

Summary Workflow for Photogrammetry

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Camera options when flying

Disable any internal electronic and optical **image stabilization**

- o Reduces blurriness due to the camera movements during exposure
- o Changes the camera's internal parameters

Double grid mission



- At least 85% frontal overlap
- At least 70% side overlap
- Camera on a slightly oblique angle
- Designed for both 2D and 3D deliverables
- At least one flight line beyond the area of interest

Data download

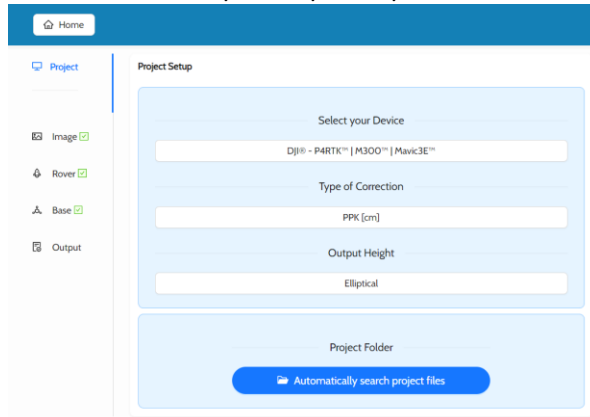
Preprocessing data

OPUS correct base station data

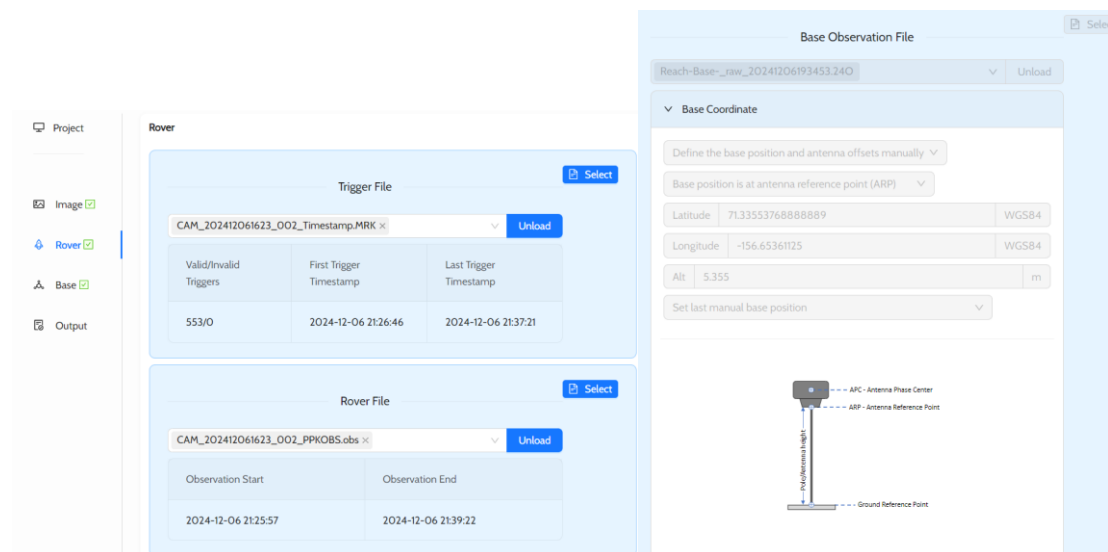
- As alternative use CORS data and PPK data base

PPK of images positions

- Use REDToolbox (Desktop program)
 - Select: DJI/P4RTK/M300/Mavic3E



- upload the picture folder
- use rover observation and position files that the drone should have recorded in the picture folder
- OPUS correct the base station data
- use OPUS corrected base data to run REDToolbox image correct with
- output folder



Valid/Invalid Triggers	First Trigger Timestamp	Last Trigger Timestamp
553/O	2024-12-06 21:26:46	2024-12-06 21:37:21

Observation Start	Observation End
2024-12-06 21:25:57	2024-12-06 21:39:22

PPK of Ground control points GCP

- With Emlid Studio postprocess (PPK) data using Reach base station data and the data from the Emlid rover
-

Emlid Processing

- OPUS correct base station files
- open Emlid Studio
- Rover: O file
- Base: O file
- Navigation file: P
- Antenna height: should be in the csv file but double check. If needed correct values!

Export of EXIF data form pictures

- Open command line/power shell
- type in power shell
- ls = checking filepath
- cd = set file path
- Navigate to folder with images
- **D:\exiftool\exiftool.exe -r -n -csv *.JPG > metadata.csv -GPSLatitude -GPSLongitude -GPSAltitude -GimbalYawDegree -GimbalPitchDegree -GimbalRollDegree**
- open file (metadata.csv) in notepad++ , **delete last row and change encoding to UTF-8**

```
Windows PowerShell
PS D:\exiftool> cd d:
PS D:\exiftool> cd C:\Users\apinzner
PS C:\Users\apinzner> cd \
PS C:\>
PS C:\> cd C:\Users\apinzner
PS C:\Users\apinzner> cd .\Desktop\REDToolBoxOutput_2024-12-18_17-50-29\
PS C:\Users\apinzner\Desktop\REDToolBoxOutput_2024-12-18_17-50-29> ls

Directory: C:\Users\apinzner\Desktop\REDToolBoxOutput_2024-12-18_17-50-29

Mode                LastWriteTime         Length Name
----                -
d-----         12/18/2024   5:51 PM             EXIF_images
d-----         12/18/2024   5:51 PM             PDFReport
d-----         12/18/2024   5:51 PM             RawText
d-----         12/18/2024   5:51 PM             Shapefile
-a-----         12/18/2024   5:51 PM          571743 CAM_202412061623_002_PPKOBS.pos
-a-----         12/18/2024   5:51 PM          79273 CAM_202412061623_002_PPKOBS_553_events.pos
-a-----         12/18/2024   5:50 PM      85833409 Reach-Base-_raw_20241206193453redtoolbox_cut_to_rover_span.obs
-a-----         12/18/2024   5:51 PM          7903696 redcatchmapping.json
-a-----         12/18/2024   5:51 PM          58316 redcatch_output.log

PS C:\Users\apinzner\Desktop\REDToolBoxOutput_2024-12-18_17-50-29> D:\exiftool\exiftool.exe -r -n -csv *.JPG > metadata.csv -GPSLatitude -GPSLongitude -GPSAltitude -GimbalYawDegree -GimbalPitchDegree -GimbalRollDegree
No matching files
PS C:\Users\apinzner\Desktop\REDToolBoxOutput_2024-12-18_17-50-29> D:\exiftool\exiftool.exe -r -n -csv *.JPG > metadata.csv -GPSLatitude -GPSLongitude -GPSAltitude -GimbalYawDegree -GimbalPitchDegree -GimbalRollDegree
No matching files
PS C:\Users\apinzner\Desktop\REDToolBoxOutput_2024-12-18_17-50-29> cd .\EXIF_images\
PS C:\Users\apinzner\Desktop\REDToolBoxOutput_2024-12-18_17-50-29\EXIF_images> D:\exiftool\exiftool.exe -r -n -csv *.JPG > metadata.csv -GPSLatitude -GPSLongitude -GPSAltitude -GimbalYawDegree -GimbalPitchDegree -GimbalRollDegree
553 image files read
PS C:\Users\apinzner\Desktop\REDToolBoxOutput_2024-12-18_17-50-29\EXIF_images>
```

```
magna009.sbf_SBF_ExtEvent1.txt  Geo1_0.dat  mg2_3380.24__SBF_ExtEvent1.txt  metadata.csv
File Edit View
CAM_20241206163646_0524_V.JPG,71.3345894672006,-156.6571526468,57.20544023,+48.90,-90.00,+180.00
CAM_20241206163647_0525_V.JPG,71.334588134,-156.657158415181,57.22365039,-131.30,-89.90,+0.00
CAM_20241206163653_0526_V.JPG,71.3345781857031,-156.657163809044,57.46883988,-168.90,-45.00,+0.00
CAM_20241206163654_0527_V.JPG,71.3345815013064,-156.657162781431,57.34340992,+107.40,-44.90,+0.00
CAM_20241206163655_0528_V.JPG,71.3346118051106,-156.657139725703,57.43950995,+21.80,-44.90,+0.00
CAM_20241206163656_0529_V.JPG,71.3346430673936,-156.6571137568,57.51483051,+14.80,-44.90,+0.00
CAM_20241206163657_0530_V.JPG,71.3346596573006,-156.657097730497,57.52203976,+15.10,-44.90,+0.00
CAM_20241206163658_0531_V.JPG,71.3346835375958,-156.6570780858,57.46550994,+16.00,-45.00,+0.00
CAM_20241206163700_0532_V.JPG,71.3347343938972,-156.657035792256,57.50534979,+16.50,-44.90,+0.00
CAM_20241206163701_0533_V.JPG,71.3347997038,-156.656978709072,57.44162033,+16.50,-44.90,+0.00
CAM_20241206163702_0534_V.JPG,71.3348810554022,-156.6569106079,57.4908,+16.60,-44.90,+0.00
CAM_20241206163703_0535_V.JPG,71.3349712701025,-156.656831786639,57.46043956,+16.70,-44.90,+0.00
CAM_20241206163704_0536_V.JPG,71.3350782412017,-156.656740286392,57.50992991,+17.30,-44.90,+0.00
CAM_20241206163705_0537_V.JPG,71.3351926719114,-156.656642852386,57.51006036,+17.30,-45.00,+0.00
CAM_20241206163707_0538_V.JPG,71.3353079367981,-156.656544432706,57.48680042,+17.10,-45.00,+0.00
CAM_20241206163708_0539_V.JPG,71.3354177268872,-156.656449659044,57.55862978,+17.10,-45.00,+0.00
CAM_20241206163709_0540_V.JPG,71.3355313828008,-156.656352672519,57.58391003,+16.90,-44.90,+0.00
CAM_20241206163710_0541_V.JPG,71.3356446486981,-156.6562557221,57.58692972,+17.00,-45.00,+0.00
CAM_20241206163711_0542_V.JPG,71.3357540836997,-156.656162151803,57.66396002,+16.90,-45.00,+0.00
CAM_20241206163712_0543_V.JPG,71.3358666081031,-156.656066019417,57.80674003,+17.10,-44.90,+0.00
CAM_20241206163713_0544_V.JPG,71.3359787222753,-156.655970232111,57.86838006,+16.90,-45.00,+0.00
CAM_20241206163714_0545_V.JPG,71.3360895662978,-156.655875039992,57.90777006,+16.90,-45.00,+0.00
CAM_20241206163716_0546_V.JPG,71.3362016963917,-156.655779276825,57.96746032,+16.80,-44.90,+0.00
CAM_20241206163717_0547_V.JPG,71.3363139254861,-156.65568329055,57.95576037,+16.80,-45.00,+0.00
CAM_20241206163718_0548_V.JPG,71.3364263733,-156.655588802447,57.9920904,+16.90,-45.00,+0.00
CAM_20241206163719_0549_V.JPG,71.3365375926972,-156.655492046947,57.93913956,+17.00,-45.00,+0.00
CAM_20241206163720_0550_V.JPG,71.3366247655889,-156.655417804003,58.5122399,+15.10,-45.00,+0.00
CAM_20241206163721_0551_V.JPG,71.3366640661111,-156.655380705792,58.07338017,+14.70,-45.00,+0.00
CAM_20241206163722_0552_V.JPG,71.3366805346,-156.655368672244,58.1098991,+15.00,-45.00,+0.00
CAM_20241206163724_0553_V.JPG,71.336684502125,-156.655362354086,57.85067007,+15.30,-45.00,+0.00
Ln 554, Col 96 | 53,854 characters | 100% | Windows (CRLF) | UTF-16 LE
```

Corrections of angles to Pix4D format and add position accuracy

The pitch angle of all images must be corrected by adding 90 deg. The roll angle of some images is 180 deg and the yaw is off by 180 deg too. Basically indicating that the picture was taken from below. Therefore, it is necessary to subtract 180 deg from both the roll and yaw angles. See picture below with original orientation in blue and orientation after calibration in green.

Pix4D allows to indicate the accuracy for the GPS position (x,y,z). There are no accuracy of the PPK position in the EXIF data but we can add our own accuracy estimate.

The python script *correctMetadataPix4D.py* can be used to correct the angles and add the accuracy data. As alternative there is a Matlabversion too.

Github repository: <https://github.com/Sealce-UAF/RaptorCode>

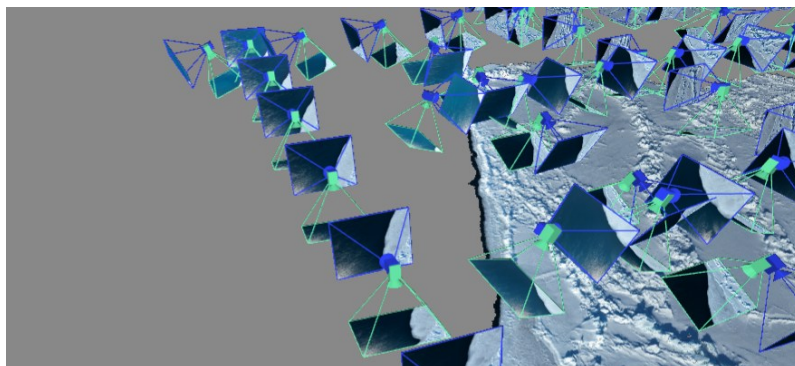
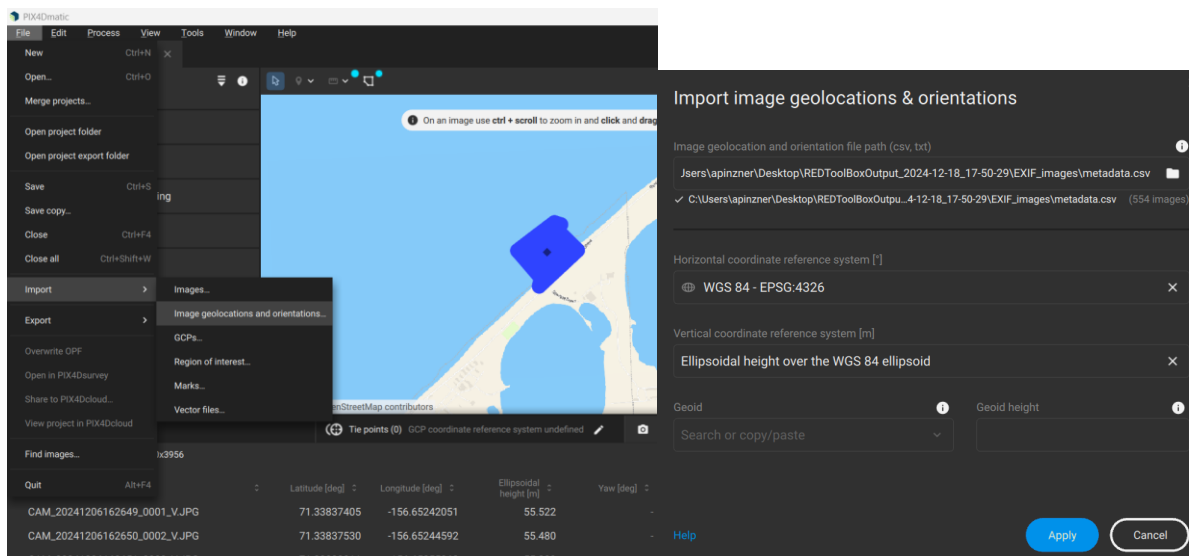


Figure 1: Camera angle as imported with original metadata (blue) and after calibration (green). It is visible that there is a consistent 90deg offset (roll). With the python script *correctMetadataPix4D.py* we can add three columns with the accuracy estimates to the metadata file.

Processing in Pix4D

- upload project folder or images
- Upload metadata with image position, orientation (and accuracy).
 - File → Import → Image geolocations and orientations:
 - upload metadata file that had the last row deleted in previous step
 - select WGS 84 - EPSG:4326
 - select Ellipsoidal height over the WGS 84 ellipsoid
 -
- If no orientation data were passed: (→ Calibrate: the Yaw, Pitch, Roll etc. columns that were previously empty should fill up)



- when low light images, set Calibration to Template: Flat scene low texture, Pipeline: Low texture planar, automatic ITPs, Compute relative confidence, Vertex conversion
- Higher contrast: map?
- Image scale: 1/1
-
- Keypoints: 50k for low overlap/light

Reoptimization
Updates the internal and external camera parameters.

Rematch ☒
Computes more matches between images and optimizes the internal and external camera parameters.

Compute relative confidence ☒
Computes the relative confidence of the generated ATPs and enables color by confidence. Processing time is impacted

Vertex conversion ☒
Converts marked vertices into vertex tie points to improve calibration

Calibration

Template Flat scene low texture

Pipeline Low texture planar

Image scale 1/1 1/2 1/4 1/8

Keypoints Auto Custom 10000

Internals confidence Low

Automatic ITPs ☐
Generate tie points out of the structural line intersections

Compute relative confidence ☐
Computes the relative confidence of the generated ATPs and enables color by confidence. Processing time is impacted

Vertex conversion ☐
Converts marked vertices into vertex tie points to improve calibration

Start