Freefly Astro PPK Test Report
Field Testing at: Davis Nursery
By: David B. Karoly, PLS7849
Date: December 5, 2022

Introduction:

David Karoly with the assistance of Nicholas Labedzki conducted test flight missions to assess the positional quality of orthomosaics and point clouds processed from photos processed through the Freefly PPK tool. Results indicate that for the best positional quality GCPs should still be used however the following reported statistics give an indication of the quality of the PPK product should an occasion arise where it is not feasible to set out GCPs.

Field Procedures:

Pre-existing C.P. 103 was used for the RTK base but a new position was obtained from OPUS for purposes of this project, the base was set to collect a file at 1 second epochs. 9 new G.C.P.s are set 40d nails and numbered targets were used for identification. The new G.C.P. 10 is pre-existing C.P. 1006, a 60d nail, found on top of the mound behind the R.V. parking area.

All GCPs were located with RTK using an R12i Receiver as Observed Control Point at 60 epochs each. One set of observations was obtained in the morning before flying and one set was obtained in the afternoon after flying. The data was processed, and network adjusted in TBC.
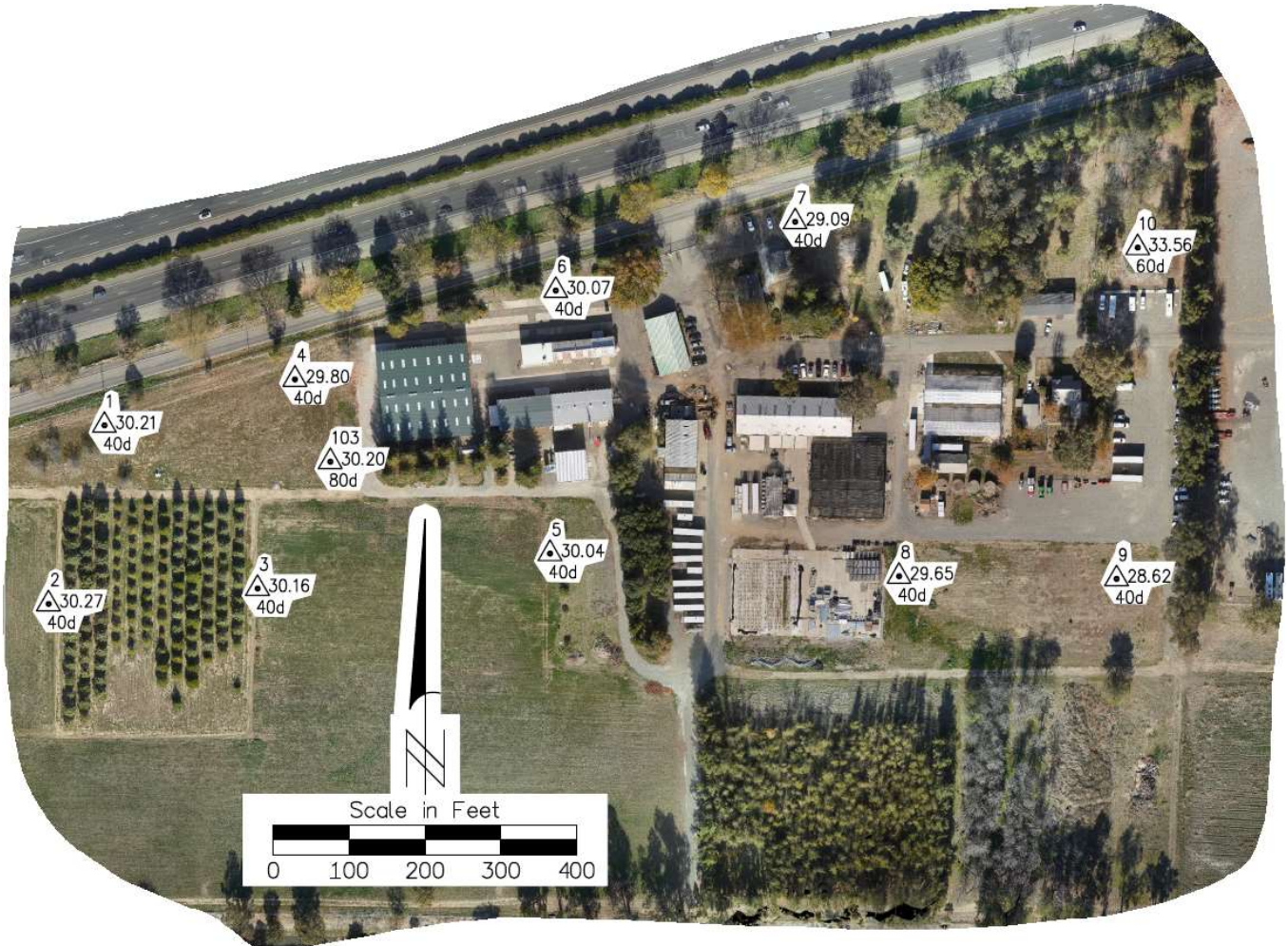
Your intrepid field crew:

Control Diagram:

The site was flown at 200 feet AGL (531 photos) and 400 feet AGL (199 photos).

The 200 feet AGL flight was flown east-west over the west approximately 60% of the site and east-west, north-south over the east approximately 40% of the site:

The 400 feet AGL flight was flown east-west and north-south over the entire site:
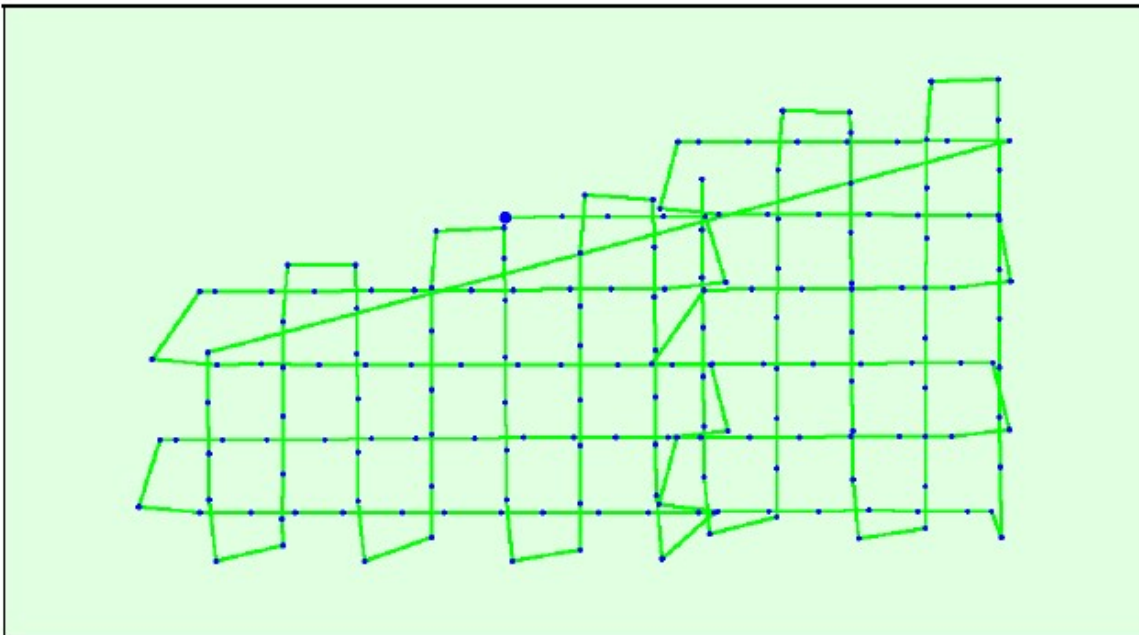
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Office Procedures:
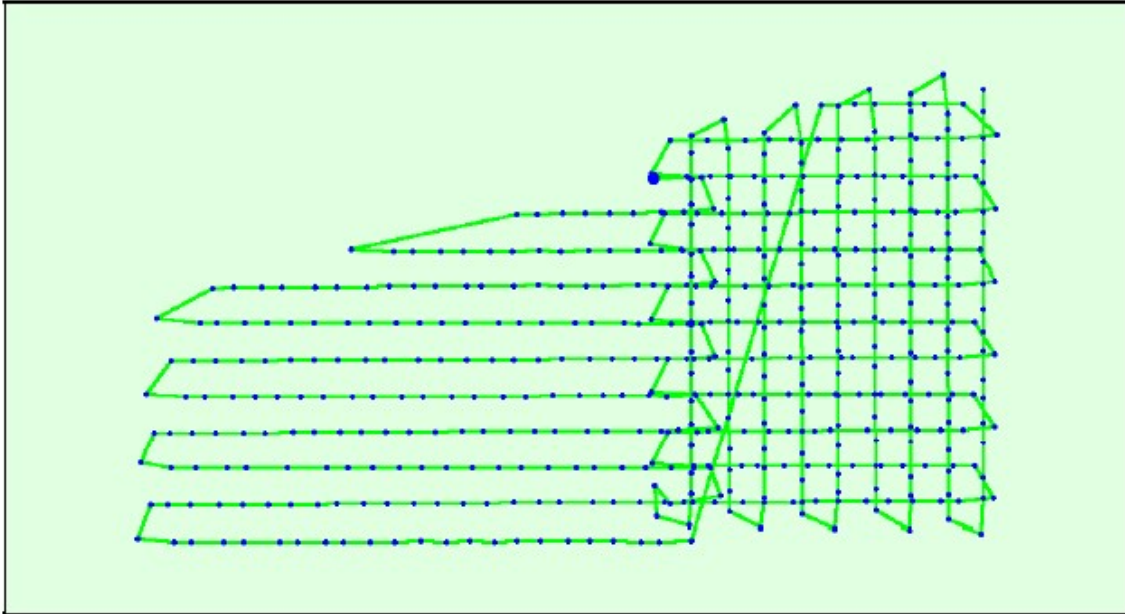
The project was processed as Step 1 in 6 Pix4D projects:

200 and 400 using the autonomous photos (not processed through PPK tool) and using all GCPs as Check Points only so that they did not influence the results.

200 and 400 using the PPK processed photos and using all GCPs as Check Points only so that they did not influence the results.

200 and 400 using the PPK processed photos and constraining to selected GCPs while using some as Check Points. These 2 projects were also processed through Step 2 and 3.

Note that Point 103 was used as a Check Point, the little bit of flagging was picked so it is considered less reliable than the other GCPs.

Average Results:

Autonomous at 200 AGL:

Check Point Name	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]	
1		7.292	-1.415	11.364	
2		7.296	-0.896	12.273	
3		6.757	-1.115	12.335	
4		6.863	-1.625	11.185	
5		6.088	-1.387	11.712	
6		6.219	-1.965	10.134	
7		5.775	-2.212	8.971	
8		5.365	-1.604	10.600	
9		5.021	-1.802	9.656	
10		5.288	-2.409	7.297	
103		6.741	-1.418	11.572	
	Average=	**6.246**	**-1.623**	**10.645**	

Autonomous at 400 AGL:

Check Point Name	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]
1		9.028	-1.511	4.550
2		9.210	-0.639	4.590
3		8.255	-0.749	5.598
4		8.175	-1.683	5.331
5		7.019	-0.951	6.381
6		7.032	-2.128	5.540
7		6.028	-2.436	5.391
8		5.521	-0.982	6.479
9		4.642	-1.053	5.908
10		4.669	-2.437	4.704
103		8.042	-1.296	5.650
	Average=	**7.056**	**-1.442**	**5.466**

PPK unconstrained at 200 AGL:

Check Point Name	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]
1		-0.394	0.047	9.414
2		-0.467	-0.042	9.712
3		-0.347	-0.087	9.227
4		-0.262	0.080	9.079
5		-0.116	-0.093	8.827
6		-0.131	0.127	8.783
7		0.163	0.251	8.939
8		0.240	-0.209	9.125
9		0.587	-0.291	9.640
10		0.710	0.109	9.571
103		-0.229	0.059	8.987
	Average=	**-0.022**	**-0.004**	**9.209**

It is unknown why the vertical error averages 9.2 feet. All settings in the PPK tool were the same across all processing.

PPK unconstrained at 400 AGL:

Check Point Name	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]
1		1.840	-0.204	1.406
2		2.036	0.511	0.882
3		1.224	0.437	2.188
4		1.143	-0.332	2.441
5		0.223	0.299	3.047
6		0.179	-0.666	2.916
7		-0.654	-0.891	2.561
8		-1.052	0.290	2.737
9		-1.779	0.266	1.520
10		-1.757	-0.867	1.213
103		1.005	0.044	2.679
	Average=	**0.219**	**-0.101**	**2.145**

The vertical error at 400 feet was much lower at 2.1 feet than the 200 feet AGL error.

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PPK Constrained by GCPs at 200 AGL:

GCP Name	Type	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]
1	(3D)	'0.020/0.020	0.002	-0.001	0.000
2	(3D)	'0.020/0.020	-0.001	0.000	0.000
5	(3D)	'0.020/0.020	-0.001	0.004	-0.001
6	(3D)	'0.020/0.020	-0.003	-0.008	0.004
8	(3D)	'0.020/0.020	-0.020	0.009	0.002
9	(3D)	'0.020/0.020	0.018	0.006	0.006
10	(3D)	'0.020/0.020	0.004	-0.010	-0.003
		Average=	**0.000**	**0.000**	**0.001**

Check Point Name	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]	Projection E
3		-0.011	-0.013	0.051	0.553
4		0.025	0.030	0.089	0.712
7		-0.049	-0.044	0.094	0.489
103		0.042	0.062	0.038	0.548
	Average=	**0.002**	**0.008**	**0.068**	**0.575**

PPK Constrained by GCPs at 400 AGL:

GCP Name	Type	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]
1	(3D)	'0.020/0.020	0.000	-0.025	0.014
2	(3D)	'0.020/0.020	-0.002	0.014	0.002
5	(3D)	'0.020/0.020	0.021	0.022	-0.050
6	(3D)	'0.020/0.020	-0.012	-0.004	-0.011
8	(3D)	'0.020/0.020	-0.013	-0.008	0.077
9	(3D)	'0.020/0.020	0.006	0.002	-0.044
10	(3D)	'0.020/0.020	0.009	-0.002	0.023
		Average=	**0.001**	**0.000**	**0.002**

Check Point Name	Accuracy XY/Z [ft]	Error X [ft]	Error Y [ft]	Error Z [ft]	Projection E
3		-0.040	0.013	-0.011	0.893
4		0.008	0.016	0.034	0.676
7		-0.026	0.018	-0.044	0.883
103		0.001	0.089	0.076	0.949
	Average=	**-0.014**	**0.034**	**0.014**	**0.850**

The average errors in horizontal appear to be very good using the PPK processed photos. However, the residuals at individual GCPs show larger errors on either side of zero therefore it can be concluded the averages are not showing the true accuracy of the project not constrained by GCPs.

The conclusion drawn from these results is that the PPK tool helps achieve somewhat better results but not improved enough for most of the work performed by this office.

We have tested using a GPS file collected at 5 second epochs and the results were similar, so it does not appear necessary to collect 1 second files for the purpose of PPK processing.

This report and the underlying field surveys were conducted by me or under my direction:

December 5, 2022

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