Quality Report

Generated with Pix4Dmapper version 4.3.31

Important: Click on the different icons for:

Help to analyze the results in the Quality Report

Additional information about the sections

Click here for additional tips to analyze the Quality Report

Summary

Project	phantom_pix4d
Processed	2018-11-11 18:22:15
Camera Model Name(s)	FC6310_8.8_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	2.11 cm / 0.83 in
Area Covered	0.398 km^2 / 39.8479 ha / 0.15 sq. mi. / 98.5173 acres

Quality Check

Images	median of 35968 keypoints per image	✓
Dataset	774 out of 774 images calibrated (100%), all images enabled	✓
Camera Optimization	0.46% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 15732.6 matches per calibrated image	✓
Georeferencing	yes, 10 GCPs (10 3D), mean RMS error = 0.039 m	✓

Preview

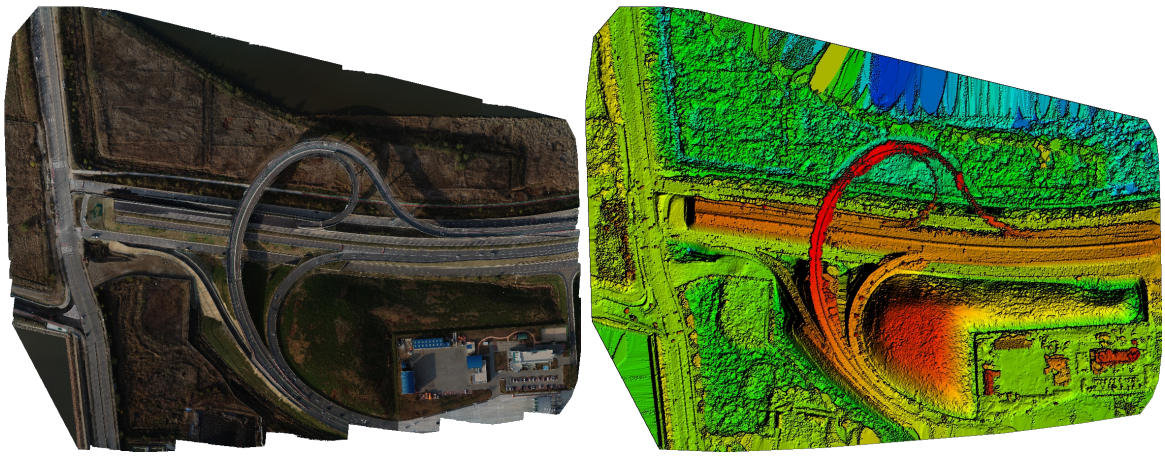


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	774 out of 774
Number of Geolocated Images	774 out of 774

Initial Image Positions

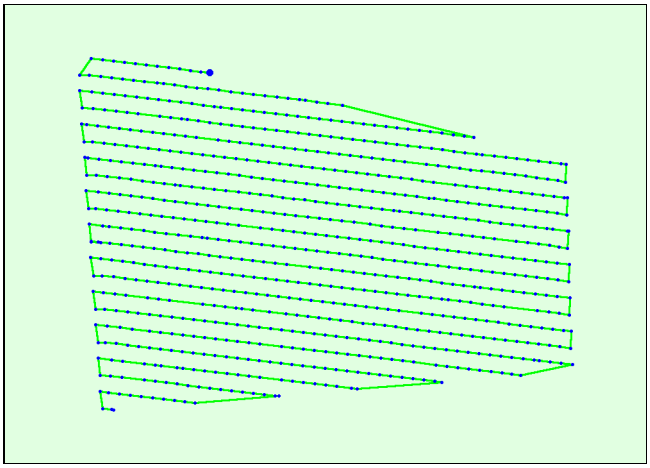


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions

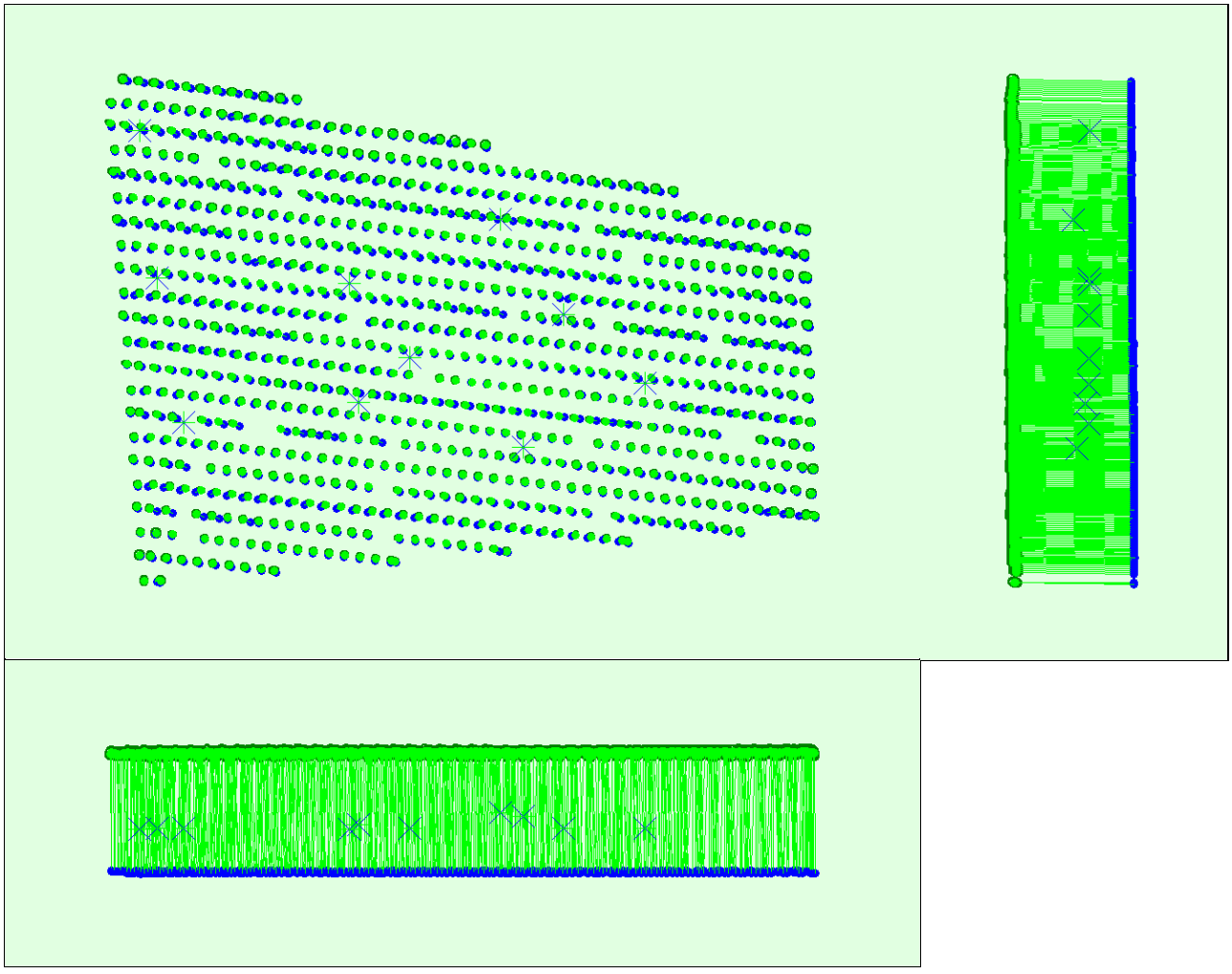


Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and their computed positions (green crosses) in the top-view (XY plane), front-view (XZ plane), and side-view (YZ plane). Dark green ellipses indicate the absolute position uncertainty of the bundle block adjustment result.

Absolute camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]

Mean	0.038	0.036	0.058	0.009	0.011	0.004
Sigma	0.003	0.003	0.004	0.003	0.003	0.001

Overlap

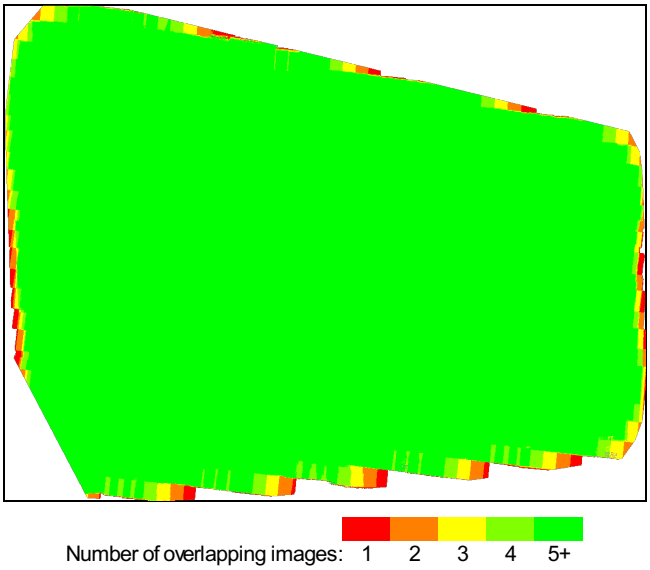


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint matches is also sufficient for these areas (see Figure 5 for keypoint matches).

Bundle Block Adjustment Details

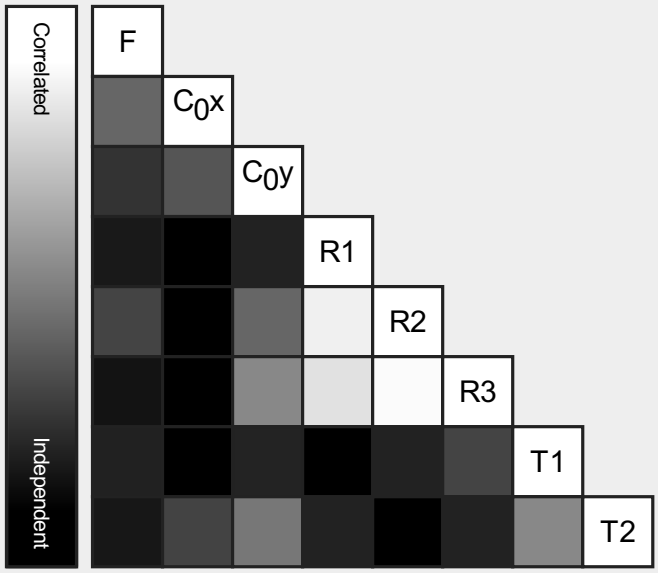
Number of 2D Keypoint Observations for Bundle Block Adjustment	12224999
Number of 3D Points for Bundle Block Adjustment	3980994
Mean Reprojection Error [pixels]	0.180

Internal Camera Parameters

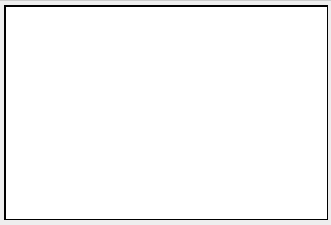
FC6310_8.8_5472x3648 (RGB). Sensor Dimensions: 12.833 [mm] x 8.556 [mm]

EXIF ID: FC6310_8.8_5472x3648

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	3668.759 [pixel] 8.604 [mm]	2736.001 [pixel] 6.417 [mm]	1823.999 [pixel] 4.278 [mm]	0.003	-0.008	0.008	-0.000	0.000
Optimized Values	3651.676 [pixel] 8.564 [mm]	2723.354 [pixel] 6.387 [mm]	1801.716 [pixel] 4.226 [mm]	-0.004	-0.006	0.006	-0.001	0.001
Uncertainties (Sigma)	2.774 [pixel] 0.007 [mm]	1.580 [pixel] 0.004 [mm]	1.701 [pixel] 0.004 [mm]	0.000	0.000	0.000	0.000	0.000



The correlation between camera internal parameters determined by the bundle adjustment. White indicates a full correlation between the parameters, ie. any change in one can be fully compensated by the other. Black indicates that the parameter is completely independent, and is not affected by other parameters.



The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the pixel location. Click on the image to the see the average direction and magnitude of the re-projection error for each pixel. Note that the vectors are scaled for better visualization. The scale bar indicates the magnitude of 1 pixel error.

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	35968	15733
Min	20039	1651
Max	89204	43508
Mean	40347	15795

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	2618566
In 3 Images	612910
In 4 Images	260041
In 5 Images	138755
In 6 Images	81901
In 7 Images	58057
In 8 Images	43908
In 9 Images	33271
In 10 Images	24858
In 11 Images	18692
In 12 Images	15831
In 13 Images	13223
In 14 Images	11547
In 15 Images	9712
In 16 Images	8733
In 17 Images	7113
In 18 Images	5959
In 19 Images	4793
In 20 Images	3783
In 21 Images	3057
In 22 Images	2652
In 23 Images	1901

In 24 Images	1109
In 25 Images	476
In 26 Images	111
In 27 Images	9
In 28 Images	16
In 29 Images	6
In 30 Images	4

2D Keypoint Matches

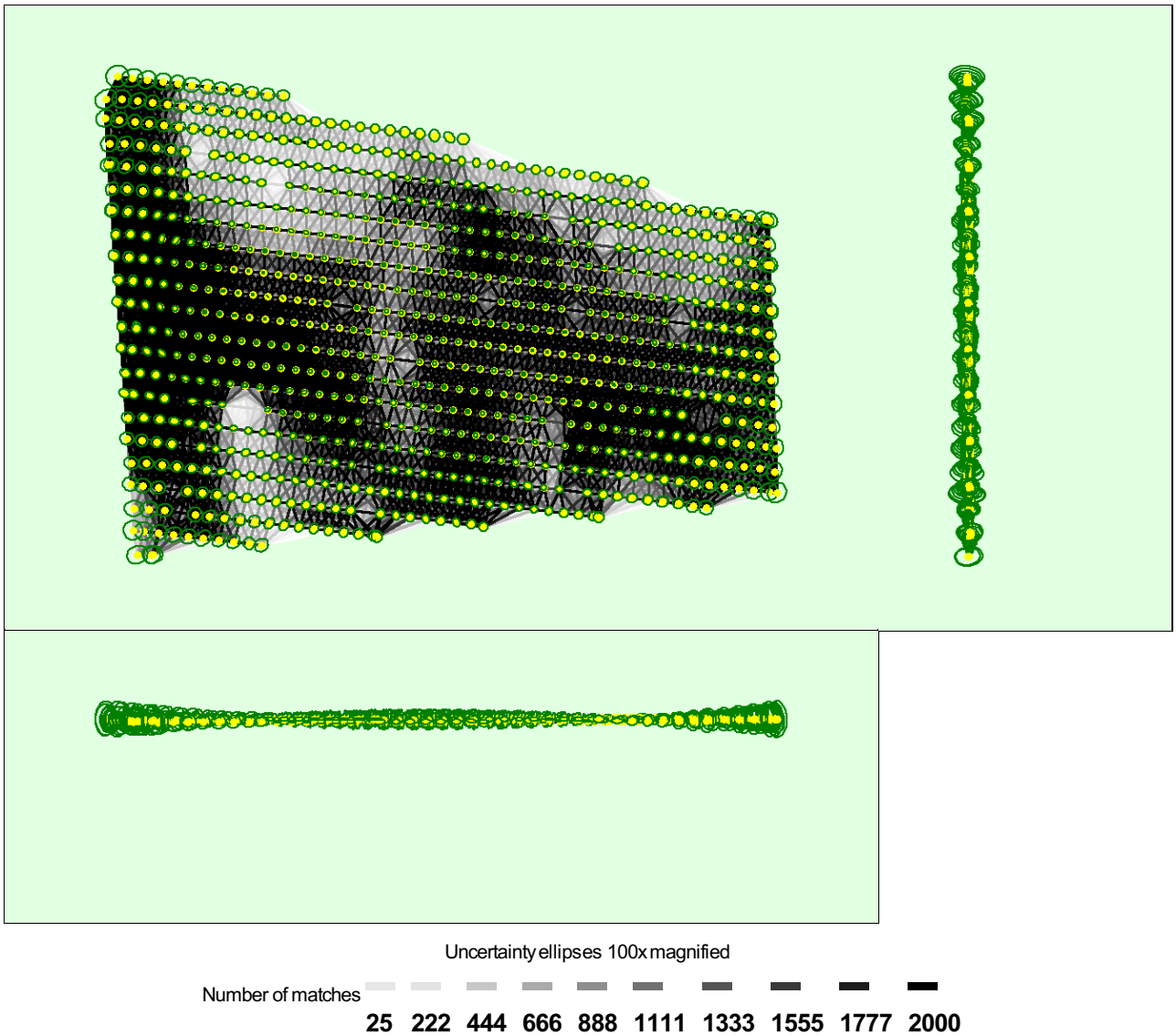


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty of the bundle block adjustment result.

Relative camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.042	0.041	0.058	0.023	0.036	0.018
Sigma	0.022	0.021	0.036	0.011	0.017	0.007

Geolocation Details

Ground Control Points

GCP Name	Accuracy XY/Z [m]	Error X [m]	Error Y [m]	Error Z [m]	Projection Error [pixel]	Verified/Marked
GCP02mtp21 (3D)	0.100/ 0.100	-0.023	0.014	0.036	0.159	23 / 23
GCP01mtp22 (3D)	0.100/ 0.100	-0.039	-0.028	-0.014	0.178	22 / 22
gcp03mtp23 (3D)	0.100/ 0.100	0.017	-0.041	-0.024	0.401	23 / 23
gcp08mtp25 (3D)	0.100/ 0.100	-0.003	0.045	0.051	0.362	23 / 23
gcp11mtp26 (3D)	0.100/ 0.100	-0.002	0.036	-0.052	0.318	16 / 16
gcp09mtp27 (3D)	0.100/ 0.100	-0.005	0.052	0.041	0.143	12 / 12
gcp05mtp28 (3D)	0.100/ 0.100	0.031	-0.140	-0.062	0.346	23 / 23
gcp07mtp31 (3D)	0.100/ 0.100	0.016	0.018	0.012	0.170	18 / 18
gcp06mtp38 (3D)	0.100/ 0.100	-0.020	0.061	0.038	0.433	17 / 17
gcp04mtp39 (3D)	0.100/ 0.100	0.030	-0.015	-0.026	0.368	18 / 18
Mean [m]		0.000131	-0.000001	-0.000018		
Sigma [m]		0.022028	0.056983	0.038812		
RMS Error [m]		0.022028	0.056983	0.038812		

0 out of 10 check points have been labeled as inaccurate.

Check Point Name	Accuracy XY/Z [m]	Error X [m]	Error Y [m]	Error Z [m]	Projection Error [pixel]	Verified/Marked
CKP10mtp24		0.0305	-0.0268	-0.1543	0.3269	15 / 15
ckp07mtp29		-0.0233	0.0035	-0.0806	0.3038	3 / 3
ckp04mtp30		-0.0340	-0.0121	0.0319	0.4507	16 / 16
ckp01mtp32		-0.0111	-0.0845	0.0019	0.1971	18 / 18
ckp09mtp33		-0.0498	-0.0693	-0.1248	0.6366	23 / 23
ckp08mtp34		-0.0436	-0.0514	0.0487	0.6196	22 / 22
ckp02mtp35		0.0252	-0.1044	0.1374	0.1941	20 / 20
ckp05mtp36		-0.0110	0.0720	-0.0294	0.1509	16 / 16
ckp03mtp37		-0.0385	0.0348	0.0491	0.2123	22 / 22
ckp06mtp40		0.0025	-0.0058	-0.0453	0.3776	7 / 7
Mean [m]		-0.015310	-0.024411	-0.016521		
Sigma [m]		0.026523	0.051791	0.084099		
RMS Error [m]		0.030625	0.057256	0.085706		

Localisation accuracy per GCP and mean errors in the three coordinate directions. The last column counts the number of calibrated images where the GCP has been automatically verified vs. manually marked.

Absolute Geolocation Variance

Min Error [m]	Max Error [m]	Geolocation Error X [%]	Geolocation Error Y [%]	Geolocation Error Z [%]
-	-15.00	0.00	0.00	0.00
-15.00	-12.00	0.00	0.00	0.00
-12.00	-9.00	0.00	0.00	0.00
-9.00	-6.00	6.07	0.00	0.00
-6.00	-3.00	17.96	0.00	0.00
-3.00	0.00	26.10	47.29	52.97
0.00	3.00	26.87	52.71	46.38
3.00	6.00	16.80	0.00	0.65
6.00	9.00	6.20	0.00	0.00
9.00	12.00	0.00	0.00	0.00
12.00	15.00	0.00	0.00	0.00
15.00	-	0.00	0.00	0.00
Mean [m]		0.572638	-1.980091	-120.663896
Sigma [m]		3.723474	0.924995	1.542950
RMS Error [m]		3.767250	2.185492	120.673760

Min Error and Max Error represent geolocation error intervals between -1.5 and 1.5 times the maximum accuracy of all the images. Columns X, Y, Z show the percentage of images with geolocation errors within the predefined error intervals. The geolocation error is the difference between the initial and computed image positions. Note that the image geolocation errors do not correspond to the accuracy of the observed 3D points.

Geolocation Bias	X	Y	Z
Translation [m]	0.572638	-1.980091	-120.663896

Bias between image initial and computed geolocation given in output coordinate system.

Relative Geolocation Variance

Relative Geolocation Error	Images X [%]	Images Y [%]	Images Z [%]
[-1.00, 1.00]	77.78	100.00	100.00
[-2.00, 2.00]	100.00	100.00	100.00
[-3.00, 3.00]	100.00	100.00	100.00
Mean of Geolocation Accuracy [m]	5.000000	5.000000	10.000000
Sigma of Geolocation Accuracy [m]	0.000000	0.000000	0.000000

Images X, Y, Z represent the percentage of images with a relative geolocation error in X, Y, Z.

Geolocation Orientational Variance	RMS [degree]
Omega	0.218
Phi	0.278
Kappa	1.832

Geolocation RMS error of the orientation angles given by the difference between the initial and computed image orientation angles.

Initial Processing Details

System Information

Hardware	CPU: Intel(R) Core(TM) i7-3930K CPU @ 3.20GHz RAM: 32GB GPU: NVIDIA GeForce GTX 1060 3GB (Driver: 24.21.13.9811)
Operating System	Windows 10 Pro, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84 (EGM96 Geoid)
Ground Control Point (GCP) Coordinate System	WGS 84 (EGM96 Geoid)
Output Coordinate System	WGS 84 / UTM zone 52N (EGM96 Geoid)

Processing Options

Detected Template	3D Maps
Keypoints Image Scale	Full, Image Scale: 1
Advanced: Matching Image Pairs	Aerial Grid or Corridor
Advanced: Matching Strategy	Use Geometrically Verified Matching: no
Advanced: Keypoint Extraction	Targeted Number of Keypoints: Automatic
Advanced: Calibration	Calibration Method: Standard Internal Parameters Optimization: All External Parameters Optimization: All Rematch: Auto, no

Point Cloud Densification details

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: no
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	04h:25m:53s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	37m:44s

Results

Number of Processed Clusters	2
Number of Generated Tiles	5
Number of 3D Densified Points	98125334
Average Density (per m^3)	268.23

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (2.11 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Sharp
Raster DSM	Generated: yes Method: Inverse Distance Weighting Merge Tiles: yes
Orthomosaic	Generated: yes Merge Tiles: yes GeoTIFF Without Transparency: no Google Maps Tiles and KML: no
Time for DSM Generation	55m:15s
Time for Orthomosaic Generation	01h:49m:53s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s