Quality Report

Generated with Pix4Denterprise version 4.4.12

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	CA502_ReDateTime_reprocess
Processed	2022-12-05 21:22:44
Camera Model Name(s)	Camera_MID_28.0_6000x4000 (RGB), Camera_43.0_6000x4000 (RGB)(2), Camera_43.0_6000x4000 (RGB)(3), Camera_43.0_6000x4000 (RGB)(4), Camera_43.0_6000x4000 (RGB)(5)
Rig name(s)	«CA502R_Oblique_Camera_relative»
Average Ground Sampling Distance (GSD)	2.55 cm / 1.00 in
Area Covered	0.459 km^2 / 45.8542 ha / 0.18 sq. mi. / 113.3668 acres
Time for Initial Processing (without report)	18m:03s

Quality Check

Images	median of 7150 keypoints per image	✓
Dataset	1265 out of 1265 images calibrated (100%), all images enabled	✓
Camera Optimization	0.56% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 249.2 matches per calibrated image	✓
Georeferencing	yes, 11 GCPs (11 3D), mean RMS error = 0.017 m	✓

Preview

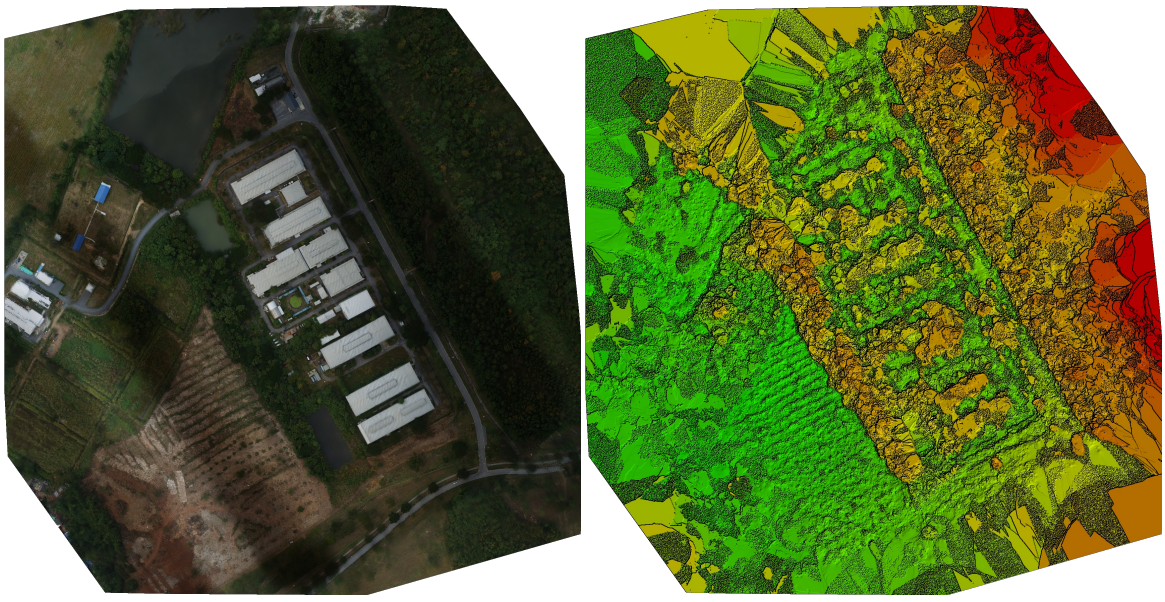


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	1265 out of 1265
Number of Geolocated Images	1265 out of 1265

Initial Image Positions

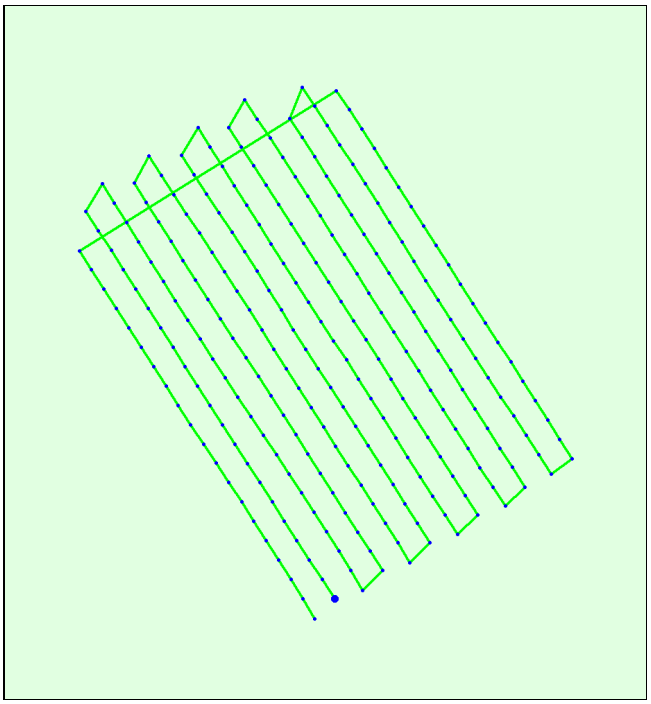
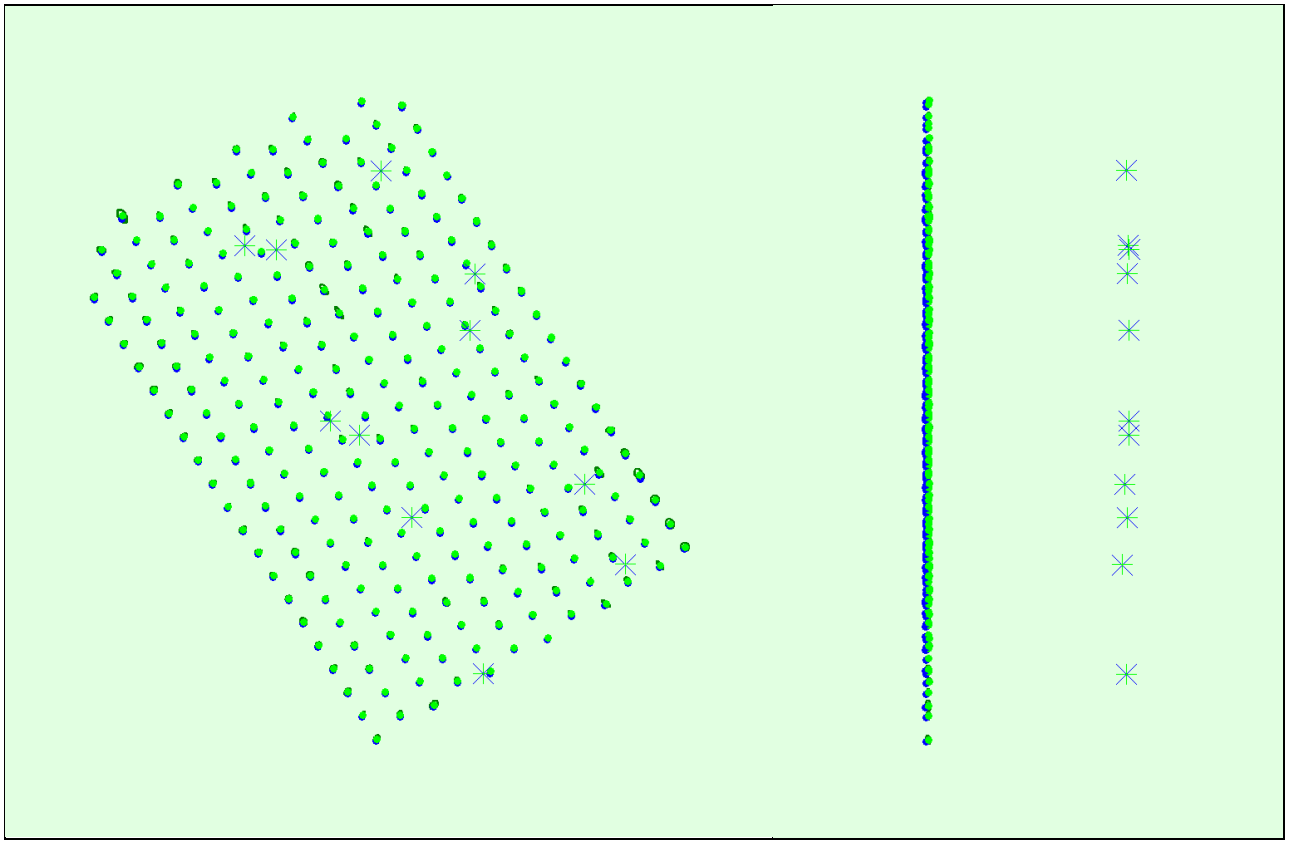


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions



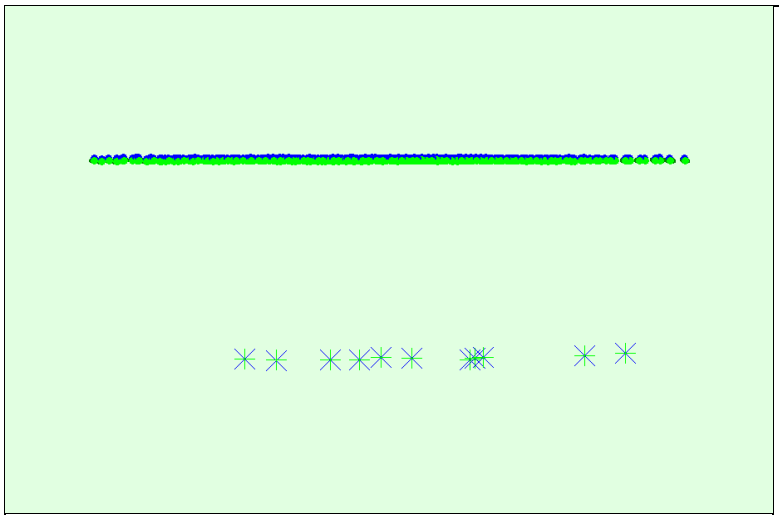


Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and their computed positions (green crosses) in the top-view (XY plane), front-view (XZ plane), and side-view (YZ plane). Dark green ellipses 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	0.024	0.026	0.021	0.009	0.007	0.006
Sigma	0.006	0.008	0.001	0.003	0.002	0.003

Overlap

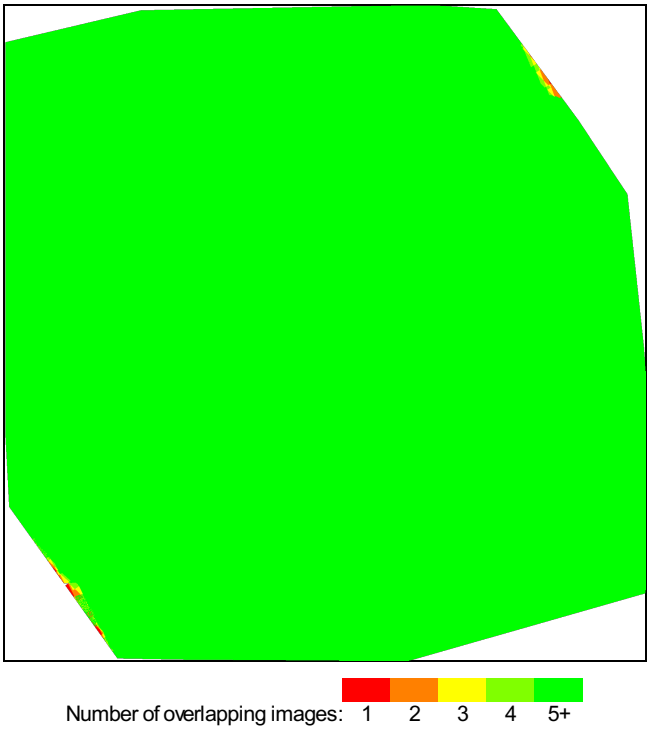


**Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

Bundle Block Adjustment Details

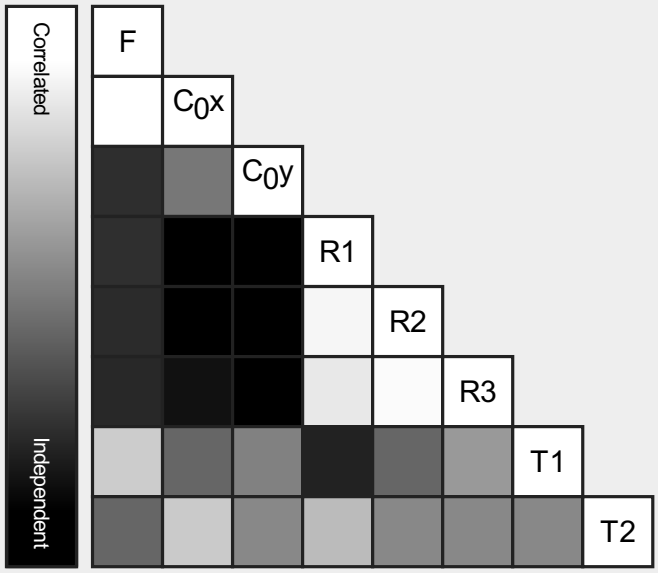
Number of 2D Keypoint Observations for Bundle Block Adjustment	612768
Number of 3D Points for Bundle Block Adjustment	224349
Mean Reprojection Error [pixels]	0.093

Internal Camera Parameters

Camera_MID_28.0_6000x4000 (RGB). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	7142.860 [pixel] 28.000 [mm]	3000.000 [pixel] 11.760 [mm]	2000.000 [pixel] 7.840 [mm]	-0.048	0.037	-0.011	-0.000	-0.001
Optimized Values	7151.077 [pixel] 28.032 [mm]	3035.713 [pixel] 11.900 [mm]	1928.521 [pixel] 7.560 [mm]	-0.105	-0.017	0.034	-0.001	0.001
Uncertainties (Sigma)	0.757 [pixel] 0.003 [mm]	0.569 [pixel] 0.002 [mm]	0.450 [pixel] 0.002 [mm]	0.001	0.006	0.016	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.

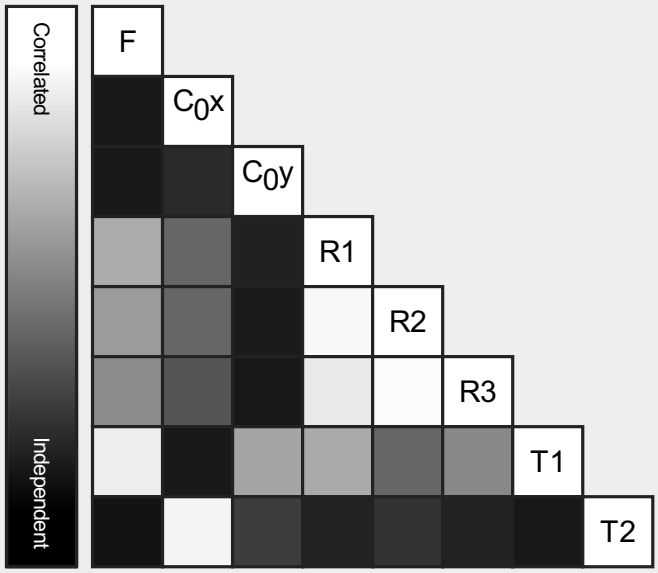
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the 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.

Internal Camera Parameters

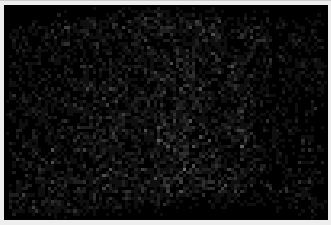
Camera_43.0_6000x4000 (RGB)(2). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	10969.400 [pixel] 43.000 [mm]	3000.000 [pixel] 11.760 [mm]	2000.000 [pixel] 7.840 [mm]	-0.048	0.037	-0.011	-0.000	-0.001
Optimized Values	11065.662 [pixel] 43.377 [mm]	3112.098 [pixel] 12.199 [mm]	1971.204 [pixel] 7.727 [mm]	-0.003	-0.162	0.681	0.001	0.002
Uncertainties (Sigma)	1.240 [pixel] 0.005 [mm]	6.985 [pixel] 0.027 [mm]	4.625 [pixel] 0.018 [mm]	0.007	0.165	1.155	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.



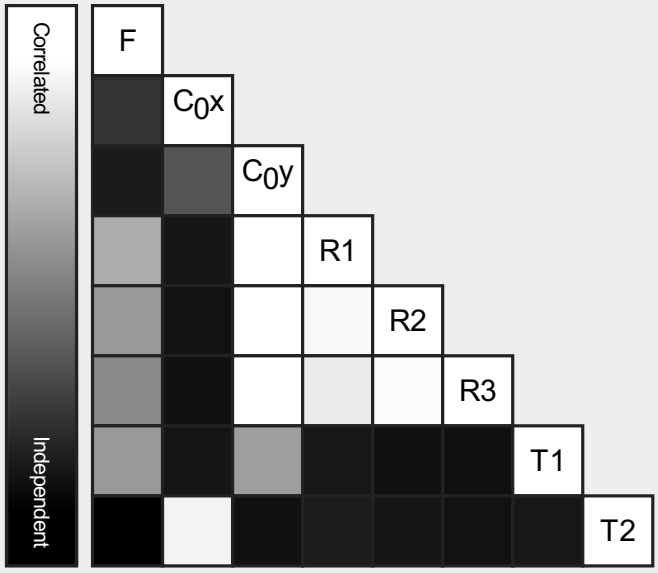
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the 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.

Internal Camera Parameters

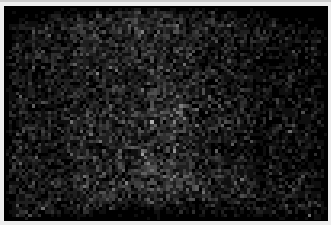
Camera_43.0_6000x4000 (RGB)(3). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	10969.400 [pixel] 43.000 [mm]	3000.000 [pixel] 11.760 [mm]	2000.000 [pixel] 7.840 [mm]	-0.048	0.037	-0.011	-0.000	-0.001
Optimized Values	11009.716 [pixel] 43.158 [mm]	3062.149 [pixel] 12.004 [mm]	1952.693 [pixel] 7.655 [mm]	-0.016	0.098	-1.016	0.001	-0.001
Uncertainties (Sigma)	1.414 [pixel] 0.006 [mm]	6.736 [pixel] 0.026 [mm]	4.379 [pixel] 0.017 [mm]	0.007	0.157	1.078	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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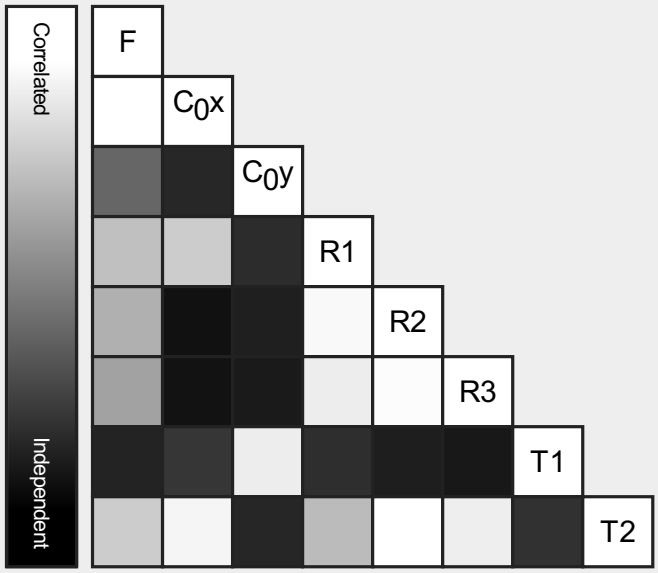
Internal Camera Parameters

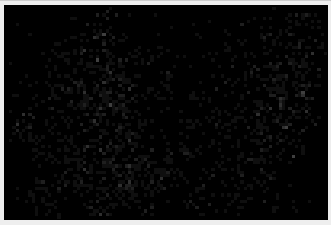
Camera_43.0_6000x4000 (RGB)(4). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	10969.400 [pixel] 43.000 [mm]	3000.000 [pixel] 11.760 [mm]	2000.000 [pixel] 7.840 [mm]	-0.048	0.037	-0.011	-0.000	-0.001
Optimized Values	11049.230 [pixel] 43.313 [mm]	2993.309 [pixel] 11.734 [mm]	1941.384 [pixel] 7.610 [mm]	-0.020	-0.107	2.105	0.000	-0.001
Uncertainties (Sigma)	1.167 [pixel] 0.005 [mm]	3.921 [pixel] 0.015 [mm]	4.072 [pixel] 0.016 [mm]	0.007	0.152	1.032	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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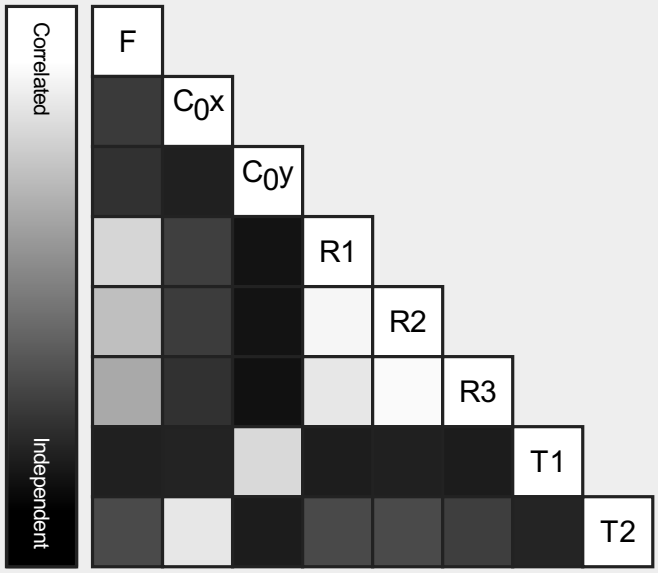
Internal Camera Parameters

Camera_43.0_6000x4000 (RGB)(5). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	10969.400 [pixel] 43.000 [mm]	3000.000 [pixel] 11.760 [mm]	2000.000 [pixel] 7.840 [mm]	-0.048	0.037	-0.011	-0.000	-0.001
Optimized Values	11049.447 [pixel] 43.314 [mm]	2920.446 [pixel] 11.448 [mm]	1891.441 [pixel] 7.414 [mm]	-0.019	0.017	0.038	-0.001	-0.003
Uncertainties (Sigma)	1.694 [pixel] 0.007 [mm]	7.394 [pixel] 0.029 [mm]	6.425 [pixel] 0.025 [mm]	0.009	0.199	1.254	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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Camera Rig «CA502R_Oblique_Camera_relative» Relatives. Images: 1265

	Transl X [m]	Transl Y [m]	Transl Z [m]	Rot X [degree]	Rot Y [degree]	Rot Z [degree]
Camera_MID_28.0_6000x4000 (RGB)	Reference Camera					
Camera_43.0_6000x4000 (RGB)(2)						
Initial Values	0.000	0.051	-0.022	0.633	-45.648	-89.796
Optimized values	0.000	0.051	-0.022	0.612	-45.715	-89.799
Uncertainties (sigma)				0.026	0.024	0.041
Camera_43.0_6000x4000 (RGB)(3)						
Initial Values	0.000	-0.051	-0.022	0.501	44.211	89.499
Optimized values	0.000	-0.051	-0.022	0.487	44.102	89.499
Uncertainties (sigma)				0.026	0.022	0.040
Camera_43.0_6000x4000 (RGB)(4)						
Initial Values	-0.051	0.000	-0.022	43.478	-0.985	0.095
Optimized values	-0.051	0.000	-0.022	43.437	-0.981	0.099
Uncertainties (sigma)				0.021	0.004	0.021
Camera_43.0_6000x4000 (RGB)(5)						
Initial Values	0.051	0.000	-0.022	-45.043	0.055	179.115
Optimized values	0.051	0.000	-0.022	-45.122	0.122	179.098
Uncertainties (sigma)				0.033	0.039	0.004

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7150	249
Min	3572	1
Max	9790	4179
Mean	7021	484

2D Keypoints Table for Camera Camera_MID_28.0_6000x4000 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6965	1405

Min	3854	228
Max	8467	4179
Mean	6812	1516

2D Keypoints Table for Camera Camera_43.0_6000x4000 (RGB)(2)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7438	215
Min	4955	4
Max	8949	681
Mean	7215	228

2D Keypoints Table for Camera Camera_43.0_6000x4000 (RGB)(3)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7338	269
Min	4247	1
Max	8501	819
Mean	7162	287

2D Keypoints Table for Camera Camera_43.0_6000x4000 (RGB)(4)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7130	203
Min	3572	3
Max	9790	704
Mean	7010	214

2D Keypoints Table for Camera Camera_43.0_6000x4000 (RGB)(5)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7063	160
Min	3667	4
Max	8476	548
Mean	6903	177

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

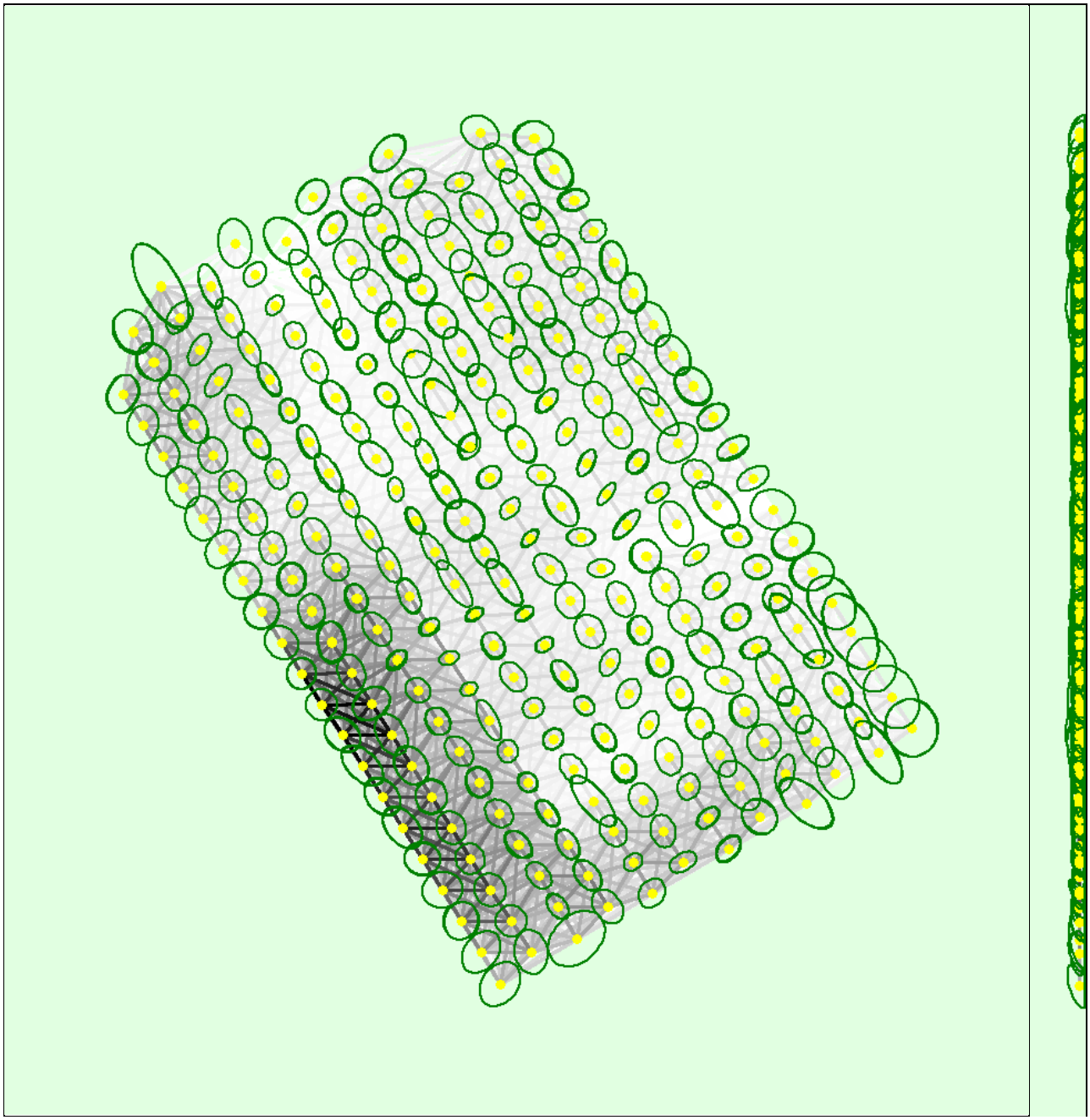
	Camera_MD_28.0... (RGB)	Camera_43.0_... (RGB)(2)	Camera_43.0_... (RGB)(3)	Camera_43.0_... (RGB)(4)	Camera_43.0_... (RGB)(5)
Camera_MD_28.0_6000x4000 (RGB)	45 / 155 / 2393	1 / 1 / 8	1 / 1 / 4	1 / 2 / 358	1 / 1 / 5
Camera_43.0_6000x4000 (RGB)(2)		7 / 38 / 461	1 / 2 / 24	1 / 1 / 3	1 / 1 / 1
Camera_43.0_6000x4000 (RGB)(3)			8 / 54 / 538	1 / 1 / 3	1 / 1 / 1
Camera_43.0_6000x4000 (RGB)(4)				7 / 39 / 571	1 / 2 / 24
Camera_43.0_6000x4000 (RGB)(5)					6 / 35 / 398

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	171811
In 3 Images	24171
In 4 Images	9100
In 5 Images	4751
In 6 Images	3350

In 7 Images	2338
In 8 Images	1988
In 9 Images	1459
In 10 Images	1062
In 11 Images	839
In 12 Images	708
In 13 Images	583
In 14 Images	554
In 15 Images	480
In 16 Images	450
In 17 Images	299
In 18 Images	179
In 19 Images	95
In 20 Images	58
In 21 Images	28
In 22 Images	28
In 23 Images	10
In 24 Images	7
In 25 Images	1

2D Keypoint Matches



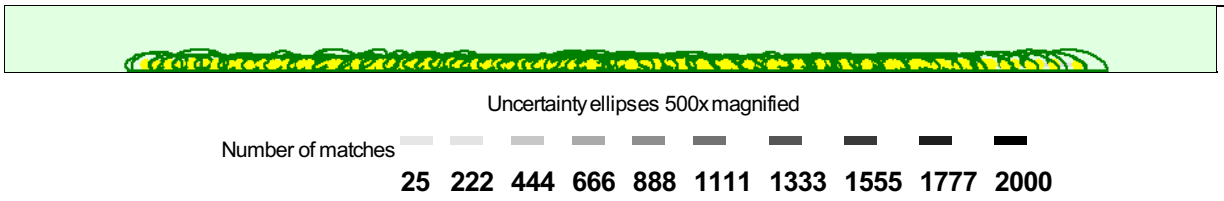


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty 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	0.022	0.024	0.010	0.009	0.007	0.006
Sigma	0.006	0.007	0.002	0.003	0.002	0.002

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
LCP-19 (3D)	0.020/ 0.050	0.013	0.002	-0.005	0.126	21 / 21
LCP-20 (3D)	0.020/ 0.050	-0.014	-0.013	0.034	0.138	20 / 21
LCP-24 (3D)	0.020/ 0.050	-0.001	0.023	0.001	0.171	21 / 21
LCP-25 (3D)	0.020/ 0.050	-0.016	-0.015	0.019	0.144	20 / 21
LCP-29 (3D)	0.020/ 0.050	-0.010	0.035	0.038	0.149	21 / 21
LCP-30 (3D)	0.020/ 0.050	-0.010	-0.010	0.001	0.093	21 / 21
GCP-02 (3D)	0.020/ 0.050	0.005	0.007	-0.027	0.146	21 / 21
GCP-05 (3D)	0.020/ 0.050	-0.014	-0.026	-0.035	0.089	21 / 21
GCP-07 (3D)	0.020/ 0.050	0.011	0.002	-0.014	0.159	21 / 21
GCP-09 (3D)	0.020/ 0.050	0.027	0.010	0.000	0.132	21 / 21
GCP-10 (3D)	0.020/ 0.050	0.009	-0.015	-0.011	0.120	21 / 21
Mean [m]		-0.000016	-0.000005	0.000013		
Sigma [m]		0.013622	0.017324	0.021824		
RMS Error [m]		0.013622	0.017324	0.021824		

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	0.00	0.00	0.00
-6.00	-3.00	0.00	0.00	0.00
-3.00	0.00	51.94	50.43	55.49
0.00	3.00	48.06	49.57	44.51
3.00	6.00	0.00	0.00	0.00
6.00	9.00	0.00	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]		-0.348008	-1.812496	2.502543
Sigma [m]		0.273659	0.225701	0.098748
RMS Error [m]		0.442718	1.826495	2.504490

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]	-0.348054	-1.812614	2.520096

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	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.

Initial Processing Details

System Information

Hardware	CPU: Intel(R) Core(TM) i7-5930K CPU @ 3.50GHz RAM: 32GB GPU: NVIDIA GeForce GTX 1660 Ti (Driver: 31.0.15.2686)
Operating System	Windows 10 Pro, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84 (2D)
Ground Control Point (GCP) Coordinate System	WGS 84 / UTM zone 47N (2D)
Output Coordinate System	WGS 84 / UTM zone 47N (2D)

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 «CA502R_Oblique_Camera_relative» processing	optimize relative rotation