

Quality Report



Generated with PIX4Dmapper version 4.8.4



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Additional information about the sections



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Summary



Project	MP64_02August2023
Processed	2023-11-15 16:59:07
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)	6.86 cm / 2.70 in
Area Covered	0.000 km ² / 0.0000 ha / 0.00 sq. mi. / 0.0001 acres

Quality Check



Images	median of 10000 keypoints per image	
Dataset	2284 out of 2292 images calibrated (99%), all images enabled, 2 blocks	
Camera Optimization	4.42% relative difference between initial and optimized internal camera parameters	
Matching	median of 6009.86 matches per calibrated image	
Georeferencing	yes, no 3D GCP	

Preview

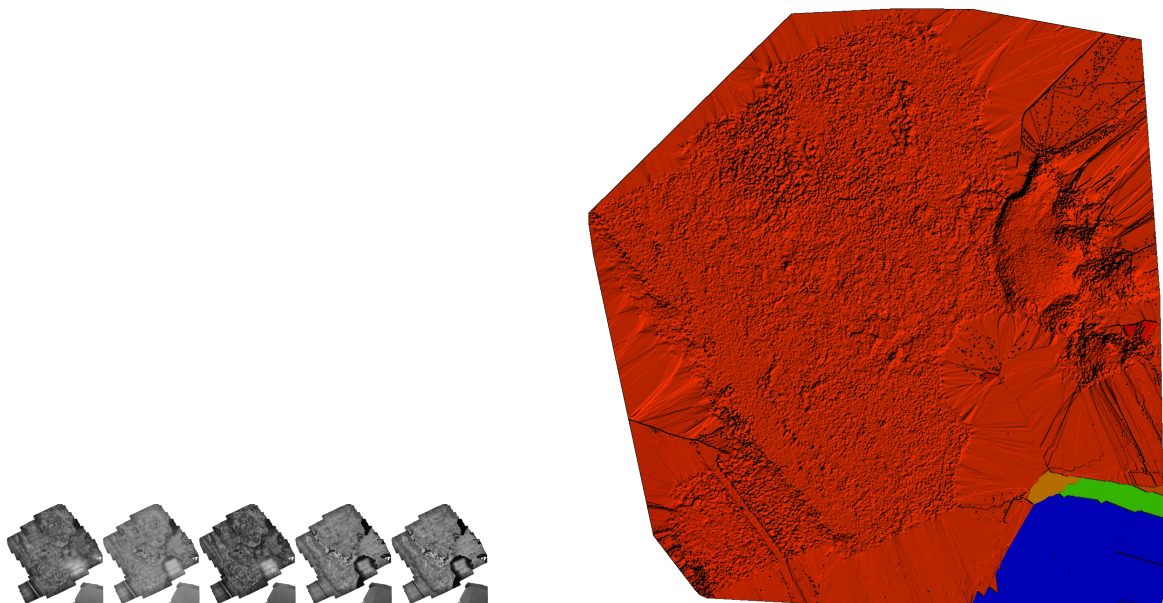


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details



Number of Calibrated Images	2284 out of 2292
Number of Geolocated Images	2292 out of 2292

? Initial Image Positions

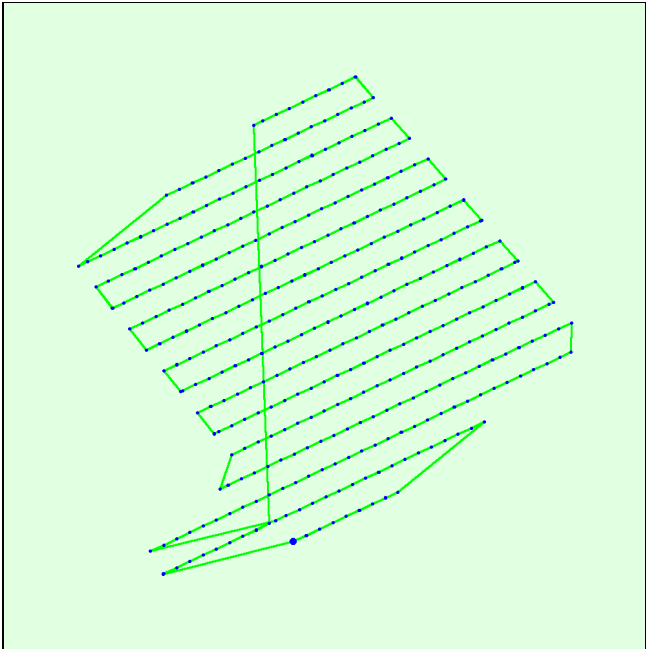
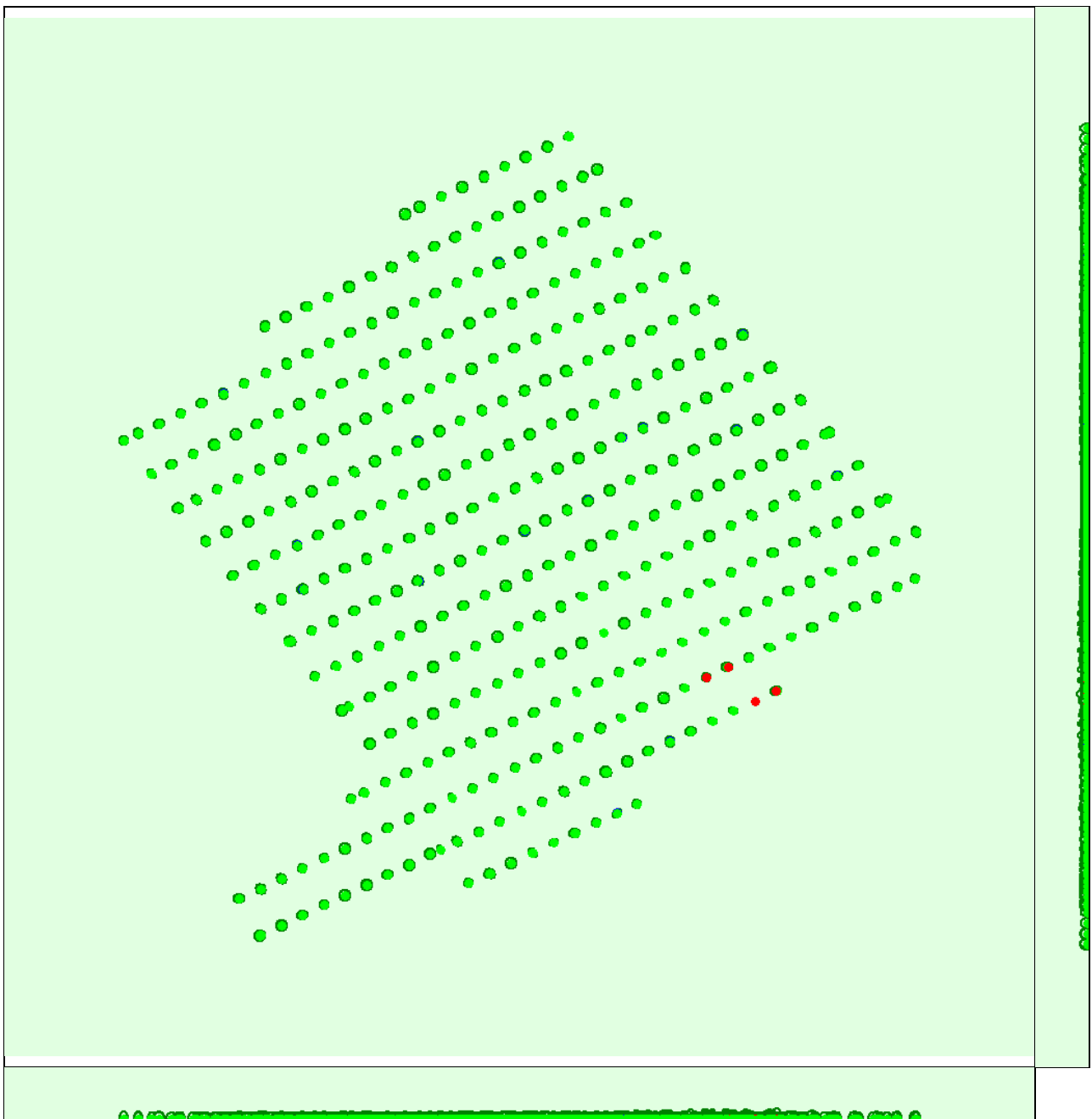


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

? Computed Image/GCPs/Manual Tie Points Positions





Uncertainty ellipses 1000x 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). Red dots indicate disabled or uncalibrated images. 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	0.003	0.003	0.004	0.003	0.003	0.003
Sigma	0.000	0.000	0.001	0.000	0.000	0.002

? Overlap



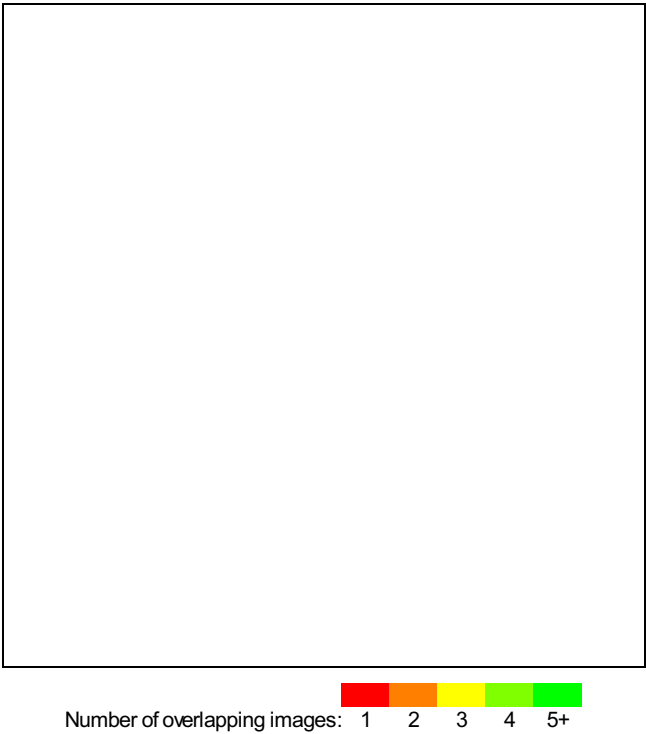


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic. Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

Bundle Block Adjustment Details

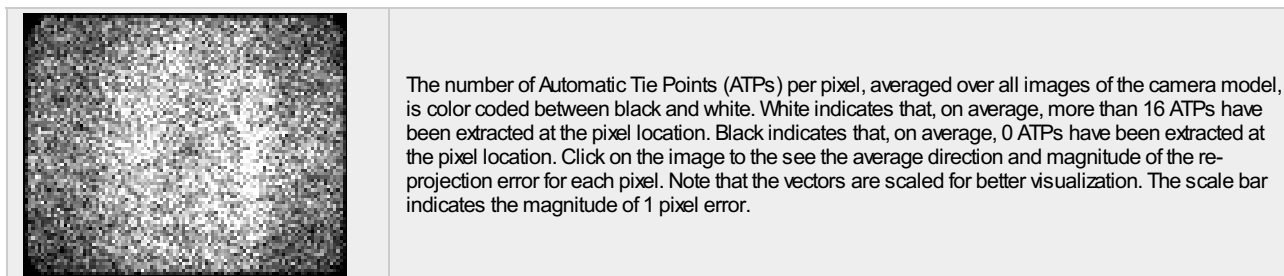
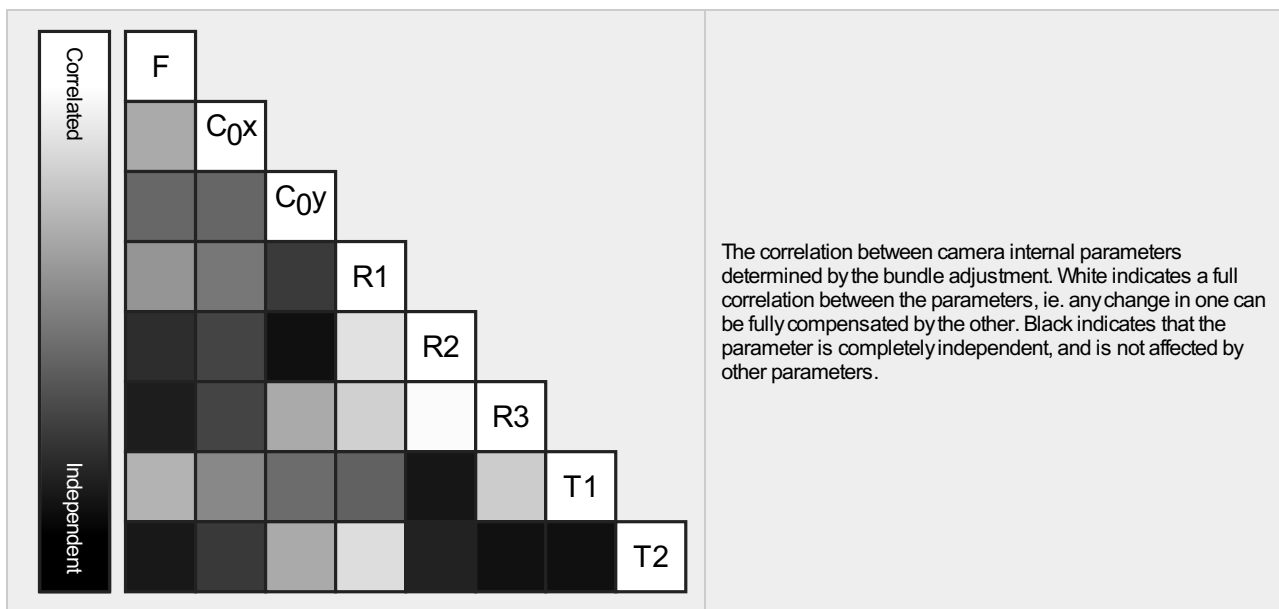
Number of 2D Keypoint Observations for Bundle Block Adjustment	5224827
Number of 3D Points for Bundle Block Adjustment	1256836
Mean Reprojection Error [pixels]	0.142

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]	775.674 [pixel] 2.435 [mm]	605.420 [pixel] 1.900 [mm]	-0.466	0.777	-1.318	0.002	0.002
Optimized Values	1876.998 [pixel] 5.892 [mm]	811.108 [pixel] 2.546 [mm]	659.244 [pixel] 2.069 [mm]	-0.386	0.281	-0.219	0.000	-0.000
Uncertainties (Sigma)	2.388 [pixel] 0.007 [mm]	0.331 [pixel] 0.001 [mm]	0.299 [pixel] 0.001 [mm]	0.002	0.010	0.021	0.000	0.000



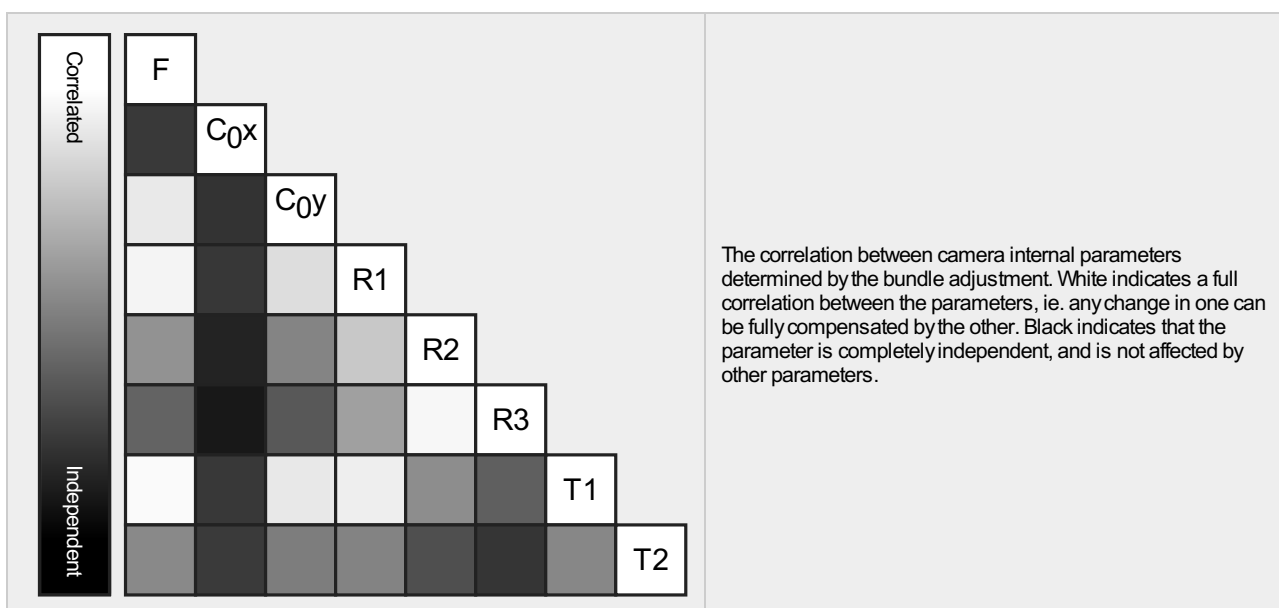
Internal Camera Parameters

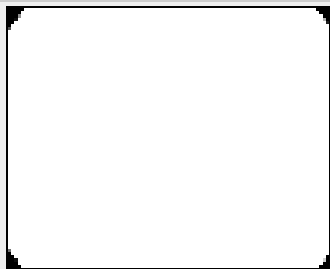
FC6360_5.7_1600x1300 (Green). Sensor Dimensions: 5.022 [mm] x 4.081 [mm]



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]	775.582 [pixel] 2.435 [mm]	604.949 [pixel] 1.899 [mm]	-0.468	0.822	-1.469	0.002	0.002
Optimized Values	1869.077 [pixel] 5.867 [mm]	810.353 [pixel] 2.544 [mm]	658.033 [pixel] 2.066 [mm]	-0.385	0.282	-0.219	-0.000	0.000
Uncertainties (Sigma)	2.375 [pixel] 0.007 [mm]	0.067 [pixel] 0.000 [mm]	0.131 [pixel] 0.000 [mm]	0.001	0.002	0.004	0.000	0.000





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 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.

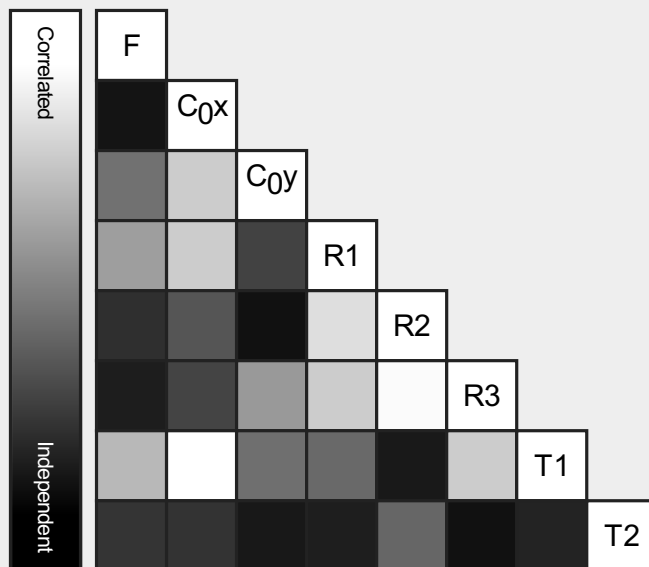
Internal Camera Parameters

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

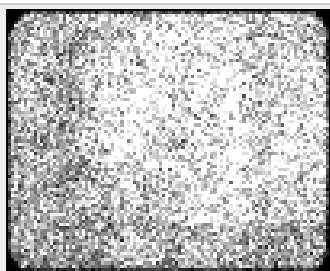


EXIF ID: FC6360_5.7_1600x1300

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1828.571 [pixel] 5.740 [mm]	775.727 [pixel] 2.435 [mm]	605.657 [pixel] 1.901 [mm]	-0.475	0.845	-1.450	0.002	0.002
Optimized Values	1873.969 [pixel] 5.883 [mm]	804.816 [pixel] 2.526 [mm]	657.313 [pixel] 2.063 [mm]	-0.380	0.257	-0.178	-0.000	-0.000
Uncertainties (Sigma)	2.385 [pixel] 0.007 [mm]	0.288 [pixel] 0.001 [mm]	0.260 [pixel] 0.001 [mm]	0.002	0.009	0.017	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.



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Internal Camera Parameters

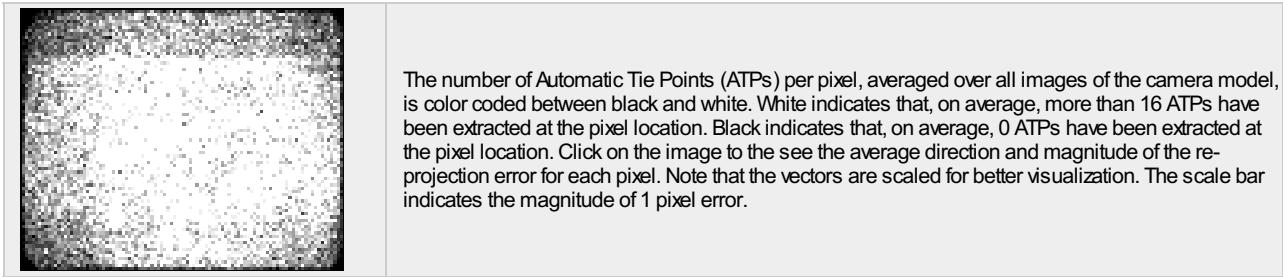
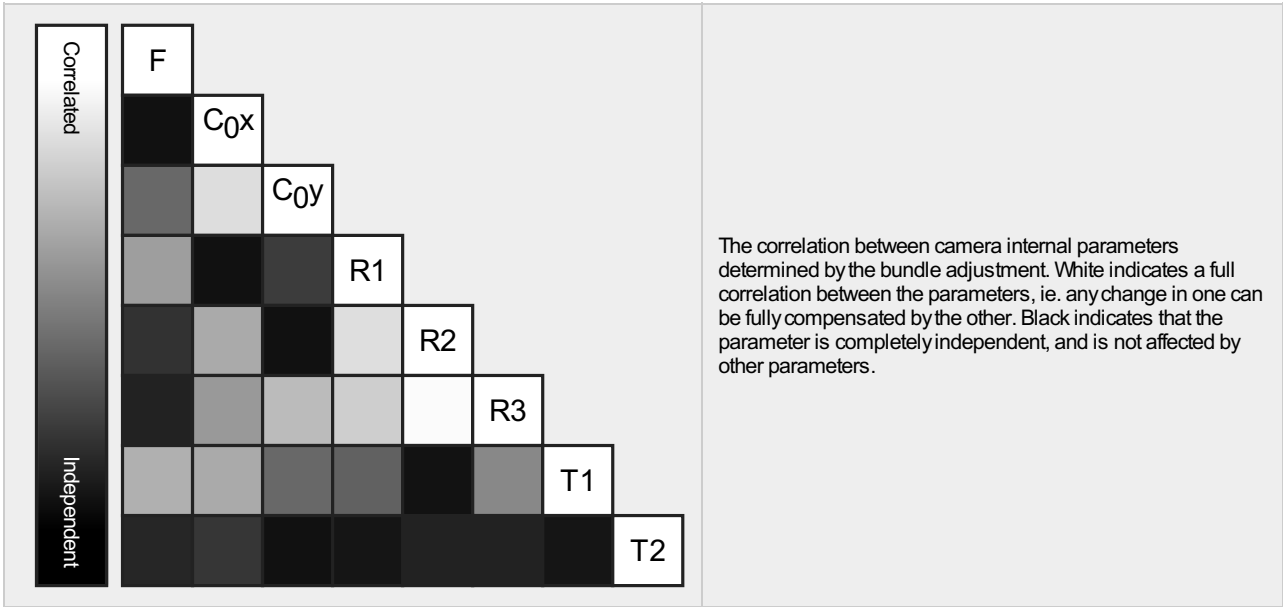
FC6360_5.7_1600x1300 (Red edge). Sensor Dimensions: 5.022 [mm] x 4.081 [mm]



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]	776.144 [pixel] 2.436 [mm]	604.775 [pixel] 1.898 [mm]	-0.483	0.924	-1.689	0.002	0.002
Optimized Values	1874.162 [pixel] 5.883 [mm]	806.724 [pixel] 2.532 [mm]	655.326 [pixel] 2.057 [mm]	-0.386	0.299	-0.259	-0.000	-0.000

Uncertainties (Sigma)	2.384 [pixel] 0.007 [mm]	0.307 [pixel] 0.001 [mm]	0.281 [pixel] 0.001 [mm]	0.002	0.009	0.018	0.000	0.000
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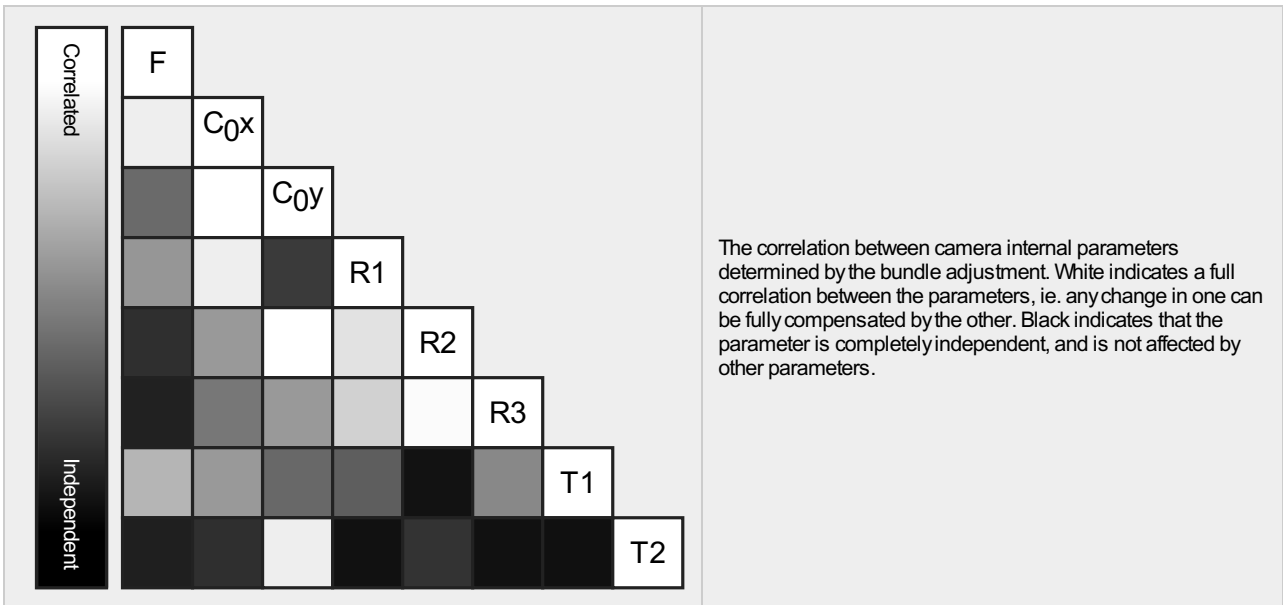
Internal Camera Parameters

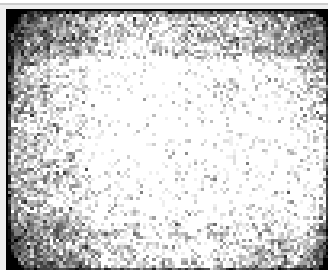
FC6360_5.7_1600x1300 (NIR). Sensor Dimensions: 5.022 [mm] x 4.081 [mm]



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]	775.538 [pixel] 2.434 [mm]	605.898 [pixel] 1.902 [mm]	-0.470	0.787	-1.306	0.002	0.002
Optimized Values	1879.839 [pixel] 5.901 [mm]	809.796 [pixel] 2.542 [mm]	652.766 [pixel] 2.049 [mm]	-0.385	0.294	-0.245	0.000	-0.000
Uncertainties (Sigma)	2.392 [pixel] 0.008 [mm]	0.331 [pixel] 0.001 [mm]	0.301 [pixel] 0.001 [mm]	0.002	0.010	0.020	0.000	0.000





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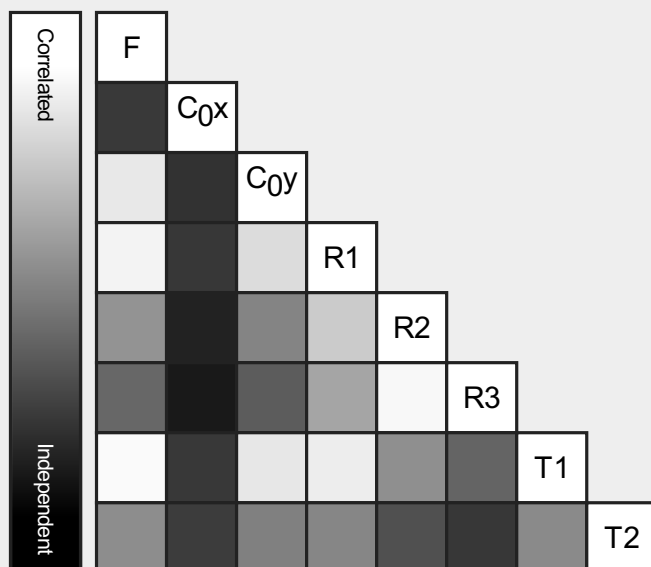
Internal Camera Parameters

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

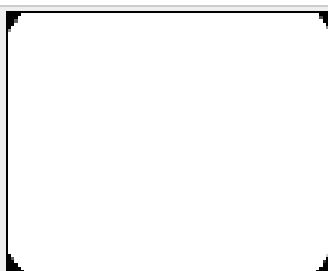


EXIF ID: FC6360_5.7_1600x1300

	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	1870.994 [pixel] 5.873 [mm]	805.944 [pixel] 2.530 [mm]	643.514 [pixel] 2.020 [mm]	-0.389	0.296	-0.238	0.000	0.000
Uncertainties (Sigma)	2.378 [pixel] 0.007 [mm]	0.072 [pixel] 0.000 [mm]	0.136 [pixel] 0.000 [mm]	0.001	0.003	0.005	0.000	0.000



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Camera Rig «FC6360» Relatives. Images: 1910



	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	0.009	0.038	-0.026
Uncertainties (sigma)				0.009	0.010	0.001
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	-0.056	-0.070	-0.029
Uncertainties (sigma)				0.007	0.009	0.001
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	-0.075	-0.050	-0.054
Uncertainties (sigma)				0.008	0.010	0.001
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	0.051	-0.021	-0.037
Uncertainties (sigma)				0.009	0.010	0.001

? 2D Keypoints Table



	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	6010
Mn	2110	48
Max	10000	8239
Mean	9603	5685

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	4309
Mn	5087	1165
Max	10000	5948
Mean	9741	4329

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	6169
Mn	2110	48
Max	10000	8239
Mean	9350	5871

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	5027
Mn	4722	1352
Max	10000	6066
Mean	9642	4918

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	10000	5407
Mn	2697	158
Max	10000	6825
Mean	9667	4991

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	5464
Mn	2573	153
Max	10000	7160

Mean	9701	5238
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2D Keypoints Table for Camera FC6360_5.7_1600x1300 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	10000	6051
Mn	5945	72
Max	10000	7338
Mean	9823	5844

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)	188 / 868 / 4016	22 / 61 / 603	100 / 317 / 1088	5 / 14 / 311	4 / 11 / 280	45 / 155 / 902
FC6360_5.7_1600x1300 (Green)		248 / 745 / 6868	24 / 70 / 791	21 / 72 / 1032	18 / 61 / 845	135 / 392 / 2724
FC6360_5.7_1600x1300 (Red)			243 / 1006 / 4105	4 / 16 / 350	5 / 18 / 376	69 / 232 / 1702
FC6360_5.7_1600x1300 (Red edge)				231 / 1087 / 5048	330 / 1239 / 3946	15 / 52 / 665
FC6360_5.7_1600x1300 (NIR)					399 / 1431 / 5360	12 / 44 / 554
FC6360_5.7_1600x1300 (RGB)						231 / 679 / 4754

? 3D Points from 2D Keypoint Matches



	Number of 3D Points Observed
In 2 Images	623449
In 3 Images	224034
In 4 Images	114287
In 5 Images	71273
In 6 Images	47200
In 7 Images	34123
In 8 Images	24981
In 9 Images	19878
In 10 Images	15703
In 11 Images	12100
In 12 Images	9804
In 13 Images	8274
In 14 Images	6895
In 15 Images	6034
In 16 Images	5136
In 17 Images	4272
In 18 Images	3718
In 19 Images	3177
In 20 Images	2859
In 21 Images	2346
In 22 Images	2035
In 23 Images	1696
In 24 Images	1523
In 25 Images	1285
In 26 Images	1182
In 27 Images	1091
In 28 Images	1065
In 29 Images	891
In 30 Images	818
In 31 Images	683
In 32 Images	670

In 33 Images	577
In 34 Images	557
In 35 Images	466
In 36 Images	440
In 37 Images	348
In 38 Images	337
In 39 Images	277
In 40 Images	274
In 41 Images	207
In 42 Images	205
In 43 Images	151
In 44 Images	139
In 45 Images	103
In 46 Images	73
In 47 Images	56
In 48 Images	48
In 49 Images	26
In 50 Images	22
In 51 Images	16
In 52 Images	6
In 53 Images	8
In 54 Images	8
In 55 Images	5
In 56 Images	1
In 58 Images	3
In 62 Images	1

 **2D Keypoint Matches**



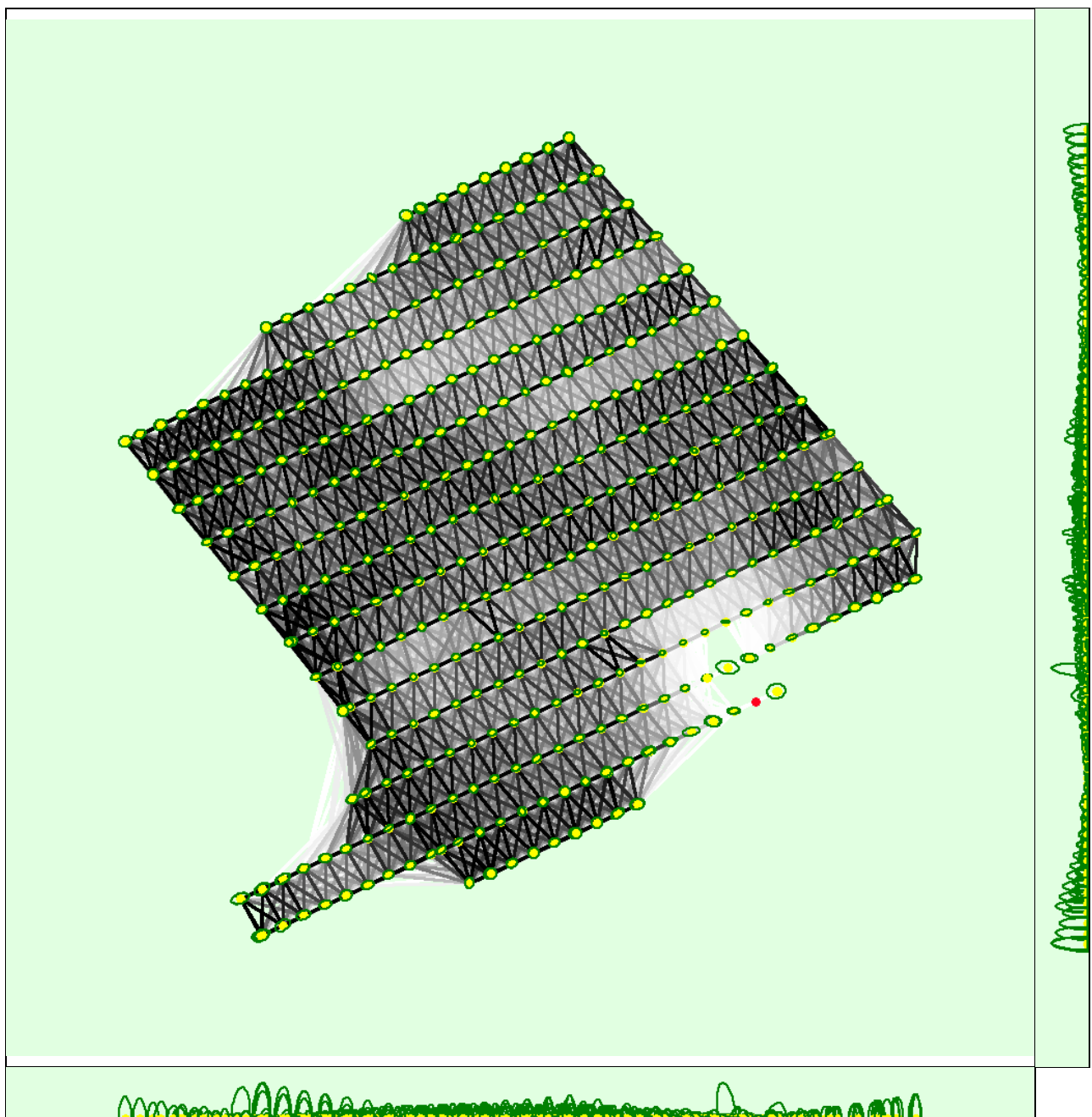


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty 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	0.031	0.027	0.059	0.041	0.044	0.004
Sigma	0.007	0.006	0.040	0.022	0.024	0.002

Geolocation Details

? Absolute Geolocation Variance



Min Error [m]	Max Error [m]	Geolocation Error X[%]	Geolocation Error Y[%]	Geolocation Error Z[%]
-	-0.04	0.04	0.00	0.22
-0.04	-0.03	0.00	0.04	0.79
-0.03	-0.02	4.90	1.23	5.95
-0.02	-0.01	5.12	13.40	12.22
-0.01	-0.01	8.23	13.84	22.07
-0.01	0.00	31.83	22.11	26.71
0.00	0.01	32.18	20.67	20.36
0.01	0.01	8.19	12.17	8.71
0.01	0.02	5.04	14.32	2.06
0.02	0.03	4.42	2.10	0.74
0.03	0.04	0.04	0.13	0.18
0.04	-	0.00	0.00	0.00
Mean [m]		-0.000144	0.000219	-0.005273
Sigma [m]		0.011012	0.012612	0.011155
RMS Error [m]		0.011013	0.012614	0.012338

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]	75.70	55.04	91.68
[-2.00, 2.00]	93.26	97.02	100.00
[-3.00, 3.00]	99.96	100.00	100.00
Mean of Geolocation Accuracy [m]	0.011603	0.011603	0.022347
Sigma of Geolocation Accuracy [m]	0.000444	0.000444	0.000826

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

Geolocation Orientational Variance	RMS [degree]
Omega	0.801
Phi	1.155
Kappa	1.240

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) i7-10850H CPU @ 2.70GHz RAM: 128GB GPU: Intel(R) UHD Graphics (Driver: 31.0.101.2115), NVIDIA Quadro T2000 (Driver: 31.0.15.3645), DisplayLink USB Device (Driver: 11.0.2412.0)
Operating System	Windows 10 Enterprise, 64-bit

Coordinate Systems



Image Coordinate System	WGS 84
Output Coordinate System	WGS 84 / UTMzone 3N

Processing Options



Detected Template	 P4MultiSpecFinal*
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: Custom, Number of Keypoints: 10000
Advanced: Calibration	Calibration Method: Geolocation Based Internal Parameters Optimization: All External Parameters Optimization: All Rematch: Custom, yes
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	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	Blue, Green, Red, Red edge, NIR, group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes

Results



Number of Generated Tiles	2
Number of 3D Densified Points	7880812
Average Density (per m ³)	12.16

DSM, Orthomosaic and Index Details



Processing Options



DSM and Orthomosaic Resolution	1 x GSD (6.86 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Medium
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
Radiometric calibration with reflectance target	yes
Index Calculator: Reflectance Map	Generated: yes Resolution: 1 x GSD (6.86 [cm/pixel]) Merge Tiles: yes

Camera Radiometric Correction



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