Quality Report

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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	CA502R_FullBlock_CU_SBR_PartialCP
Processed	2022-12-10 17:25:09
Camera Model Name(s)	CA502R_NADIR_28.0_6000x4000 (RGB), CA502R_RIGHT_43.0_6000x4000 (RGB), CA502R_LEFT_43.0_6000x4000 (RGB), CA502R_REAR_43.0_6000x4000 (RGB), CA502R_FRONT_43.0_6000x4000 (RGB)
Rig name(s)	«CA502_OBLIQUE_RIG»
Average Ground Sampling Distance (GSD)	2.59 cm / 1.02 in
Area Covered	1.575 km^2 / 157.4603 ha / 0.61 sq. mi. / 389.2943 acres

Quality Check

Images	median of 7189 keypoints per image	✓
Dataset	6065 out of 6065 images calibrated (100%), all images enabled	✓
Camera Optimization	0.49% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 233.534 matches per calibrated image	✓
Georeferencing	yes, 24 GCPs (24 3D), mean RMS error = 0.022 m	✓

Preview

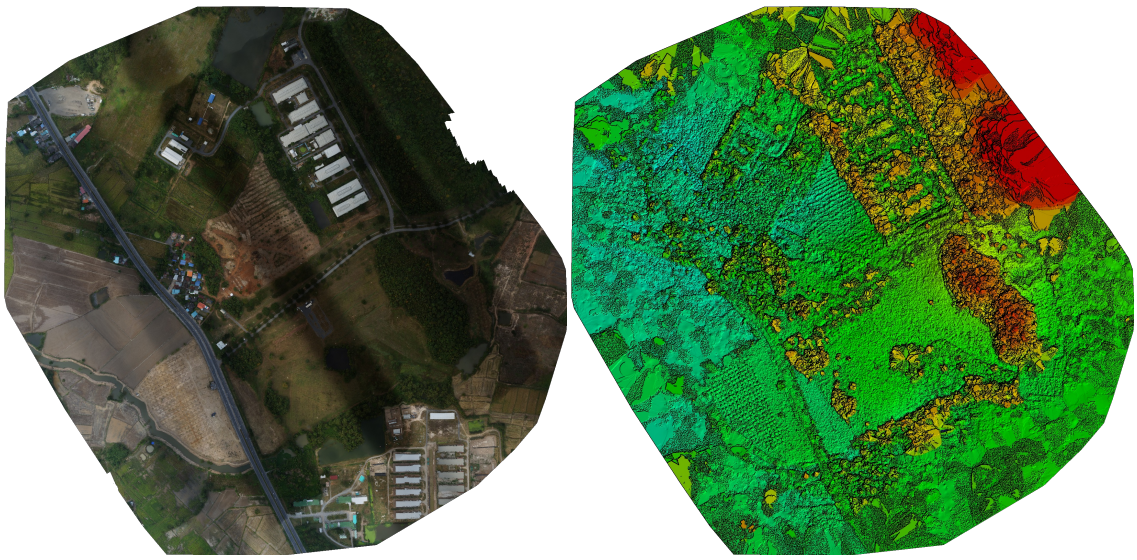


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	6065 out of 6065
Number of Geolocated Images	6065 out of 6065

Initial Image Positions

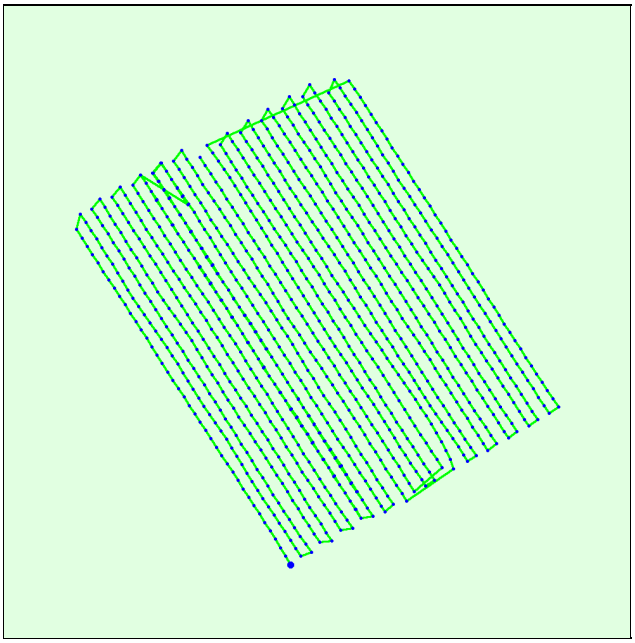
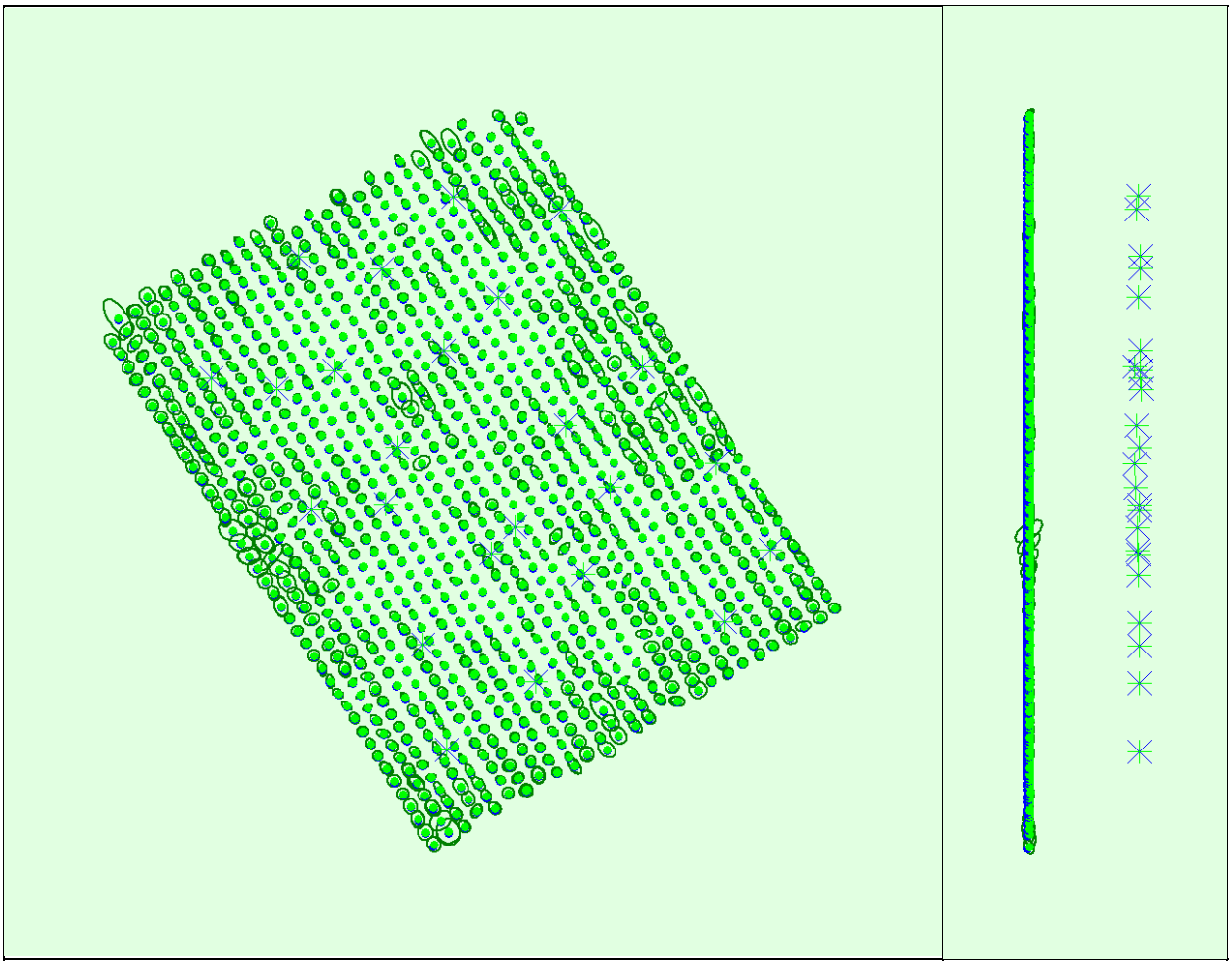
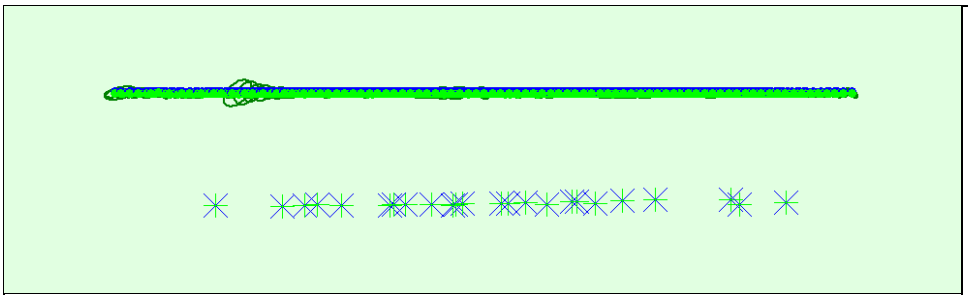


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions





Uncertainty ellipses 500x 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	0.016	0.017	0.011	0.006	0.004	0.004
Sigma	0.006	0.006	0.002	0.002	0.002	0.002

Overlap

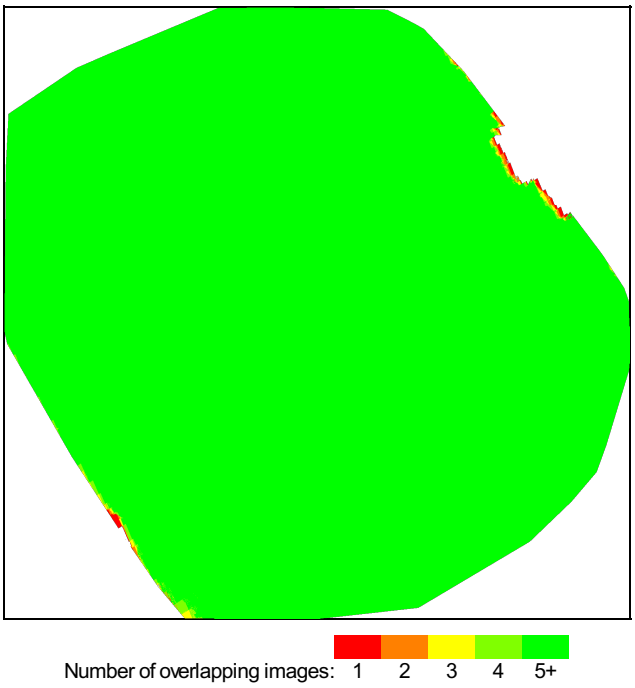


**Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

Bundle Block Adjustment Details

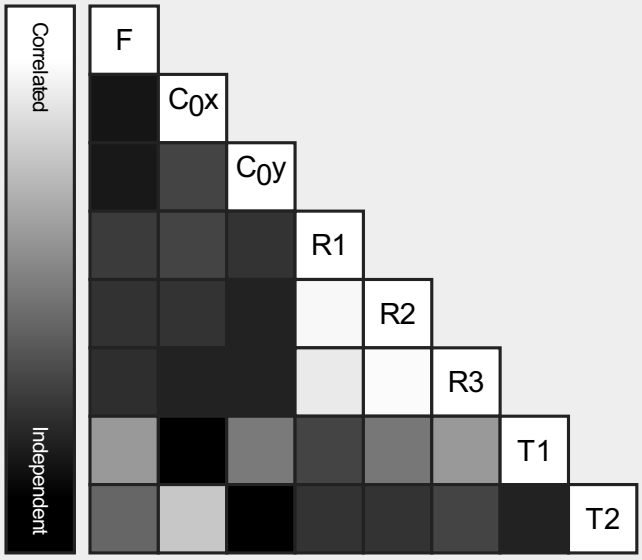
Number of 2D Keypoint Observations for Bundle Block Adjustment	3064968
Number of 3D Points for Bundle Block Adjustment	1034324
Mean Reprojection Error [pixels]	0.099

Internal Camera Parameters

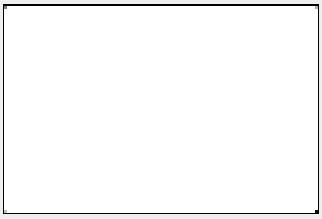
CA502R_NADIR_28.0_6000x4000 (RGB). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

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	7147.612 [pixel] 28.019 [mm]	3031.181 [pixel] 11.882 [mm]	1920.146 [pixel] 7.527 [mm]	-0.106	-0.007	0.010	-0.001	0.001
Uncertainties (Sigma)	0.261 [pixel] 0.001 [mm]	0.230 [pixel] 0.001 [mm]	0.171 [pixel] 0.001 [mm]	0.000	0.003	0.007	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.



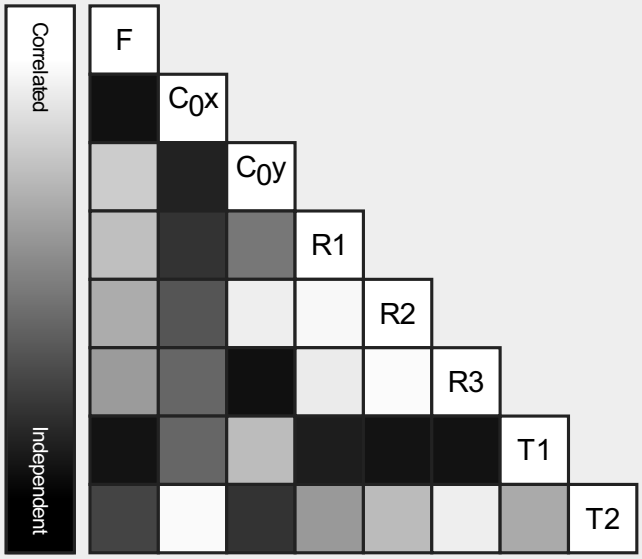
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

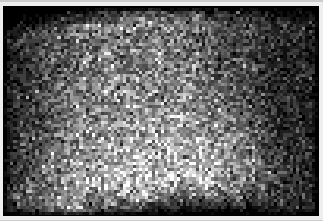
CA502R_RIGHT_43.0_6000x4000 (RGB). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	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	11059.278 [pixel] 43.352 [mm]	3082.332 [pixel] 12.083 [mm]	1963.442 [pixel] 7.697 [mm]	-0.012	-0.028	0.095	0.001	0.001
Uncertainties (Sigma)	0.408 [pixel] 0.002 [mm]	2.283 [pixel] 0.009 [mm]	1.394 [pixel] 0.005 [mm]	0.002	0.049	0.327	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.



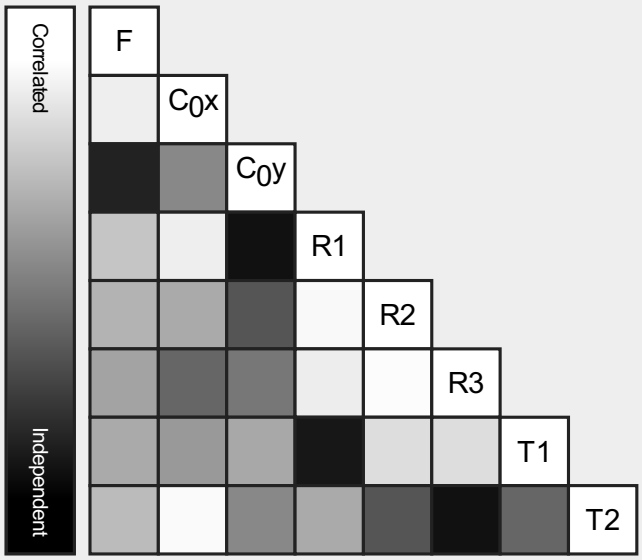
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

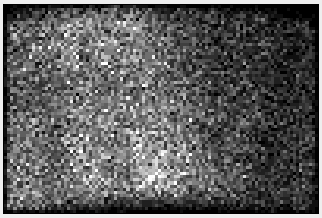
CA502R_LEFT_43.0_6000x4000 (RGB). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	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	11004.391 [pixel] 43.137 [mm]	3065.895 [pixel] 12.018 [mm]	1926.790 [pixel] 7.553 [mm]	0.001	-0.200	0.423	0.000	-0.000
Uncertainties (Sigma)	0.432 [pixel] 0.002 [mm]	2.490 [pixel] 0.010 [mm]	1.416 [pixel] 0.006 [mm]	0.002	0.051	0.332	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.



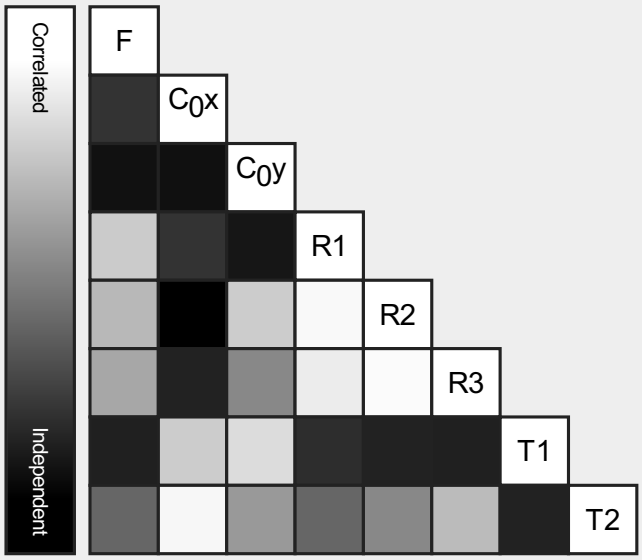
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

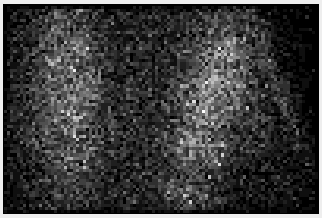
CA502R_REAR_43.0_6000x4000 (RGB). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	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	11032.877 [pixel] 43.249 [mm]	3006.831 [pixel] 11.787 [mm]	1945.553 [pixel] 7.627 [mm]	0.015	-0.375	1.291	0.000	-0.001
Uncertainties (Sigma)	0.466 [pixel] 0.002 [mm]	1.891 [pixel] 0.007 [mm]	1.454 [pixel] 0.006 [mm]	0.003	0.055	0.352	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.



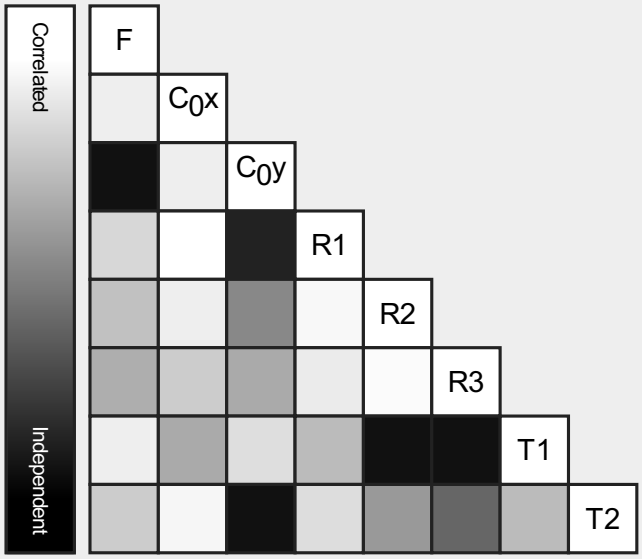
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

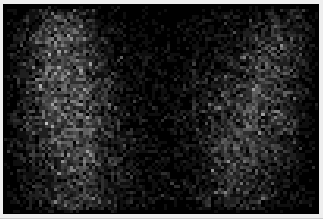
CA502R_FRONT_43.0_6000x4000 (RGB). Sensor Dimensions: 23.520 [mm] x 15.680 [mm]

EXIF ID: ILCE-5100_0.0_6000x4000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	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	11045.538 [pixel] 43.299 [mm]	3015.841 [pixel] 11.822 [mm]	1954.169 [pixel] 7.660 [mm]	-0.013	-0.196	1.434	0.001	0.000
Uncertainties (Sigma)	0.525 [pixel] 0.002 [mm]	2.461 [pixel] 0.010 [mm]	2.027 [pixel] 0.008 [mm]	0.003	0.060	0.369	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.

Camera Rig «CA502_OBLIQUE_RIG» Relatives. Images: 6065

	Transl X [m]	Transl Y [m]	Transl Z [m]	Rot X [degree]	Rot Y [degree]	Rot Z [degree]
CA502R_NADIR_28.0_6000x4000 (RGB)	Reference Camera					
CA502R_RIGHT_43.0_6000x4000 (RGB)						
Initial Values	0.000	0.051	-0.022	0.000	-45.000	-90.000
Optimized values	0.000	0.051	-0.022	0.320	-45.745	-89.983
Uncertainties (sigma)				0.009	0.007	0.014
CA502R_LEFT_43.0_6000x4000 (RGB)						
Initial Values	0.000	-0.051	-0.022	0.000	45.000	90.000
Optimized values	0.000	-0.051	-0.022	0.391	44.280	89.551
Uncertainties (sigma)				0.010	0.007	0.014
CA502R_REAR_43.0_6000x4000 (RGB)						
Initial Values	-0.051	0.000	-0.022	45.000	0.000	0.000
Optimized values	-0.051	0.000	-0.022	43.395	-0.885	0.083
Uncertainties (sigma)				0.007	0.002	0.010
CA502R_FRONT_43.0_6000x4000 (RGB)						
Initial Values	0.051	0.000	-0.022	-45.000	0.000	180.000
Optimized values	0.051	0.000	-0.022	-44.877	-0.354	179.111
Uncertainties (sigma)				0.010	0.013	0.001

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7189	234
Min	3572	0
Max	10294	3859
Mean	7145	505

2D Keypoints Table for Camera CA502R_NADIR_28.0_6000x4000 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7143	1622
Min	3854	42

Max	9889	3859
Mean	7124	1660

2D Keypoints Table for Camera CA502R_RIGHT_43.0_6000x4000 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7162	211
Min	4698	0
Max	9633	1010
Mean	7076	231

2D Keypoints Table for Camera CA502R_LEFT_43.0_6000x4000 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7149	216
Min	3685	1
Max	8760	855
Mean	7067	228

2D Keypoints Table for Camera CA502R_REAR_43.0_6000x4000 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7251	195
Min	3572	4
Max	10294	2712
Mean	7208	214

2D Keypoints Table for Camera CA502R_FRONT_43.0_6000x4000 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7279	184
Min	3667	5
Max	9313	809
Mean	7251	194

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

	CA502R_NADIR_28... (RGB)	CA502R_RIGHT_43... (RGB)	CA502R_LEFT_43.... (RGB)	CA502R_REAR_43.... (RGB)	CA502R_FRONT_43 (RGB)
CA502R_NADIR_28.0_6000x4000 (RGB)	61 / 193 / 2429	1 / 2 / 27	1 / 1 / 9	1 / 2 / 393	1 / 2 / 347
CA502R_RIGHT_43.0_6000x4000 (RGB)		6 / 28 / 624	1 / 3 / 41	1 / 1 / 2	1 / 1 / 3
CA502R_LEFT_43.0_6000x4000 (RGB)			6 / 30 / 764	1 / 1 / 4	1 / 1 / 11
CA502R_REAR_43.0_6000x4000 (RGB)				7 / 29 / 1594	1 / 2 / 64
CA502R_FRONT_43.0_6000x4000 (RGB)					6 / 24 / 475

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	760987
In 3 Images	117837
In 4 Images	47903
In 5 Images	25893
In 6 Images	16645
In 7 Images	11830
In 8 Images	8848
In 9 Images	6883
In 10 Images	5613

In 11 Images	4872
In 12 Images	4234
In 13 Images	3502
In 14 Images	3039
In 15 Images	2734
In 16 Images	2529
In 17 Images	2178
In 18 Images	1888
In 19 Images	1657
In 20 Images	1315
In 21 Images	1018
In 22 Images	757
In 23 Images	543
In 24 Images	342
In 25 Images	263
In 26 Images	243
In 27 Images	191
In 28 Images	167
In 29 Images	129
In 30 Images	96
In 31 Images	79
In 32 Images	45
In 33 Images	35
In 34 Images	14
In 35 Images	11
In 36 Images	3
In 37 Images	1

2D Keypoint Matches

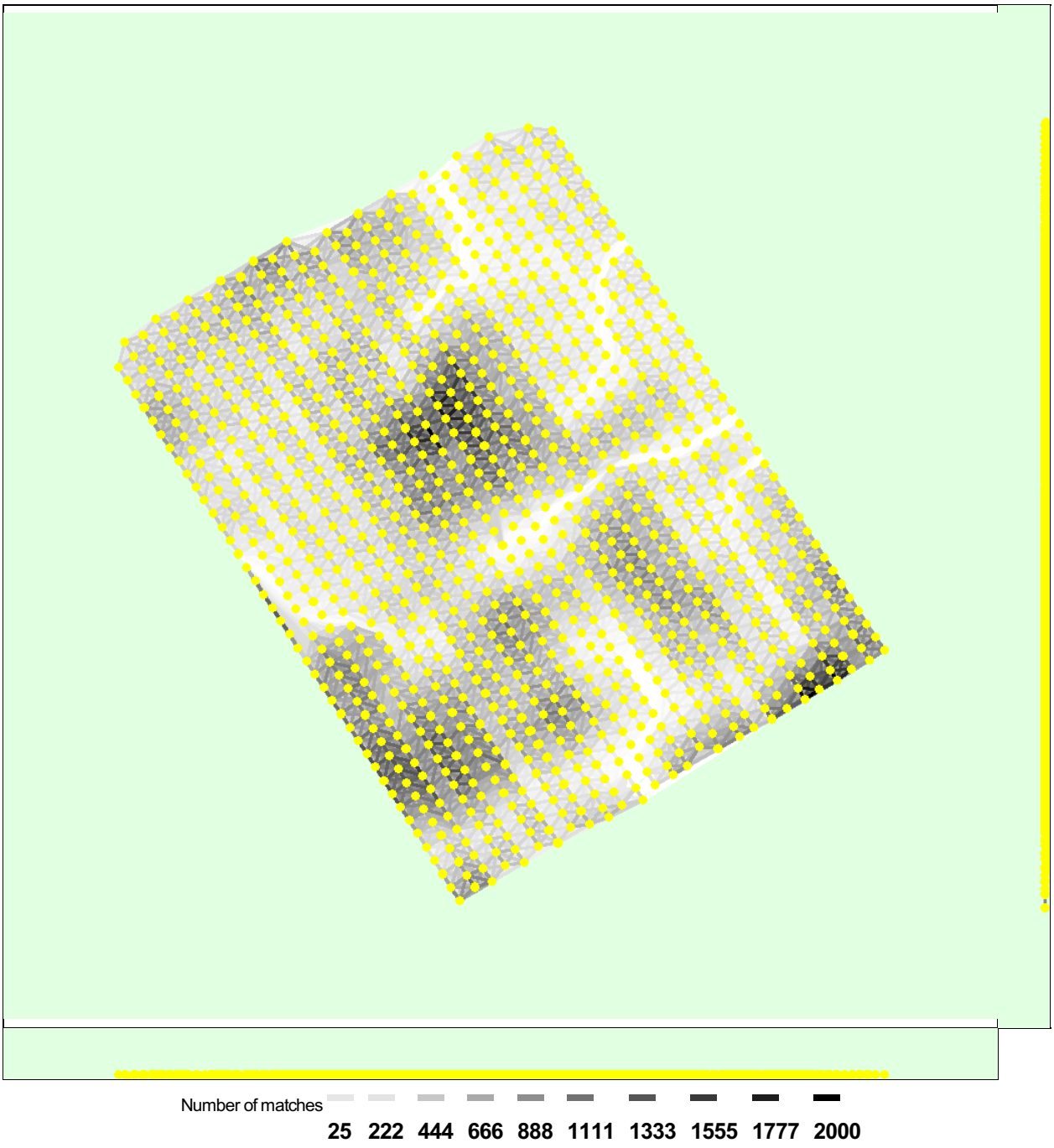


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

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-01 (3D)	0.020/ 0.050	0.041	0.021	0.015	0.173	30 / 30
LCP-05 (3D)	0.020/ 0.050	-0.004	-0.021	-0.005	0.170	30 / 30
LCP-16 (3D)	0.020/ 0.050	0.027	0.024	0.041	0.170	30 / 30
LCP-17 (3D)	0.020/ 0.050	-0.002	0.008	0.043	0.185	30 / 30
LCP-22 (3D)	0.020/ 0.050	-0.031	0.023	0.025	0.181	30 / 30
LCP-23 (3D)	0.020/ 0.050	-0.007	-0.011	0.040	0.226	30 / 30
GCP-01 (3D)	0.020/ 0.050	-0.031	0.022	-0.025	0.233	30 / 30
GCP-02 (3D)	0.020/ 0.050	-0.016	0.001	-0.009	0.311	30 / 30
GCP-03 (3D)	0.020/ 0.050	0.017	0.032	-0.003	0.297	30 / 30

GCP-04 (3D)	0.020/ 0.050	-0.025	0.011	-0.003	0.244	30 / 30
GCP-05 (3D)	0.020/ 0.050	-0.037	-0.035	0.007	0.141	30 / 30
GCP-06 (3D)	0.020/ 0.050	-0.003	0.034	-0.013	0.283	30 / 30
GCP-07 (3D)	0.020/ 0.050	-0.002	-0.010	0.008	0.312	30 / 30
GCP-08 (3D)	0.020/ 0.050	0.039	0.009	-0.019	0.304	30 / 30
GCP-09 (3D)	0.020/ 0.050	-0.014	-0.011	-0.039	0.242	30 / 30
GCP-10 (3D)	0.020/ 0.050	-0.014	-0.019	-0.026	0.096	30 / 30
GCP-11 (3D)	0.020/ 0.050	-0.003	0.005	-0.012	0.226	30 / 30
GCP-12 (3D)	0.020/ 0.050	-0.008	-0.033	0.006	0.260	30 / 30
GCP-13 (3D)	0.020/ 0.050	0.022	0.016	-0.063	0.266	30 / 30
GCP-14 (3D)	0.020/ 0.050	0.027	-0.018	0.027	0.272	30 / 30
GCP-15 (3D)	0.020/ 0.050	-0.018	-0.018	-0.004	0.310	30 / 30
GCP-16 (3D)	0.020/ 0.050	0.027	-0.007	-0.012	0.171	30 / 30
GCP-17 (3D)	0.020/ 0.050	0.031	-0.030	0.015	0.208	30 / 30
GCP-18 (3D)	0.020/ 0.050	-0.023	0.003	0.000	0.245	30 / 30
Mean [m]		-0.000306	-0.000218	-0.000200		
Sigma [m]		0.023007	0.020138	0.024829		
RMS Error [m]		0.023009	0.020139	0.024830		

0 out of 24 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
LCP-02		0.0182	-0.0078	0.0314	0.2292	30 / 30
LCP-03		0.0011	0.0075	0.0661	0.1819	30 / 30
LCP-04		0.0685	-0.0314	0.0770	0.1626	30 / 30
LCP-06		0.0199	0.0411	-0.0404	0.2429	30 / 30
LCP-07		0.0568	0.0268	0.0820	0.2596	30 / 30
LCP-08		0.0133	-0.0011	0.0781	0.2390	30 / 30
LCP-09		0.0084	-0.0469	0.0769	0.3326	30 / 30
LCP-10		0.0302	-0.0662	0.0523	0.2056	30 / 30
LCP-11		0.0483	0.0264	0.0376	0.2904	30 / 30
LCP-12		0.0342	0.0042	0.0329	0.2385	30 / 30
LCP-13		-0.0201	-0.0197	0.0496	0.2456	30 / 30
LCP-14		0.0075	-0.0254	0.0284	0.2769	30 / 30
LCP-15		-0.0063	-0.0203	0.0093	0.0726	30 / 30
LCP-18		0.0997	-0.0312	0.0005	0.1560	30 / 30
LCP-19		-0.0093	-0.0237	-0.0059	0.1504	30 / 30
LCP-21		0.0044	0.0428	0.0671	0.2255	30 / 30
LCP-24		-0.0189	0.0109	0.0261	0.3319	30 / 30
LCP-25		-0.0378	-0.0369	0.0367	0.1317	30 / 30
LCP-26		-0.0007	0.0413	0.0439	0.2573	30 / 30
LCP-27		-0.0224	0.0267	0.0360	0.1213	30 / 30
LCP-28		-0.0287	0.0263	0.0056	0.2567	30 / 30
LCP-29		-0.0292	0.0318	0.0341	0.1851	30 / 30
LCP-30		-0.0056	-0.0036	-0.0047	0.1328	30 / 30
LCP-32		-0.0171	0.0410	0.0651	0.2348	30 / 30
Mean [m]		0.008923	0.000527	0.036904		
Sigma [m]		0.033056	0.030895	0.030821		
RMS Error [m]		0.034239	0.030900	0.048082		

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	49.99	49.25	56.22
0.00	3.00	50.01	50.75	43.78
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]		-0.342891	-1.838003	2.669686
Sigma [m]		0.145534	0.121024	0.092335
RMS Error [m]		0.372497	1.841983	2.671283

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]	-0.342866	-1.838158	2.687269

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 «CA502_OBLIQUE_RIG» processing	optimize relative rotation