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PHOTOGRAMMETRIC FLIGHT PHANTOM 4 – X5

This report consists of the validation of the **X5 Multiband GNSS module of METTATEC**, coupled in a **DJI Phantom 4**, applying the Post Processed kinematic PPK technique.

1. Methodology

A test flight was carried out with the Phantom 4 drone with the PPK docking kit and GNSS X5 module, with the methodology in Post Processing Kinematics (PPK), which is based on the placement of two GNSS receivers with simultaneous readings, where one of them is the base receiver, and the other the mobile receiver or rover. The base receiver is the control point parked statically and the mobile receiver moves freely over the points to be lifted; Both record raw observation data in the field and in a post process in cabinet corrections are made to the mobile receiver, obtaining precise final coordinates.

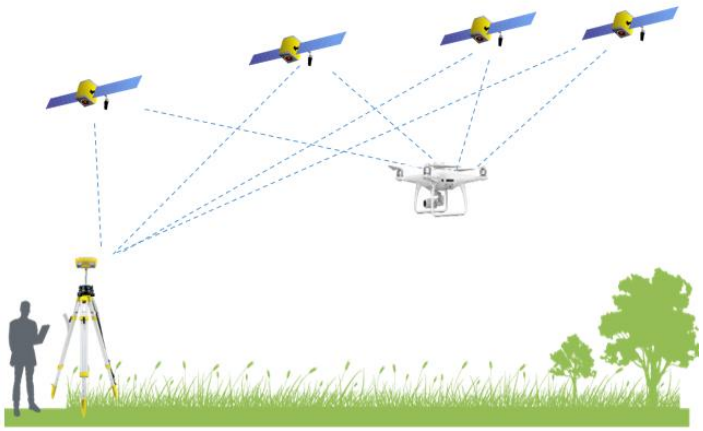

Figure 01: PPK Methodology

2. Work Area

The test flight was carried out in Magdalena del Mar Domes, beach circuit, Lima - Peru

Figure 02: Work area



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3. Field Test

Day: 01 Jun io 2022

Photogrammetric flight with a Phantom 4 aircraft and GNSS Multiband X5 module docked, was based on a Geomax Zenith 35 receiver located at a point of known coordinates LIM1809, order point C.

Figure 03: Geomax Zenith 35 and Phantom 4 base receiver with X5 Multiband GNSS Module.

LATITUDE (S) WGS-84	LONGITUDE (W) WGS-84	NORTH (N) WGS-84	EAST (E) WGS-84
12°06'06.55608"	77°04'03.75630"	8661335.518 m	274950.935 m
ELLIPSOIDAL HEIGHT		**ELEVATION (EGM08)**	**ZONE UTM**
33.437 m		10.472 m	18S

Table 01: Control point coordinates LIM1809.

The base receiver read raw data in RINEX format over a period of 37 minutes.

- Start: 11:04 am
- End: 11:41 am

And the GNSS X5 module read raw data in native UBX format over an 11-minute period.

- Start: 11:17 am
- End: 11:28 am


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The data obtained in the field was:

- Data from the base (LIM1809) in RINEX format, every 1 second.
- Native UBX data from the X5 module docked in the phantom4, set to 10 Hz.

1. Post Process

The post-processing of this PPK flight was carried out with two softwares: Emlid Studio and APP UAV PPK.

The Emlid Studio software is a cross-platform desktop application, developed by Emlid, free to download and compatible with any GNSS receiver. This performs the cinematic post process and the geotagging of images, obtaining as results two .pos files, where one of them are the precise coordinates of the entire flight path (.pos) and the other are the precise coordinates of the projection center of each photograph (events.pos).

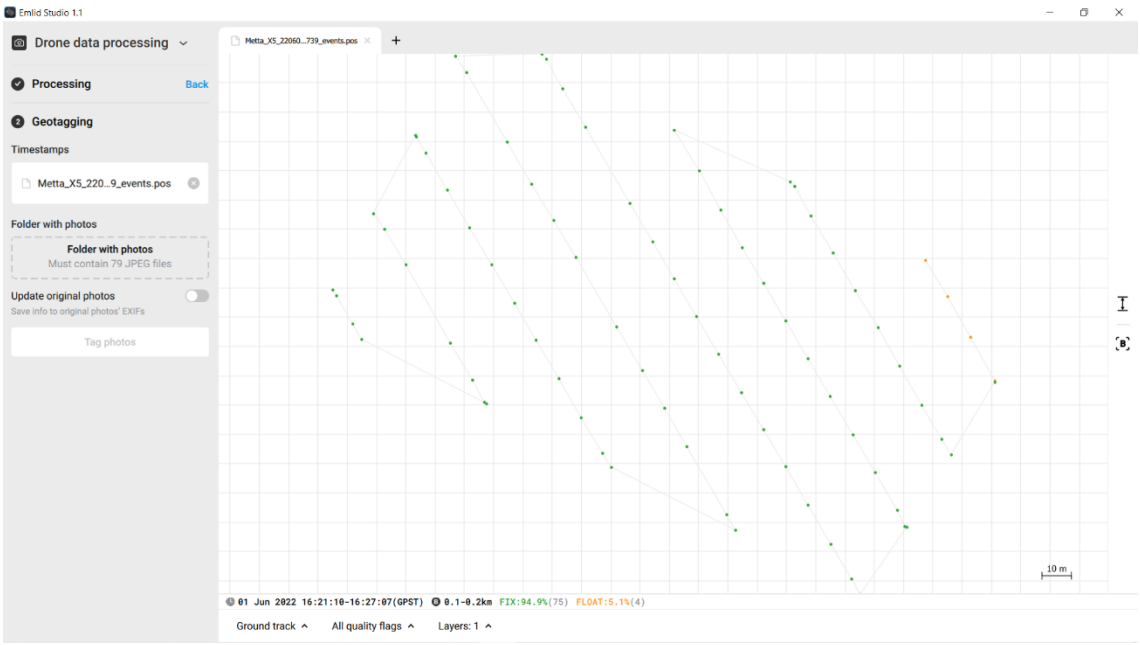

Figure 04: Post PPK kinematic processing in Emlid Studio software.

Nombre	Fecha de modificación	Tipo	Tamaño
Metta_X5_220601_161739 (2).pos	23/06/2022 12:40	Archivo POS	853 KB
Metta_X5_220601_161739_events (2).pos	23/06/2022 12:36	Archivo POS	12 KB

Figure 05: Emlid Studio results.



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The .pos file has all the resolved epochs of the observation file .obs, set to 10Hz, so the time between each epoch is every 0.1 second (see figure 06).

	A	B	C	D	E	F	G	H	I	J	K	L
1	% program : ES dev:6c22c8ac-Dev											
2	% inp file : F:/PROYECTOS/RESEARCH/GNSS/X5_METTA/CV_01062022/DATA-GNSS/VUELO02\rinex_Metta_X5_220601_161739\Metta_X5_220601_161739.22O											
3	% inp file : F:/PROYECTOS/RESEARCH/GNSS/X5_METTA/CV_01062022/DATA-GNSS/VUELO02\rinex_Metta_X5_220601_161739\Metta_X5_220601_161739.22P											
4	% inp file : F:\PROYECTOS\RESEARCH\GNSS\X5_METTA\CV_01062022\DATA-GNSS\LIM01809\LIM8152I03.22O											
5	% obs start : 2022/06/01 16:17:57.8 GPST (week2212 317877.8s)											
6	% obs end : 2022/06/01 16:28:50.5 GPST (week2212 318530.5s)											
7	% ref pos :-12.101821134 -77.067710087 33.4370											
8	%											
9	% (lat/lon/height=WGS84/ellipsoidal,Q=1:fix,2:float,3:sbas,4:dgps,5:single,6:ppp,ns=# of satellites)											
10	% GPST	latitude(deg)	longitude(deg)	height(m)	Q	ns	sdn(m)	sde(m)	sdu(m)	sdne(m)	sdeu(m)	sdun(m) age(s) ratio
11	2212 317877.801	-12.101807216	-77.067689035	33.5202	1	7	0.0056	0.0074	0.0154	-0.0022	-0.0061	0.0003 -0.20 999.9
12	2212 317877.901	-12.101807215	-77.067689048	33.5241	1	7	0.0055	0.0074	0.0152	-0.0022	-0.0061	-0.0003 -0.10 999.9
13	2212 317878.001	-12.101807209	-77.067689053	33.5281	1	7	0.0055	0.0073	0.0146	-0.0021	-0.0057	-0.0017 -0.00 999.9
14	2212 317878.101	-12.101807212	-77.067689079	33.5313	1	11	0.0054	0.0070	0.0128	-0.0017	-0.0045	-0.0035 -0.90 670.8
15	2212 317878.201	-12.101807220	-77.067689081	33.5340	1	11	0.0054	0.0070	0.0128	-0.0017	-0.0045	-0.0035 -0.80 663.4
16	2212 317878.301	-12.101807213	-77.067689068	33.5309	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0035 -0.70 656.1
17	2212 317878.400	-12.101807204	-77.067689068	33.5299	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0035 -0.60 648.8
18	2212 317878.500	-12.101807201	-77.067689075	33.5309	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.50 640.5
19	2212 317878.600	-12.101807198	-77.067689072	33.5305	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.40 633.1
20	2212 317878.700	-12.101807203	-77.067689061	33.5293	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.30 624.8
21	2212 317878.800	-12.101807199	-77.067689057	33.5289	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.20 616.0
22	2212 317878.900	-12.101807198	-77.067689059	33.5283	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.10 607.6
23	2212 317879.000	-12.101807189	-77.067689073	33.5307	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.00 598.9
24	2212 317879.100	-12.101807171	-77.067689072	33.5333	1	11	0.0054	0.0070	0.0128	-0.0017	-0.0045	-0.0035 -0.90 589.2
25	2212 317879.200	-12.101807173	-77.067689080	33.5346	1	11	0.0054	0.0070	0.0128	-0.0017	-0.0045	-0.0035 -0.80 581.1
26	2212 317879.300	-12.101807177	-77.067689081	33.5332	1	11	0.0054	0.0070	0.0128	-0.0017	-0.0045	-0.0035 -0.70 572.7
27	2212 317879.400	-12.101807177	-77.067689072	33.5310	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.60 564.1
28	2212 317879.500	-12.101807189	-77.067689072	33.5339	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.50 554.8
29	2212 317879.600	-12.101807179	-77.067689077	33.5324	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.40 546.1
30	2212 317879.700	-12.101807181	-77.067689080	33.5320	1	11	0.0054	0.0069	0.0127	-0.0017	-0.0045	-0.0034 -0.30 536.5

Figure 06: .pos file, times every10 Hz.

The PPK docking kit with the X5 module, includes a photosensor that records the taking of each photograph, this has a very small latency of 0.3 seconds, time that takes to capture the moment of taking each photograph and take it to the metadata record of the X5, generating a lag of a few centimeters in the final results of the coordinates of each photograph. To correct this, it is done through a web application "APP UAV PPK", developed by Soluciones Geográficas, where the two .pos files obtained in Emlid Studio are entered; Finally, the geotagging is obtained with the precise final coordinates, and they are downloaded in three formats (.csv, .txt and KML). This coordinate table is ready to be entered into the photogrammetry software and obtain the required 3D models.

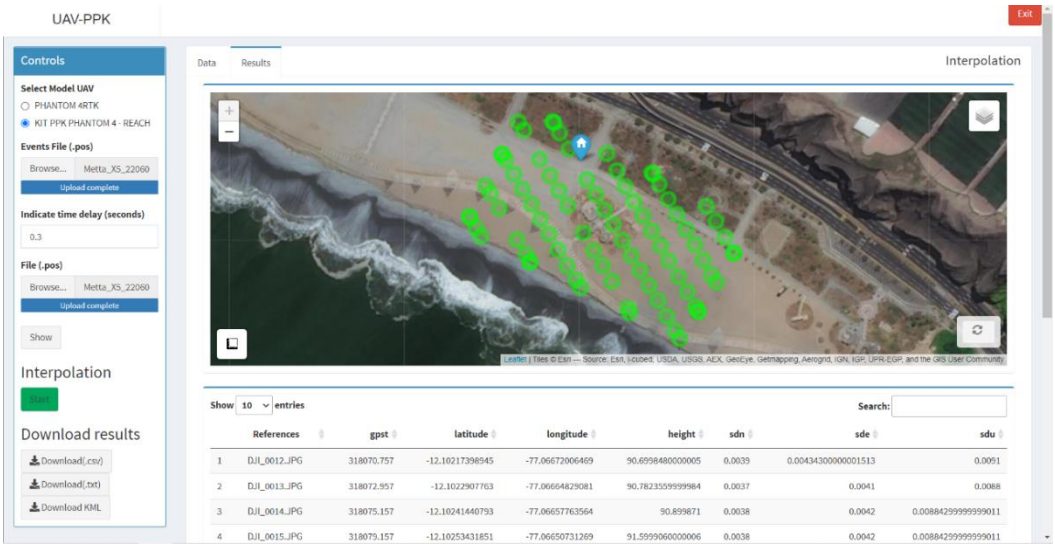

Figure 07: APP UAV PPK Results


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4. Conclusions

- The test flight was carried out with the phantom 4 drone and its PPK docking kit with the GNSS Multiband X5 module, obtaining very good results, with precision of a few centimeters.
- The photosensor of the PPK Kit has a latency of 0.3 seconds, so the coordinates have to be corrected in the PPK UAV web application as long as photogrammetric support points are not used; Otherwise, the offset of the photographs can be adjusted with the photogrammetric support points in the photogrammetry software.
- The coordinate table obtained by the UAV PPK web application are the final precise coordinates of the projection center of each photograph, these being the ones that will be entered into the photogrammetry software to obtain the final 3D models, they can be verified with checkpoints.
- Differences in the use of 10 Hz versus 5 Hz (Conventional rate for PPK flights) should be documented.
- This document was concluded on 24 – 08 – 2022.


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