Quality Report

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	40m_att5
Processed	2020-11-04 09:29:33
Camera Model Name(s)	FC6360_5.7_1600x1300 (Blue), FC6360_5.7_1600x1300 (Green), FC6360_5.7_1600x1300 (Red), FC6360_5.7_1600x1300 (Red edge), FC6360_5.7_1600x1300 (NIR), FC6360_5.7_1600x1300 (RGB)
Rig name(s)	«FC6360»
Average Ground Sampling Distance (GSD)	2.36 cm / 0.93 in
Time for Initial Processing (without report)	16m:03s

Quality Check

Images	median of 477 keypoints per image	⚠
Dataset	828 out of 828 images calibrated (100%), all images enabled	✓
Camera Optimization	47.65% relative difference between initial and optimized internal camera parameters	⚠
Matching	median of 204.494 matches per calibrated image	✓
Georeferencing	yes, no 3D GCP	⚠

Calibration Details

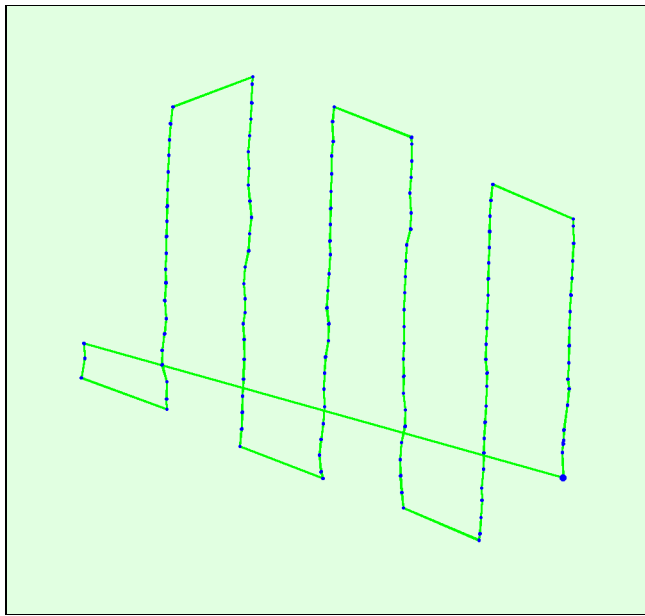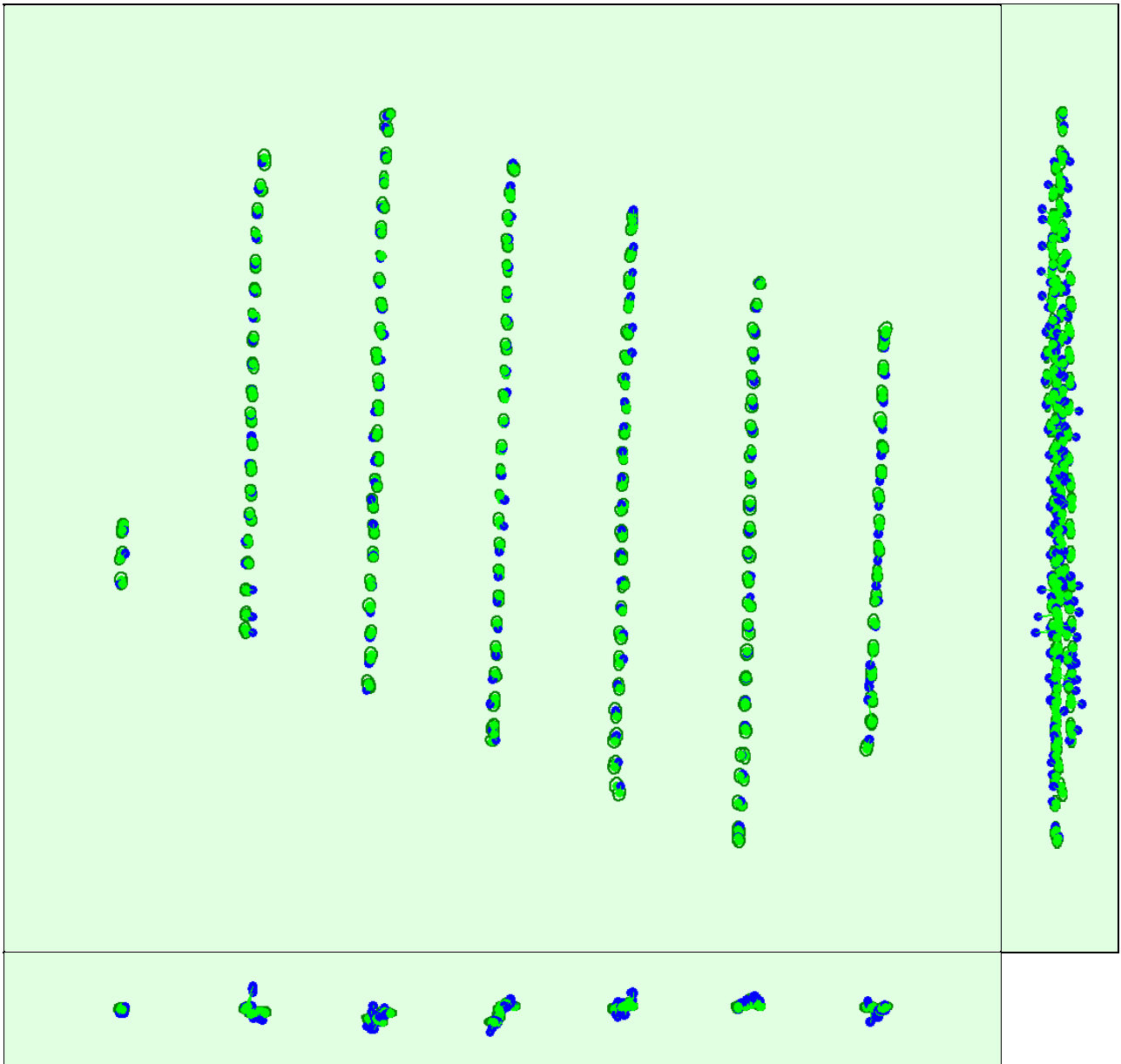|	
Number of Calibrated Images	828 out of 828
Number of Geolocated Images	828 out of 828

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

Uncertainty ellipses 5x magnified

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	0.105	0.123	0.078	0.132	0.120	0.054
Sigma	0.015	0.019	0.005	0.017	0.016	0.001

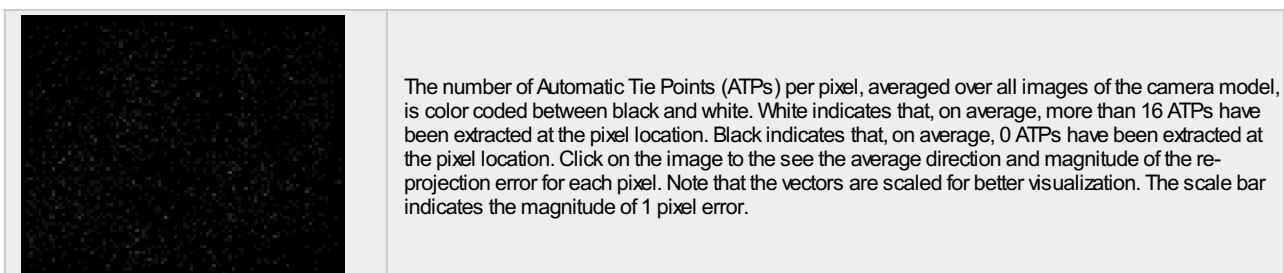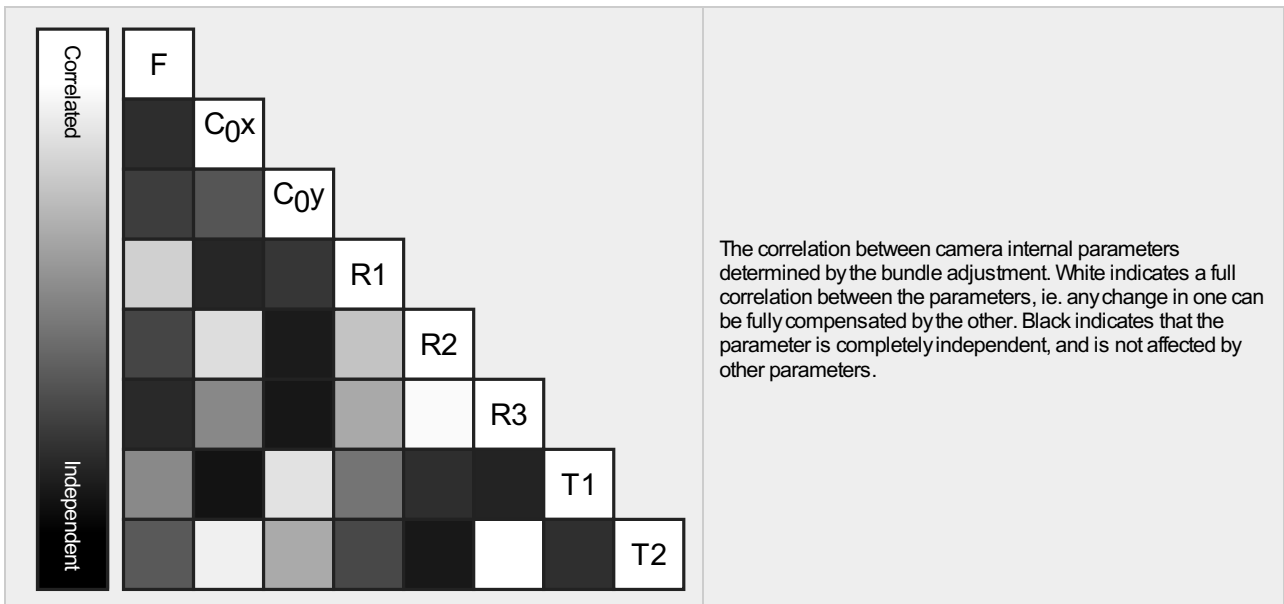# Bundle Block Adjustment Details

Number of 2D Keypoint Observations for Bundle Block Adjustment	65130
Number of 3D Points for Bundle Block Adjustment	15242
Mean Reprojection Error [pixels]	0.099

Internal Camera Parameters

📄 FC6360_5.7_1600x1300 (Blue). Sensor Dimensions: 5.022 [mm] x 4.081 [mm]

EXIF ID: FC6360_5.7_1600x1300

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1828.571 [pixel] 5.740 [mm]	755.798 [pixel] 2.372 [mm]	617.107 [pixel] 1.937 [mm]	-0.410	0.348	-0.365	0.001	0.001
Optimized Values	2790.159 [pixel] 8.758 [mm]	770.546 [pixel] 2.419 [mm]	618.151 [pixel] 1.940 [mm]	-0.843	1.280	-2.196	0.009	0.004
Uncertainties (Sigma)	49.044 [pixel] 0.154 [mm]	4.871 [pixel] 0.015 [mm]	4.224 [pixel] 0.013 [mm]	0.037	0.351	1.568	0.001	0.001

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.
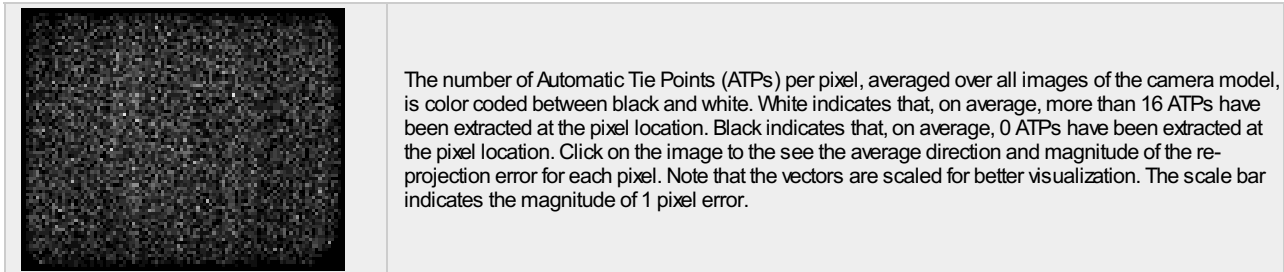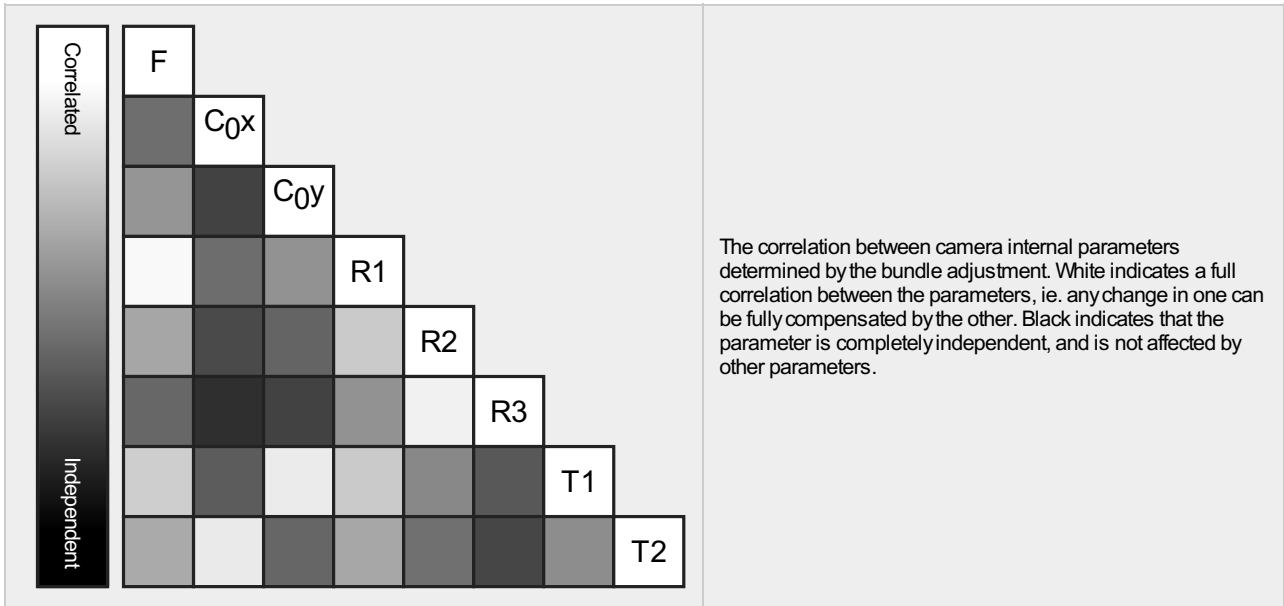
ⓘ Internal Camera Parameters

📄 **FC6360_5.7_1600x1300 (Green). Sensor Dimensions: 5.022 [mm] x 4.081 [mm]** ⓘ

    EXIF ID: FC6360_5.7_1600x1300

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1828.571 [pixel] 5.740 [mm]	756.658 [pixel] 2.375 [mm]	617.126 [pixel] 1.937 [mm]	-0.409	0.333	-0.309	0.001	0.001
Optimized Values	2780.387 [pixel] 8.728 [mm]	771.674 [pixel] 2.422 [mm]	594.076 [pixel] 1.865 [mm]	-0.846	1.225	-1.795	0.007	0.005
Uncertainties (Sigma)	48.856 [pixel] 0.153 [mm]	2.041 [pixel] 0.006 [mm]	2.224 [pixel] 0.007 [mm]	0.030	0.136	0.515	0.001	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.
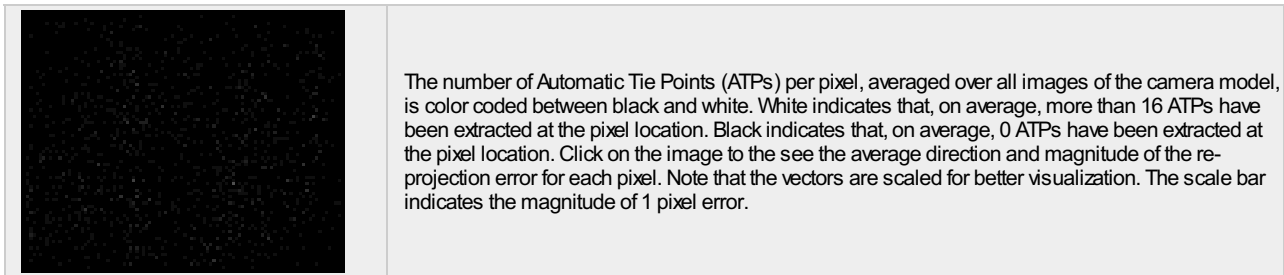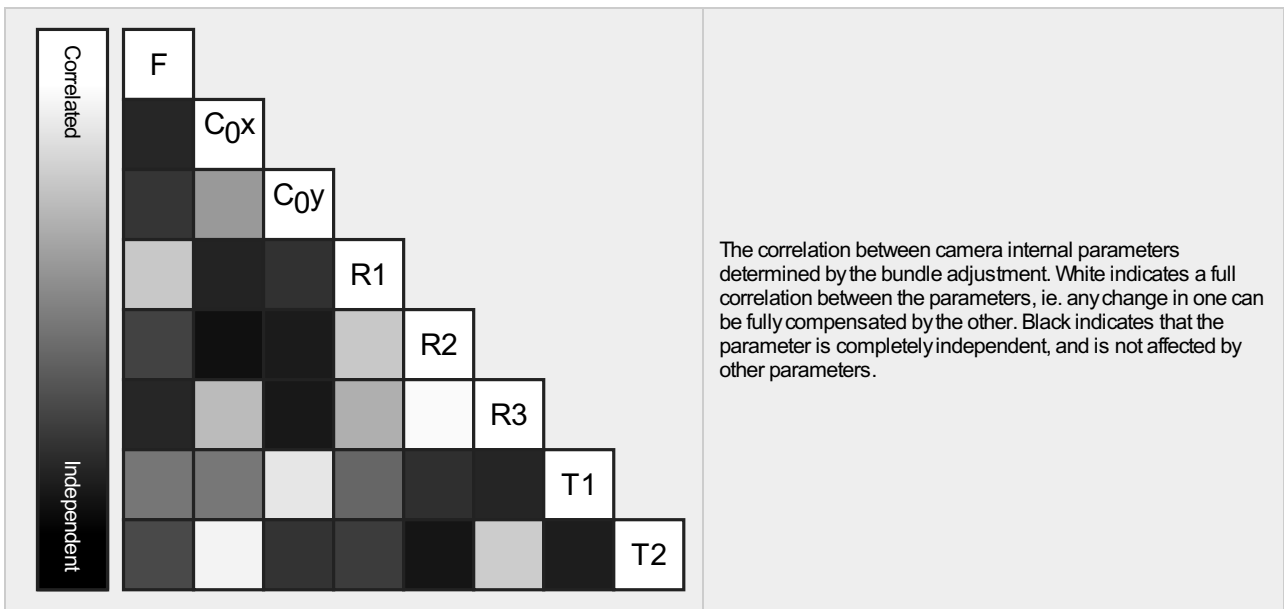
ⓘ Internal Camera Parameters

📄 **FC6360_5.7_1600x1300 (Red). Sensor Dimensions: 5.022 [mm] x 4.081 [mm]** ⓘ

    EXIF ID: FC6360_5.7_1600x1300

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1828.571 [pixel] 5.740 [mm]	756.323 [pixel] 2.374 [mm]	617.463 [pixel] 1.938 [mm]	-0.412	0.372	-0.425	0.001	0.001
Optimized Values	2787.087 [pixel] 8.749 [mm]	772.326 [pixel] 2.424 [mm]	622.349 [pixel] 1.954 [mm]	-0.845	1.327	-2.098	0.007	0.003
Uncertainties (Sigma)	49.006 [pixel] 0.154 [mm]	5.888 [pixel] 0.018 [mm]	4.954 [pixel] 0.016 [mm]	0.038	0.392	1.736	0.001	0.001

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.
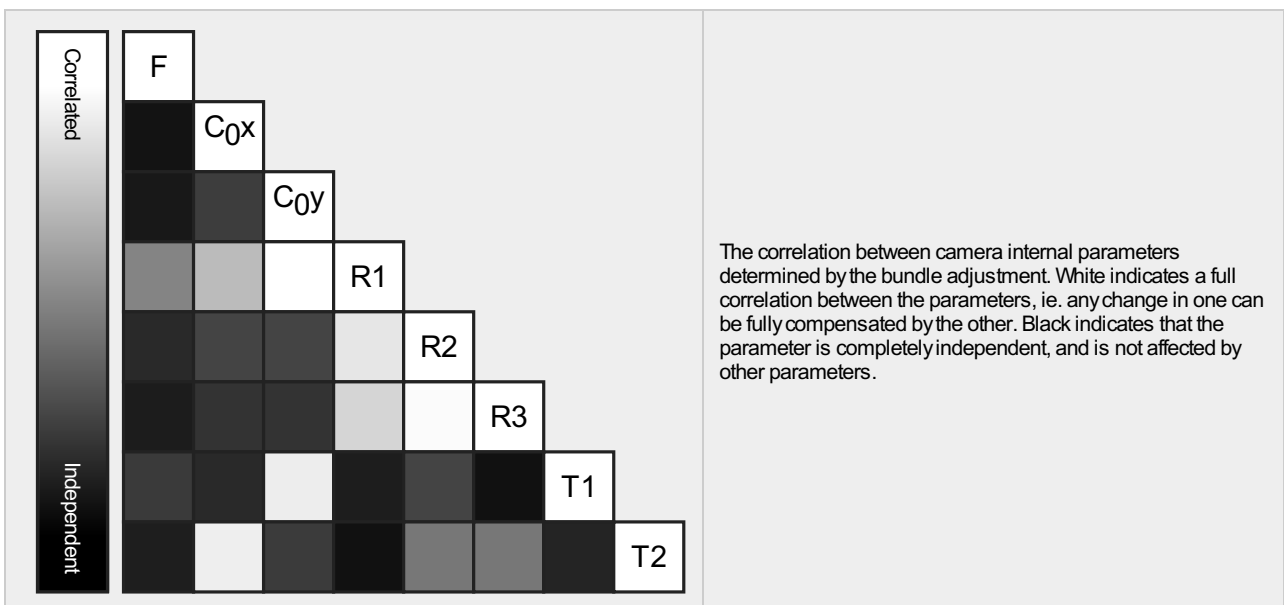
Internal Camera Parameters

FC6360_5.7_1600x1300 (Red edge). Sensor Dimensions: 5.022 [mm] x 4.081 [mm]

EXIF ID: FC6360_5.7_1600x1300

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1828.571 [pixel] 5.740 [mm]	755.613 [pixel] 2.372 [mm]	617.364 [pixel] 1.938 [mm]	-0.406	0.310	-0.258	0.001	0.001
Optimized Values	2751.136 [pixel] 8.636 [mm]	765.215 [pixel] 2.402 [mm]	614.199 [pixel] 1.928 [mm]	-0.816	1.122	-1.717	0.004	0.003
Uncertainties (Sigma)	49.047 [pixel] 0.154 [mm]	14.001 [pixel] 0.044 [mm]	15.250 [pixel] 0.048 [mm]	0.063	0.773	3.236	0.002	0.003

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.
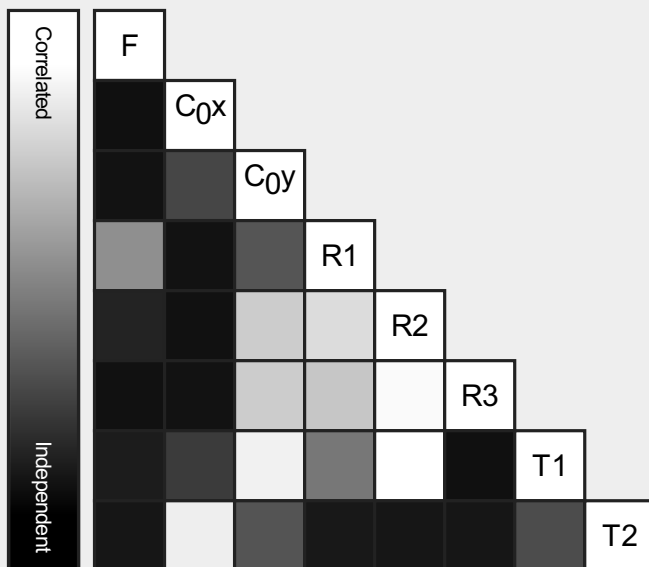
⑦ Internal Camera Parameters

🗎 FC6360_5.7_1600x1300 (NIR). Sensor Dimensions: 5.022 [mm] x 4.081 [mm] ⓘ

EXIF ID: FC6360_5.7_1600x1300

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1828.571 [pixel] 5.740 [mm]	755.238 [pixel] 2.371 [mm]	618.263 [pixel] 1.941 [mm]	-0.406	0.326	-0.312	0.001	0.001
Optimized Values	2752.753 [pixel] 8.641 [mm]	774.198 [pixel] 2.430 [mm]	635.551 [pixel] 1.995 [mm]	-0.789	0.858	-0.802	0.008	0.002
Uncertainties (Sigma)	49.373 [pixel] 0.155 [mm]	13.448 [pixel] 0.042 [mm]	25.514 [pixel] 0.080 [mm]	0.055	0.672	2.924	0.005	0.003

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.
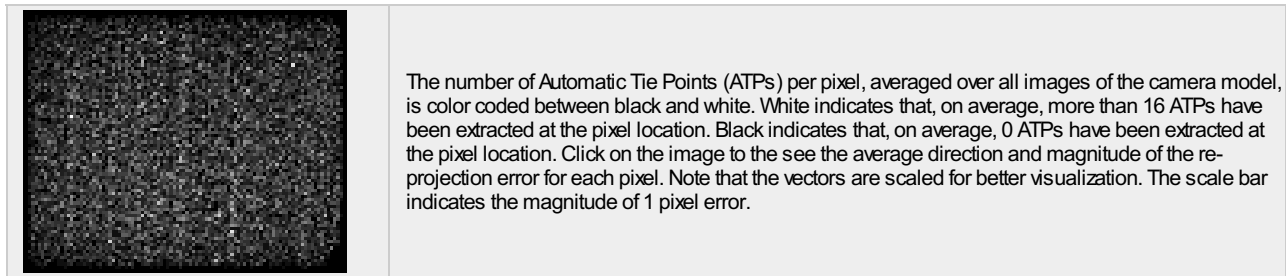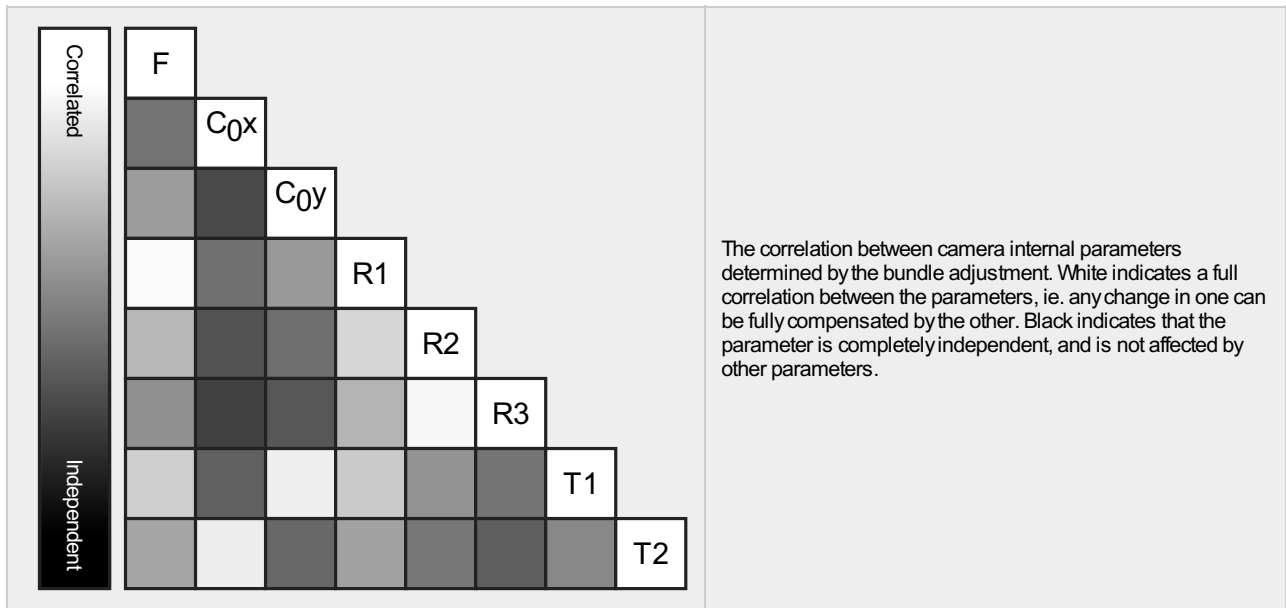
⑦ Internal Camera Parameters

🖥 FC6360_5.7_1600x1300 (RGB). Sensor Dimensions: 5.022 [mm] x 4.081 [mm] ⓘ

EXIF ID: FC6360_5.7_1600x1300

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	2173.920 [pixel] 6.824 [mm]	780.964 [pixel] 2.451 [mm]	639.519 [pixel] 2.007 [mm]	-0.511	0.507	-0.546	0.000	0.000
Optimized Values	2780.122 [pixel] 8.727 [mm]	772.657 [pixel] 2.425 [mm]	621.102 [pixel] 1.950 [mm]	-0.845	1.423	-2.820	0.006	0.004

Uncertainties (Sigma)	48.952 [pixel] 0.154 [mm]	2.037 [pixel] 0.006 [mm]	2.264 [pixel] 0.007 [mm]	0.030	0.139	0.534	0.001	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.

Camera Rig «FC6360» Relatives. Images: 690

	Transl X [m]	Transl Y [m]	Transl Z [m]	Rot X [degree]	Rot Y [degree]	Rot Z [degree]
FC6360_5.7_1600x1300 (Green)	Reference Camera					
FC6360_5.7_1600x1300 (Blue)						
Initial Values	0.000	0.016	0.000	0.000	0.000	0.000
Optimized values	0.000	0.016	0.000	-0.244	0.063	0.009
Uncertainties (sigma)				0.083	0.100	0.006
FC6360_5.7_1600x1300 (Red)						
Initial Values	0.016	0.016	0.000	0.000	0.000	0.000
Optimized values	0.016	0.016	0.000	-0.235	0.062	-0.019
Uncertainties (sigma)				0.099	0.121	0.006
FC6360_5.7_1600x1300 (Red edge)						
Initial Values	0.032	0.000	0.000	0.000	0.000	0.000
Optimized values	0.032	0.000	0.000	-0.054	-0.023	0.020
Uncertainties (sigma)				0.323	0.293	0.012
FC6360_5.7_1600x1300 (NIR)						
Initial Values	0.016	0.000	0.000	0.000	0.000	0.000
Optimized values	0.016	0.000	0.000	-0.370	-0.078	-0.012
Uncertainties (sigma)				0.330	0.274	0.014

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	477	204
Min	355	0
Max	643	316
Mean	477	196

2D Keypoints Table for Camera FC6360_5.7_1600x1300 (Blue)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	514	158
Min	481	116
Max	643	203
Mean	525	164

2D Keypoints Table for Camera FC6360_5.7_1600x1300 (Green)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	468	198
Min	362	136
Max	603	288
Mean	472	203

2D Keypoints Table for Camera FC6360_5.7_1600x1300 (Red)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	418	115
Min	372	92
Max	521	151
Mean	431	116

2D Keypoints Table for Camera FC6360_5.7_1600x1300 (Red edge)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	429	75
Min	398	0
Max	499	164
Mean	431	64

2D Keypoints Table for Camera FC6360_5.7_1600x1300 (NIR)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	488	64
Min	429	0
Max	534	218
Mean	479	78

2D Keypoints Table for Camera FC6360_5.7_1600x1300 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	485	224
Min	355	124
Max	613	316
Mean	485	226

Median / 75%/ Maximal Number of Matches Between Camera Models

	FC6360_5.7_160... (Blue)	FC6360_5.7_16... (Green)	FC6360_5.7_1600... (Red)	FC6360_5.7... (Red edge)	FC6360_5.7_1600... (NIR)	FC6360_5.7_1600... (RGB)
FC6360_5.7_1600x1300 (Blue)	12 / 31 / 113	6 / 15 / 73	16 / 25 / 88	(n/a) / (n/a) / 2		5 / 11 / 61
FC6360_5.7_1600x1300 (Green)		9 / 24 / 192	5 / 11 / 66	1 / 2 / 2		7 / 18 / 111
FC6360_5.7_1600x1300 (Red)			11 / 23 / 63	(n/a) / (n/a) / 2		4 / 8 / 46
FC6360_5.7_1600x1300 (Red edge)				5 / 15 / 130	(n/a) / (n/a) / 17	1 / 2 / 2

				3 / 27 / 183	
FC6360_5.7_1600x1300 (NIR)				3 / 27 / 183	
FC6360_5.7_1600x1300 (RGB)					14 / 33 / 193

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	7505
In 3 Images	2787
In 4 Images	1512
In 5 Images	813
In 6 Images	577
In 7 Images	379
In 8 Images	301
In 9 Images	188
In 10 Images	165
In 11 Images	125
In 12 Images	109
In 13 Images	78
In 14 Images	94
In 15 Images	63
In 16 Images	57
In 17 Images	52
In 18 Images	42
In 19 Images	36
In 20 Images	35
In 21 Images	30
In 22 Images	27
In 23 Images	21
In 24 Images	27
In 25 Images	18
In 26 Images	14
In 27 Images	16
In 28 Images	17
In 29 Images	19
In 30 Images	17
In 31 Images	7
In 32 Images	8
In 33 Images	9
In 34 Images	8
In 35 Images	12
In 36 Images	9
In 37 Images	3
In 38 Images	4
In 39 Images	6
In 40 Images	6
In 41 Images	6
In 42 Images	4
In 43 Images	2
In 44 Images	6
In 45 Images	3
In 46 Images	2
In 47 Images	3
In 48 Images	2
In 50 Images	3
In 51 Images	2
In 52 Images	1
In 53 Images	1

In 54 Images	1
In 55 Images	3
In 56 Images	2
In 58 Images	1
In 60 Images	1
In 62 Images	1
In 64 Images	1
In 66 Images	1

2D Keypoint Matches

Uncertainty ellipses 5x magnified

Number of matches
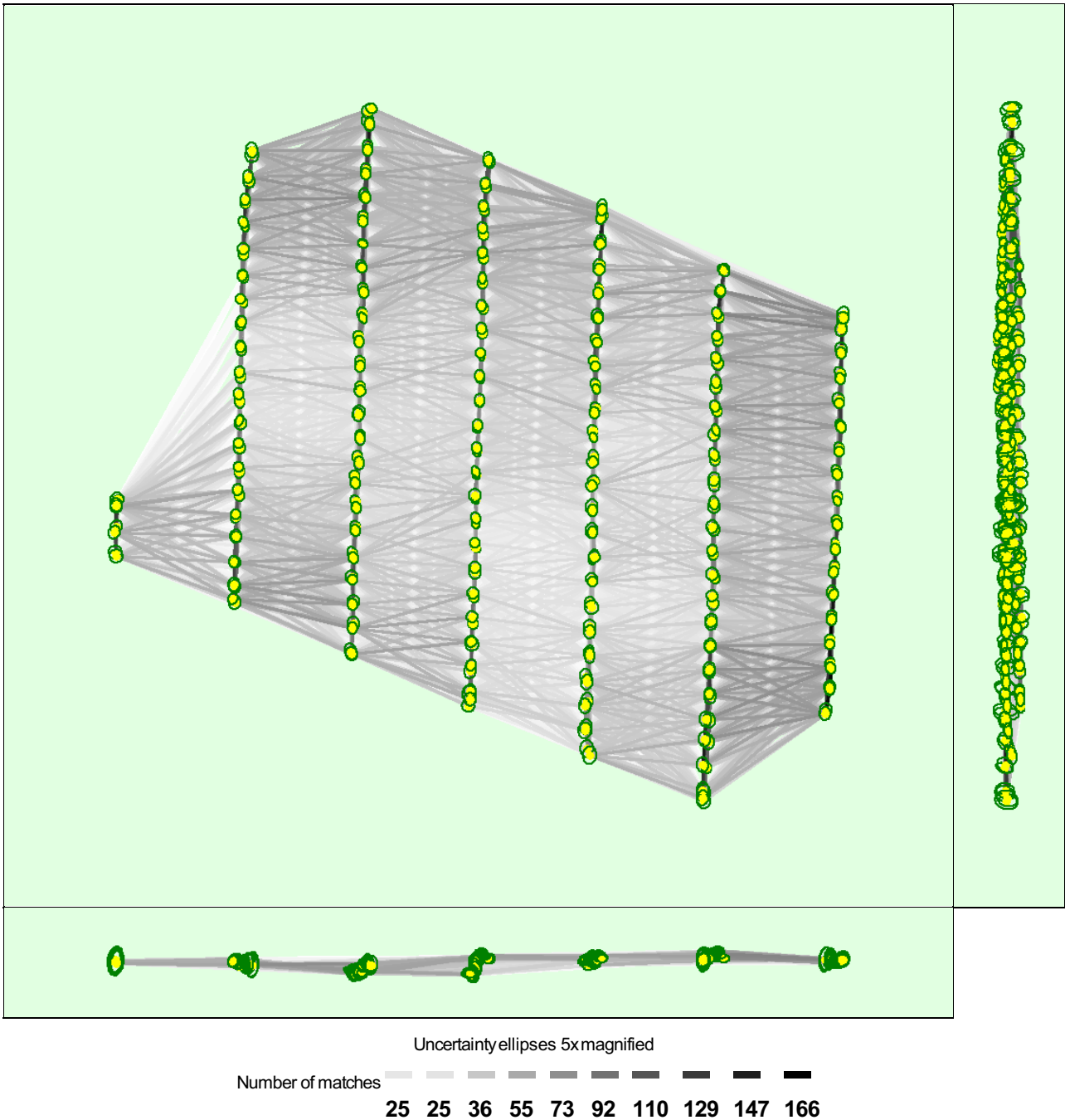
25   25   36   55   73   92   110   129   147   166

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	0.114	0.133	0.140	0.407	0.496	0.037
Sigma	0.017	0.022	0.053	0.236	0.291	0.005

Geolocation Details

Absolute Geolocation Variance

Min Error [m]	Max Error [m]	Geolocation Error X [%]	Geolocation Error Y [%]	Geolocation Error Z [%]
-	-3.49	0.00	0.00	0.00
-3.49	-2.79	0.00	0.00	0.00
-2.79	-2.09	0.00	0.00	0.00
-2.09	-1.39	0.00	1.93	1.45
-1.39	-0.70	0.00	9.06	17.39
-0.70	0.00	57.00	36.11	32.97
0.00	0.70	42.87	44.69	36.59
0.70	1.39	0.12	7.37	8.57
1.39	2.09	0.00	0.12	1.57
2.09	2.79	0.00	0.72	1.45
2.79	3.49	0.00	0.00	0.00
3.49	-	0.00	0.00	0.00
Mean [m]		-0.012712	-0.005821	-0.022761
Sigma [m]		0.235741	0.597340	0.680808
RMS Error [m]		0.236083	0.597369	0.681189

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.

Relative Geolocation Variance

Relative Geolocation Error	Images X [%]	Images Y [%]	Images Z [%]
[-1.00, 1.00]	100.00	95.17	99.28
[-2.00, 2.00]	100.00	99.88	100.00
[-3.00, 3.00]	100.00	100.00	100.00
Mean of Geolocation Accuracy [m]	1.194137	1.194137	2.232923
Sigma of Geolocation Accuracy [m]	0.020737	0.020737	0.032485

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

Geolocation Orientational Variance	RMS [degree]
Omega	1.011
Phi	1.145
Kappa	1.640

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 CPU 870 @ 2.93GHz RAM: 12GB GPU: Radeon RX 580 Series (Driver: 26.20.15019.19000)
Operating System	Windows 10 Pro, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84
Output Coordinate System	WGS 84 / UTM zone 33N

Processing Options

Detected Template	No Template Available
Keypoints Image Scale	Rapid, Image Scale: 0.25
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
Rig «FC6360» processing	optimize relative rotation using a subset of secondary cameras

Point Cloud Densification details

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Low (Fast)
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	Blue, Green, Red, Red edge, NIR, group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	02m:49s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	04m:20s

Results

Number of Processed Clusters	2
Number of Generated Tiles	2
Number of 3D Densified Points	663522
Average Density (per m^3)	78.39

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (2.36 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Sharp
Orthomosaic	Generated: yes Merge Tiles: no GeoTIFF Without Transparency: no Google Maps Tiles and KML: no
Time for DSM Generation	00s
Time for Orthomosaic Generation	27m:31s
Time for DTM Generation	00s

Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s

Camera Radiometric Correction ⓘ

Camera Name	Band	Radiometric Correction Type	Reflectance target
FC6360_5.7_1600x1300	Blue	Camera and Sun Irradiance	n/a
FC6360_5.7_1600x1300	Green	Camera and Sun Irradiance	n/a
FC6360_5.7_1600x1300	Red	Camera and Sun Irradiance	n/a
FC6360_5.7_1600x1300	Red edge	Camera and Sun Irradiance	n/a
FC6360_5.7_1600x1300	NIR	Camera and Sun Irradiance	n/a
FC6360_5.7_1600x1300	Red Green Blue	No Correction	n/a