

**Q1: What is the image sensor format (rows by columns) in mm and in pixels?**

Pixels: 5368 x 7152

Mm: 7.5152 x 10.0128

**Q2: What is the camera focal length in mm?**

7.94217 mm

**Q3. What is the pixel size on the chip in  $\mu\text{m}$ ?**

1.4  $\mu\text{m}$

**Q4: What are UTM coordinates, and what longitude range is spanned by zone 10N?**

UTM coordinates are 2 values that define the location of a point on the surface of the planet. The system uses N and W as the two directions. A single value pair can represent a point in the northern or southern hemisphere, so an additional identifier that represents which hemisphere the point is in is required. The earth is separated into 60 zones with different map projections that apply only in that zone.

10N spans 126W to 120W.

**Q5: What is the meaning of the warning symbol next to Georeferencing (in the “Quality Check”**

**section of the report)?**

The locations are georeferenced without GNSS data for ground control points.

**Q6: Under Absolute camera position and orientation uncertainties, what are the mean and standard deviation for X [m], Y [m], Z [m], Omega [degree], Phi [degree], Kappa [degree]?**

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.042	0.042	0.071	0.147	0.136	0.044
Sigma	0.008	0.008	0.014	0.004	0.005	0.000

Z error is the largest just as with GPS. Omega and Phi have larger errors. Kappa is the Z angle which corresponds to rotation of the image on the surface. The other two show increased uncertainty as to the change in height as your travel in the x or y direction.

**Q7: Do you still have the warning symbol under Georeferencing (in the Quality Check section of the report)?**

No the warning symbol is no longer there.

**Q8: What are the ‘Absolute camera position and orientation uncertainties’ now that you’ve incorporated the GCPs into the processing? Did the GCPs improve the results?**

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.003	0.003	0.004	0.011	0.011	0.002
Sigma	0.001	0.000	0.002	0.005	0.006	0.000

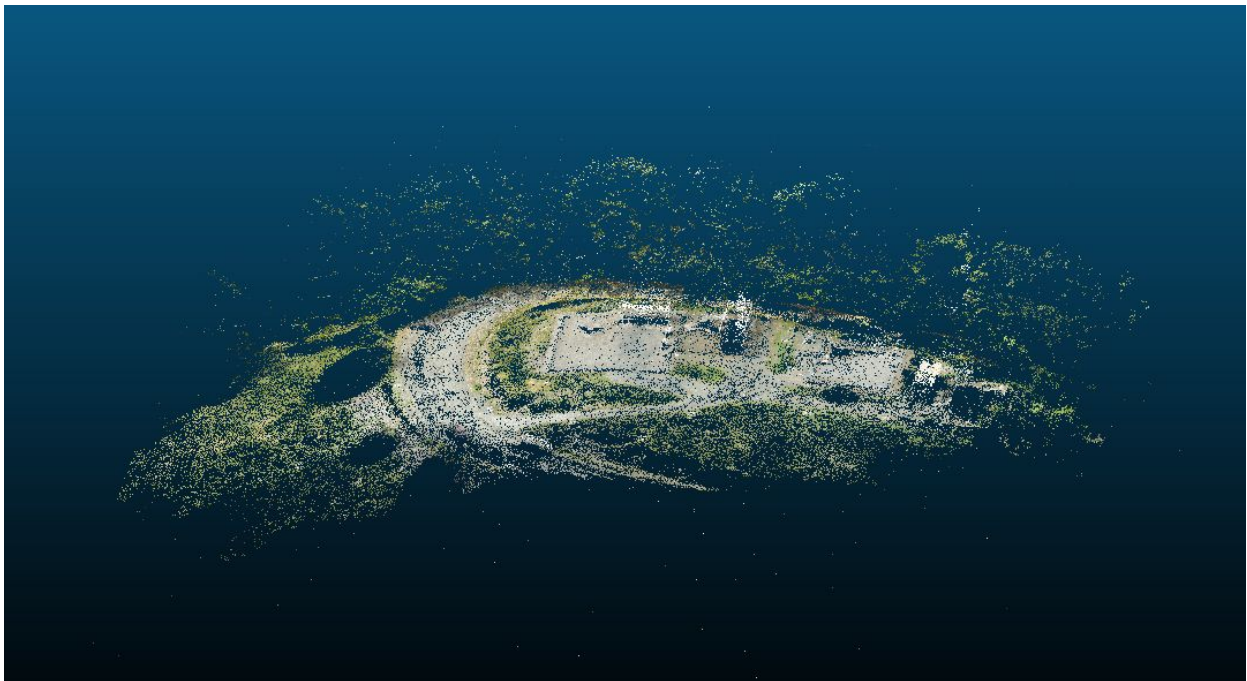
The GCPs improved the results significantly. Position and orientation accuracy has increased by a factor of approximately 10 down to mm level accuracy.

**Q9: Do you feel the camera position and orientation uncertainties listed in the report both before and after using the GCPs are realistic? Why or why not?**

I think the accuracy before using GCPs is on the low end of what I think is plausible. That amount of accuracy from satellite and imagery seems very difficult. However, the accuracy after the GCPs seems way too accurate. Millimeter level accuracy is similar to the reconstruction error when using a 3D sensor using PCL and pose estimation. That seems far too accurate from 2D images taken from a drone flying around.

I also built the file with an open source SfM software in Python. The image below shows the results. It seems similar, but significantly worse than the Pix4D version.

Pix4D:



OpenSfM:

