Quality Report

Generated with Pix4Dmapper version 4.6.4

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	濁水溪鐵橋
Processed	2021-06-13 17:36:46
Camera Model Name(s)	ZenmuseP1_35.0_8192x5460 (RGB)
Average Ground Sampling Distance (GSD)	2.49 cm / 0.98 in
Area Covered	1.304 km^2 / 130.3680 ha / 0.50 sq. mi. / 322.3132 acres
Time for Initial Processing (without report)	16m:04s

Quality Check

Images	median of 29703 keypoints per image	✓
Dataset	703 out of 703 images calibrated (100%), all images enabled	✓
Camera Optimization	0% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 8648.12 matches per calibrated image	✓
Georeferencing	yes, 5 GCPs (5 3D), mean RMS error = 0.016 m	✓

Preview

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

Calibration Details

Number of Calibrated Images	703 out of 703
Number of Geolocated Images	703 out of 703

Initial Image Positions

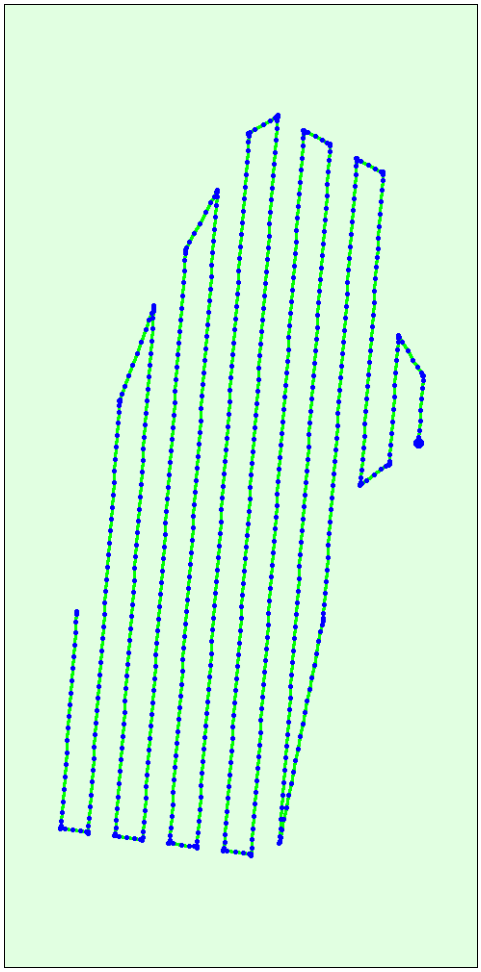


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions

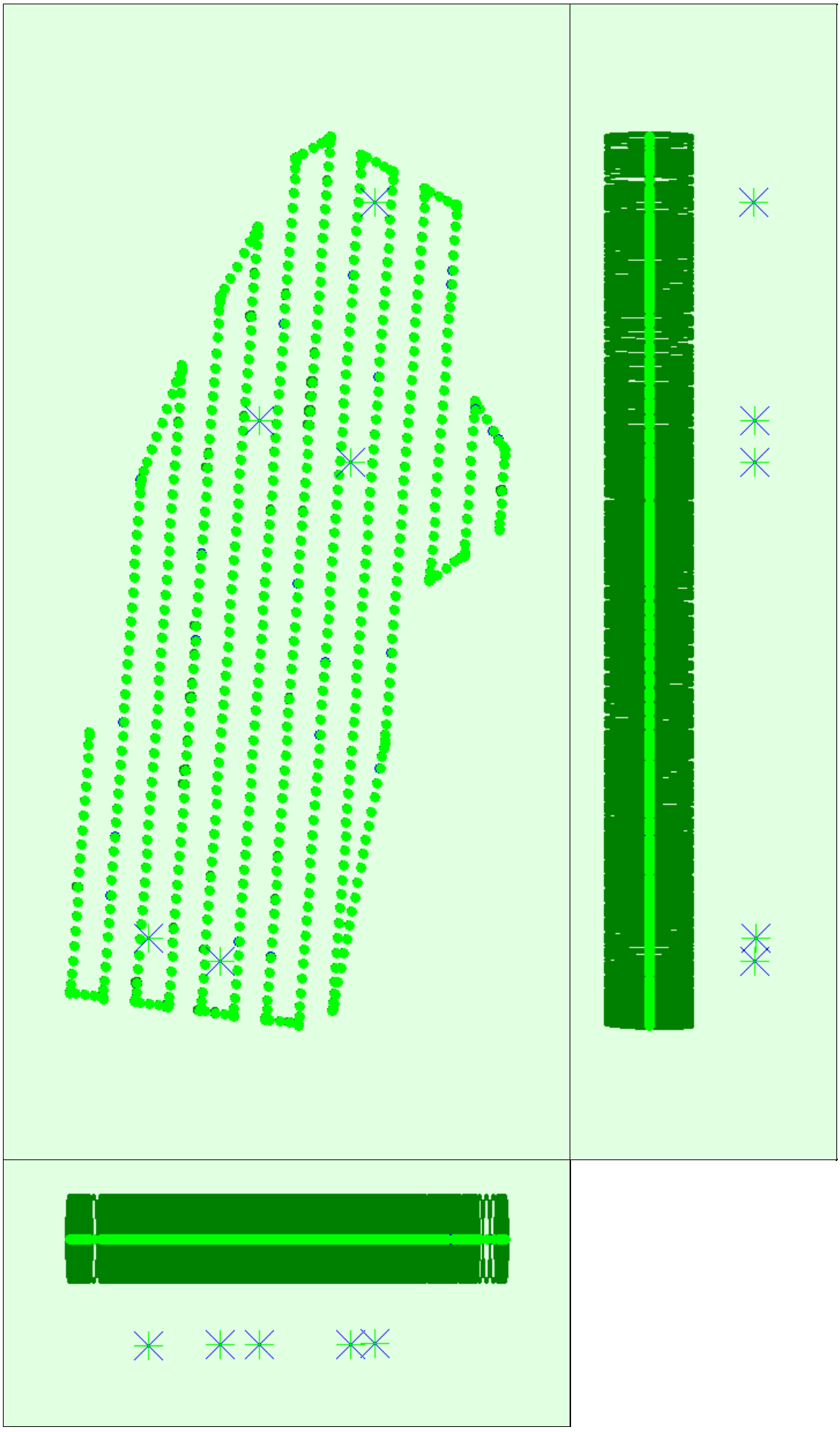


Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and

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	0.006	0.006	0.082	0.002	0.003	0.003
Sigma	0.000	0.000	0.000	0.000	0.000	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

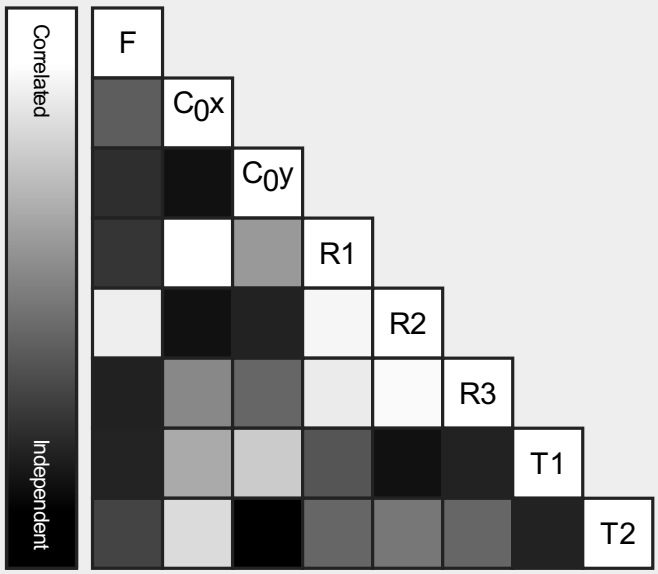
Number of 2D Keypoint Observations for Bundle Block Adjustment	6472084
Number of 3D Points for Bundle Block Adjustment	2038115
Mean Reprojection Error [pixels]	0.082

Internal Camera Parameters

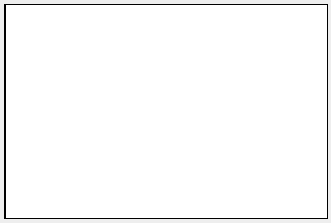
ZenmuseP1_35.0_8192x5460 (RGB). Sensor Dimensions: 35.000 [mm] x 23.328 [mm]

EXIF ID: ZenmuseP1_35.0_8192x5460

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	8194.340 [pixel] 35.010 [mm]	4096.001 [pixel] 17.500 [mm]	2729.996 [pixel] 11.664 [mm]	-0.048	0.021	-0.097	0.002	-0.001
Optimized Values	8194.193 [pixel] 35.009 [mm]	4091.358 [pixel] 17.480 [mm]	2770.756 [pixel] 11.838 [mm]	-0.049	0.025	-0.107	0.002	-0.001
Uncertainties (Sigma)	3.367 [pixel] 0.014 [mm]	0.223 [pixel] 0.001 [mm]	0.154 [pixel] 0.001 [mm]	0.000	0.001	0.002	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	29703	8648
Min	13014	1046
Max	43237	24494
Mean	29702	9206

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	1117462
In 3 Images	418841
In 4 Images	203793
In 5 Images	110498
In 6 Images	58861
In 7 Images	37665
In 8 Images	25092
In 9 Images	17271
In 10 Images	12310
In 11 Images	8010
In 12 Images	6364
In 13 Images	4969
In 14 Images	4221
In 15 Images	3450
In 16 Images	2029

In 17 Images	1685
In 18 Images	1354
In 19 Images	1101
In 20 Images	893
In 21 Images	566
In 22 Images	453
In 23 Images	314
In 24 Images	258
In 25 Images	219
In 26 Images	168
In 27 Images	117
In 28 Images	59
In 29 Images	36
In 30 Images	26
In 31 Images	16
In 32 Images	4
In 33 Images	8
In 34 Images	2

2D Keypoint Matches

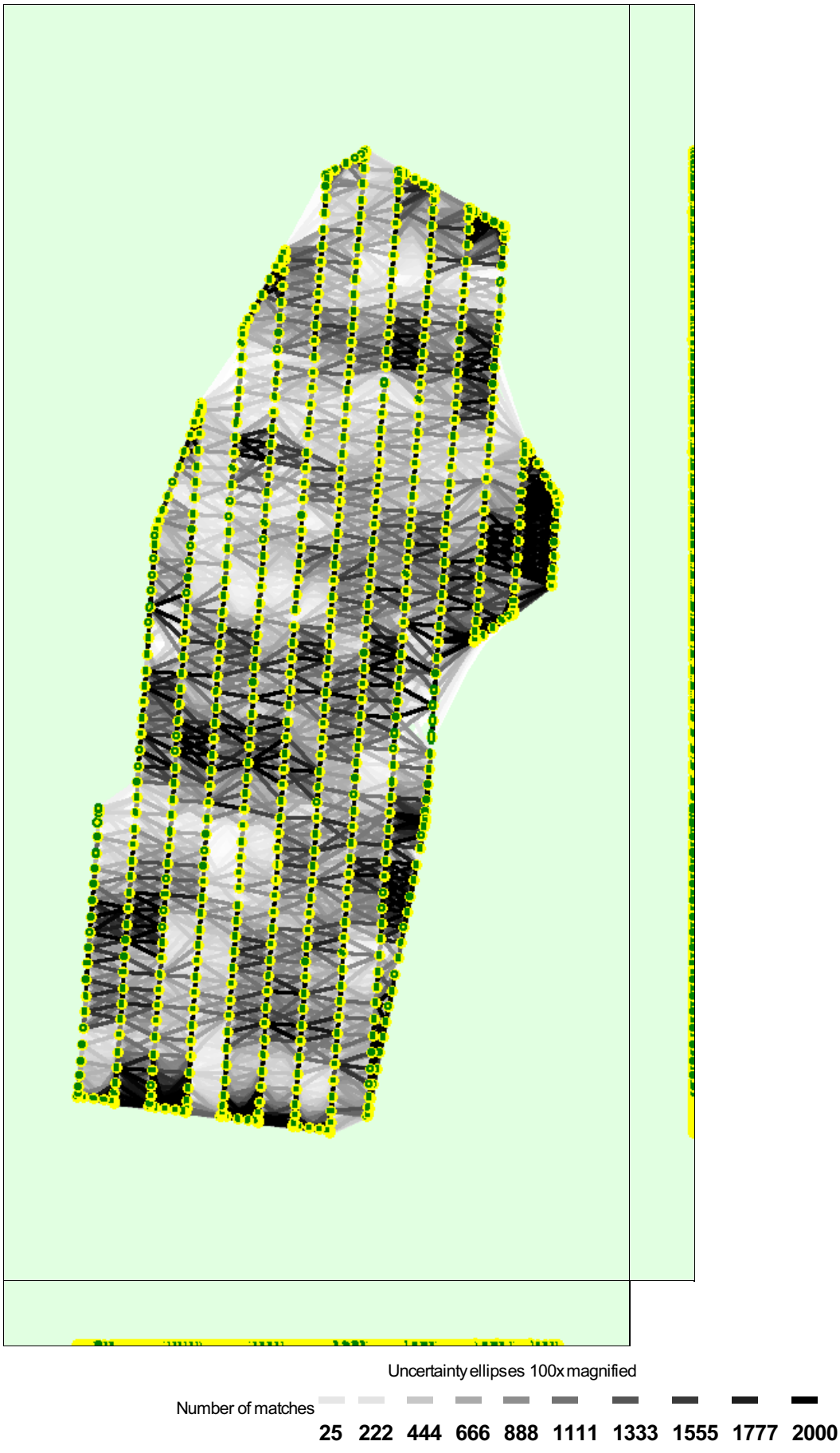


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty 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	0.027	0.037	0.019	0.010	0.008	0.003
Sigma	0.005	0.007	0.004	0.002	0.002	0.001

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
ZS01 (3D)	0.020/ 0.020	-0.007	0.001	-0.009	0.707	13 / 13
ZS02 (3D)	0.020/ 0.020	0.015	-0.012	-0.030	0.615	11 / 12
ZS03 (3D)	0.020/ 0.020	0.002	0.013	-0.006	0.452	16 / 16
ZS04 (3D)	0.020/ 0.020	-0.008	-0.014	0.044	0.466	13 / 13
ZS05 (3D)	0.020/ 0.020	0.001	0.016	0.033	1.952	4 / 4
Mean [m]		0.000610	0.001048	0.006288		
Sigma [m]		0.008312	0.012468	0.027795		
RMS Error [m]		0.008335	0.012512	0.028497		

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 [%]
-	-0.05	0.00	0.00	0.00
-0.05	-0.04	0.00	0.00	0.00
-0.04	-0.03	0.00	0.00	0.00
-0.03	-0.02	0.00	0.00	0.28
-0.02	-0.01	0.00	0.00	11.38
-0.01	0.00	51.49	50.21	42.82
0.00	0.01	48.51	49.79	30.58
0.01	0.02	0.00	0.00	12.23
0.02	0.03	0.00	0.00	1.99
0.03	0.04	0.00	0.00	0.71
0.04	0.05	0.00	0.00	0.00
0.05	-	0.00	0.00	0.00
Mean [m]		-0.043816	0.019063	0.266811
Sigma [m]		0.001155	0.000757	0.010291
RMS Error [m]		0.043831	0.019078	0.267010

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]	-0.043851	0.019063	0.266518

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]	100.00	100.00	98.15
[-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]	0.012963	0.012963	0.024606
Sigma of Geolocation Accuracy [m]	0.000824	0.000824	0.001720

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

Geolocation Orientational Variance	RMS [degree]
Omega	130.141
Phi	2.565
Kappa	36.398

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: AMD Ryzen 7 3700X 8-Core Processor RAM: 32GB GPU: NVIDIA GeForce RTX 2060 (Driver: 27.21.14.6230)
Operating System	Windows 10 Home, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84
Ground Control Point (GCP) Coordinate System	TWD97 / TM2 zone 121
Output Coordinate System	TWD97 / TM2 zone 121

Processing Options

Detected Template	3D Maps
Keypoints Image Scale	Full, Image Scale: 0.5
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	03h:02m:08s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	30m:16s

Results

Number of Processed Clusters	3
Number of Generated Tiles	8
Number of 3D Densified Points	192733238
Average Density (per m^3)	182.93

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	5 [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: yes
Time for DSM Generation	13m:50s
Time for Orthomosaic Generation	02h:07m:52s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s