortho
- 2cm DEM
- Data merged in ArcGIS and compared with independent GPS readings



Accuracy Results

- UAV are now capable of 1:200 scale topographical surveys
- Horizontal RMSE 21mm
- Vertical RMSE 35mm



DEM accurate
enough to generate
0.2m contours

- UAS can map much faster than GPS
- Photomapping has much richer data

Standard Accuracy's

Class 1 Planimetric Accuracy Limiting RMSE (meters)	Map Scale
0.0125	1:50
0.025	1:100
0.050	1:200
0.125	1:500
0.25	1:1,000
0.50	1:2,000
1.00	1:4,000
1.25	1:5,000
2.50	1:10,000
5.00	1:20,000

Photogrammetry compared with Network RTK GPS

Point No.	XY Error m	Z Error m	Point No.	XY Error m	Z Error m
1	0.025	0.06	24	0.008	0.02
2	0.023	0.02	25	0.000	0.03
3	0.014	0.01	26	0.004	-0.02
4	0.014	-0.04	27	0.012	0.03
5	0.018	-0.05	28	0.011	0.00
6	0.020	-0.02	29	0.029	0.02
7	0.035	-0.02	30	0.023	-0.05
8	0.019	-0.01	31	0.021	-0.04
9	0.010	0.04	32	0.010	-0.02
10	0.043	0.01	33	0.031	-0.07
11	0.041	0.04	34	0.007	-0.01
12	0.015	-0.01	35	0.026	-0.02
13	0.040	-0.01	36	0.040	-0.07
14	0.016	-0.02	37	0.007	-0.04
15	0.016	-0.02	38	0.012	-0.03
16	0.017	-0.03	39	0.007	-0.03
17	0.006	-0.02	40	0.025	0.02
18	0.047	-0.04	41	0.012	0.03
19	0.023	-0.02	42	0.033	0.03
20	0.008	0.05	43	0.024	0.07
21	0.010	0.00	44	0.015	0.01
22	0.013	-0.01	45	0.011	0.03
23	0.016	0.00			

Results

	$\frac{XY}{m}$	$\frac{Z}{m}$
Mean	0.021	0.031
RSME	0.023	0.035
Accuracy 95%	0.041	0.068

Discussion

- High Precision UAS Mapping accuracy is similar to GPS
- Time spent mapping using a UAV is considerably lower than GPS Surveying
- Photographic Data – Quality Assured

Discussion

- UAV photogrammetry is as accurate as RTK GPS, is much faster and provides a richer representation of geography.
- Given favourable regulatory conditions this technology will supercede current methods for most mapping and surveying applications.