Quality Report

Generated with Pix4Dmapper version 4.3.31

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	eldo_3k_3
Processed	2018-12-28 22:22:35
Camera Model Name(s)	RedEdge_5.5_1280x960 (Blue), RedEdge_5.5_1280x960 (Green), RedEdge_5.5_1280x960 (Red), RedEdge_5.5_1280x960 (NIR), RedEdge_5.5_1280x960 (Red edge), FC350_3.6_4000x3000 (RGB)
Rig name(s)	«MicaSense 5 band_merge_eldo_3k_1_re_merge_eldo_3k_1_re_merge_eldo_3k_2_re_merge_eldo_3k_3_re»
Average Ground Sampling Distance (GSD)	8.14 cm / 3.20 in
Area Covered	0.000 km^2 / 0.0000 ha / 0.00 sq. mi. / 0.0001 acres

Quality Check

Images	median of 7816 keypoints per image	⚠
Dataset	13278 out of 13323 images calibrated (99%), all images enabled	✓
Camera Optimization	1.49% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 1201.39 matches per calibrated image	✓
Georeferencing	yes, no 3D GCP	⚠

Preview

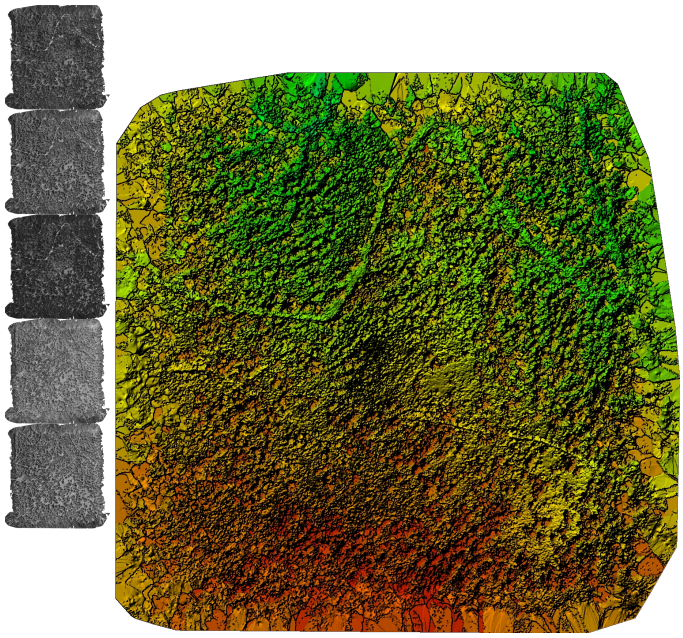


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	13278 out of 13323
Number of Geolocated Images	13323 out of 13323

Initial Image Positions

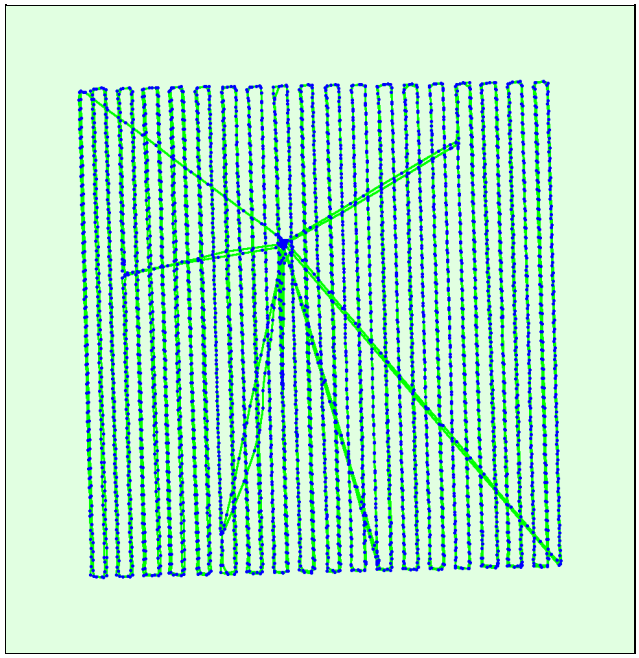
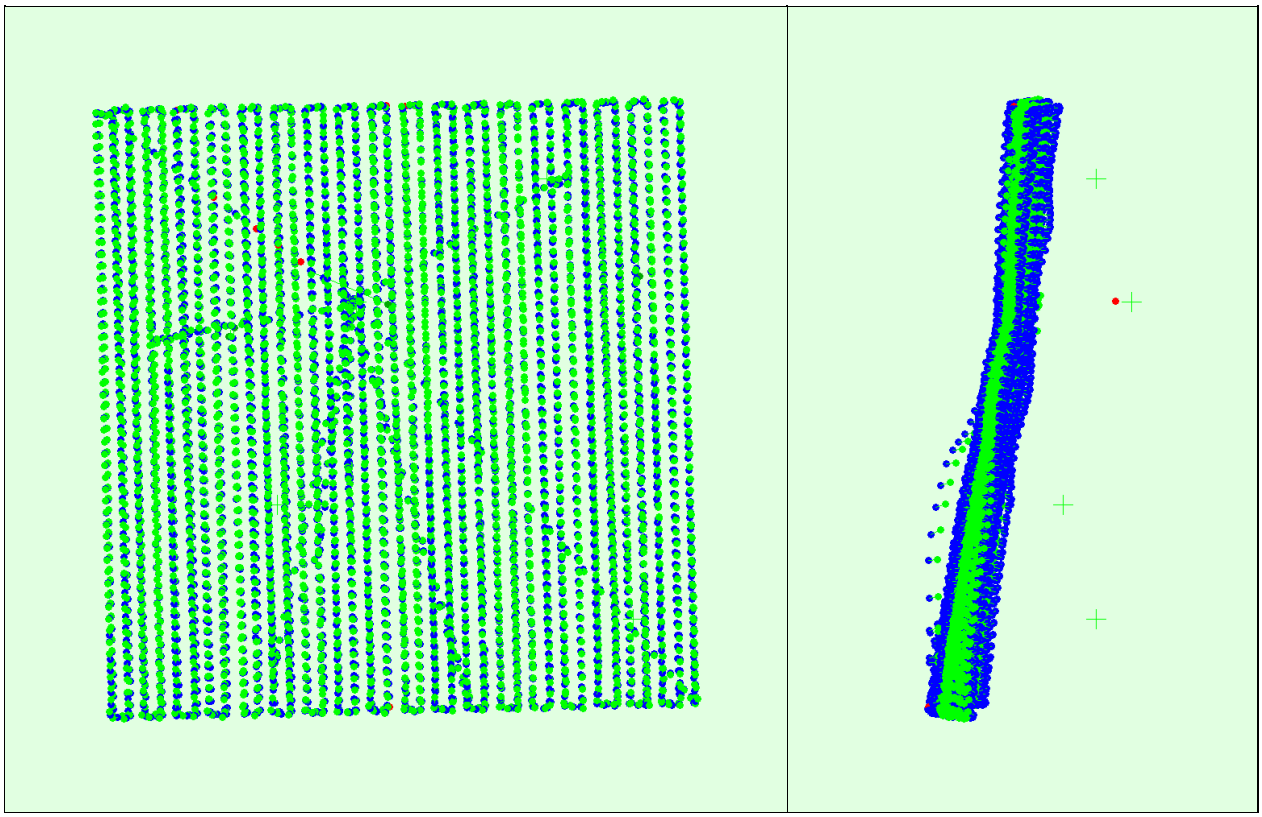
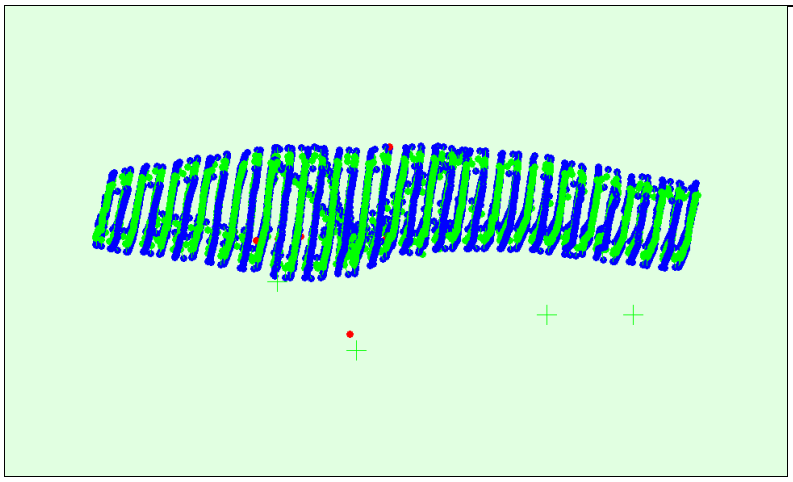


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions





Uncertainty ellipses 10x 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	0.077	0.079	0.143	0.033	0.033	0.014
Sigma	0.014	0.014	0.026	0.005	0.005	0.004

Overlap

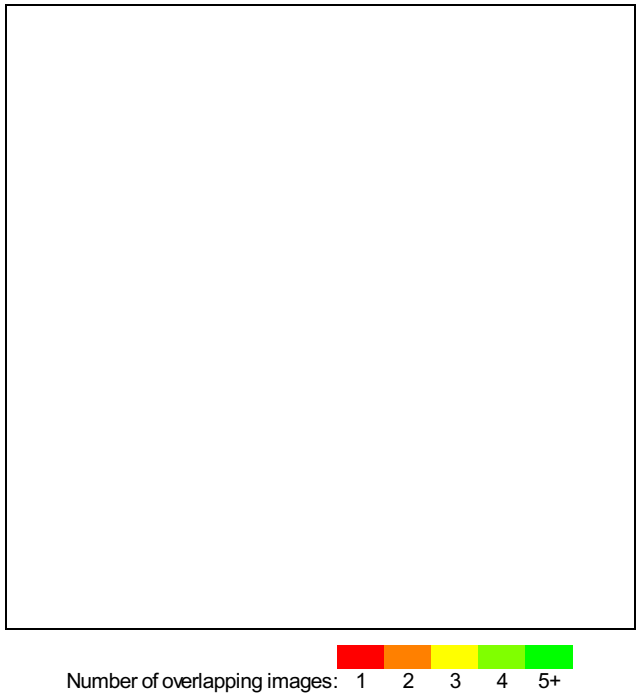


**Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

Bundle Block Adjustment Details

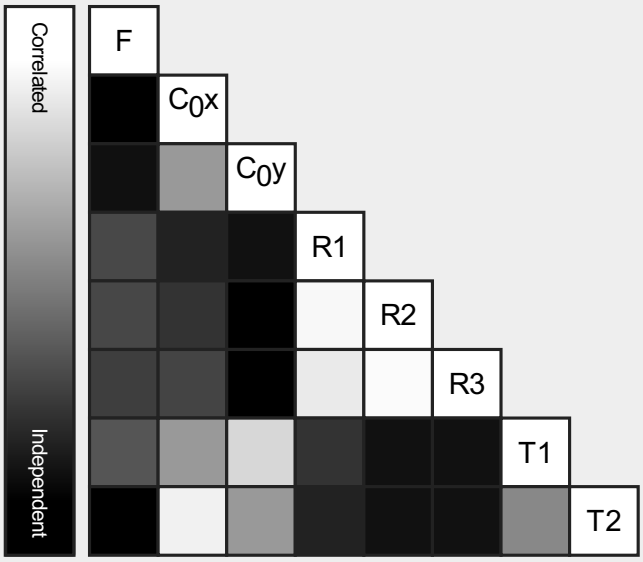
Number of 2D Keypoint Observations for Bundle Block Adjustment	6705099
Number of 3D Points for Bundle Block Adjustment	2253873
Mean Reprojection Error [pixels]	0.181

Internal Camera Parameters

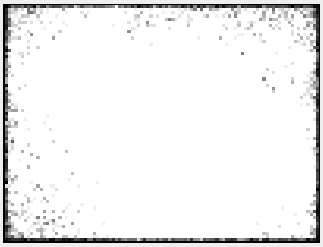
RedEdge_5.5_1280x960 (Blue). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	657.605 [pixel] 2.466 [mm]	495.123 [pixel] 1.857 [mm]	-0.097	0.149	-0.017	0.000	0.000
Optimized Values	1445.692 [pixel] 5.421 [mm]	653.576 [pixel] 2.451 [mm]	494.894 [pixel] 1.856 [mm]	-0.096	0.143	-0.013	0.000	-0.000
Uncertainties (Sigma)	0.240 [pixel] 0.001 [mm]	0.219 [pixel] 0.001 [mm]	0.165 [pixel] 0.001 [mm]	0.001	0.011	0.024	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.



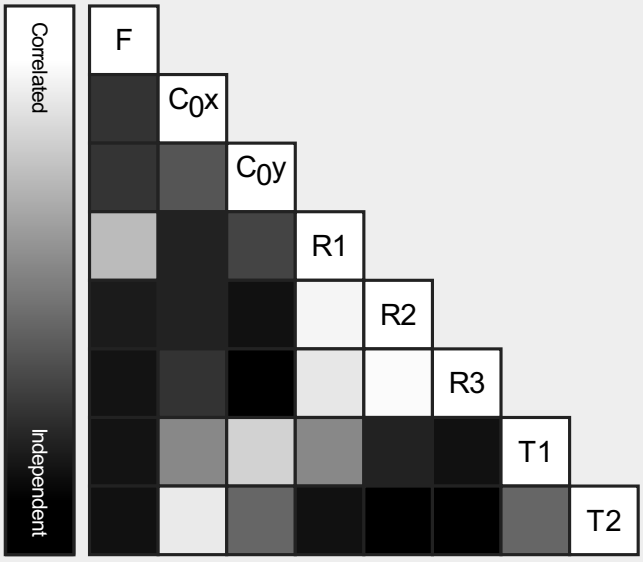
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

RedEdge_5.5_1280x960 (Green). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	657.835 [pixel] 2.467 [mm]	481.299 [pixel] 1.805 [mm]	-0.099	0.143	-0.021	0.000	0.001
Optimized Values	1442.463 [pixel] 5.409 [mm]	655.846 [pixel] 2.459 [mm]	481.434 [pixel] 1.805 [mm]	-0.097	0.127	0.013	0.000	0.000
Uncertainties (Sigma)	0.228 [pixel] 0.001 [mm]	0.073 [pixel] 0.000 [mm]	0.058 [pixel] 0.000 [mm]	0.000	0.003	0.008	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.

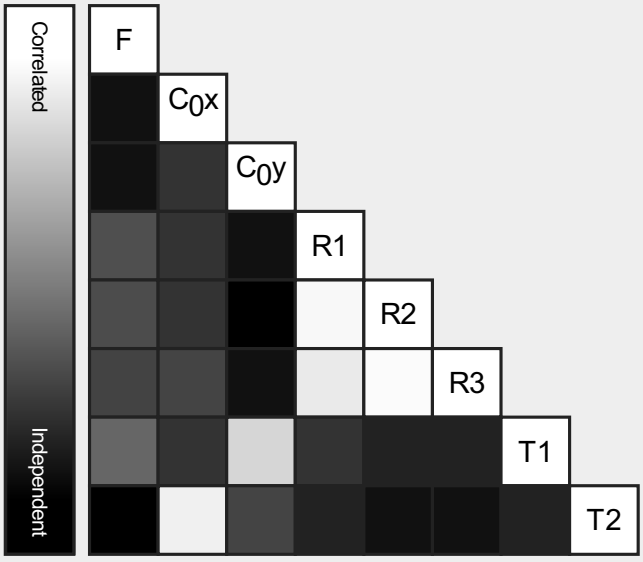
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

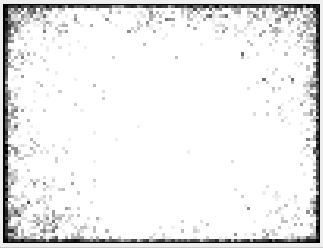
RedEdge_5.5_1280x960 (Red). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	657.200 [pixel] 2.465 [mm]	493.864 [pixel] 1.852 [mm]	-0.100	0.131	-0.003	-0.000	0.000
Optimized Values	1447.682 [pixel] 5.429 [mm]	653.260 [pixel] 2.450 [mm]	493.491 [pixel] 1.851 [mm]	-0.097	0.116	0.018	-0.000	-0.000
Uncertainties (Sigma)	0.243 [pixel] 0.001 [mm]	0.239 [pixel] 0.001 [mm]	0.181 [pixel] 0.001 [mm]	0.002	0.012	0.027	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.



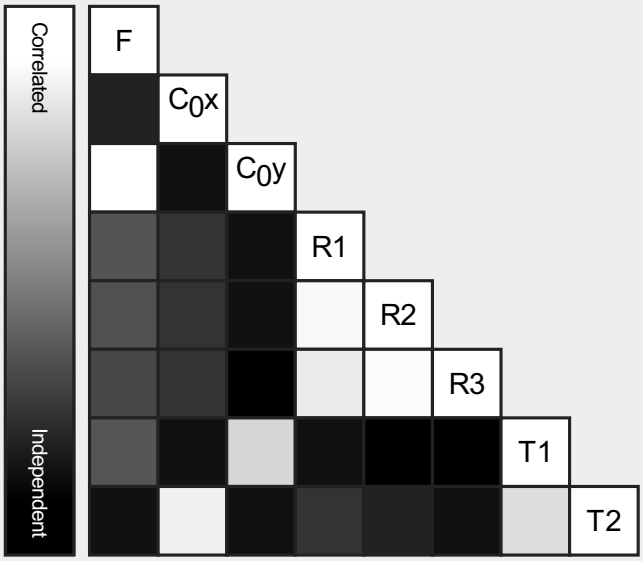
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

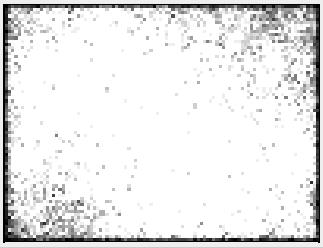
RedEdge_5.5_1280x960 (NIR). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	666.605 [pixel] 2.500 [mm]	482.221 [pixel] 1.808 [mm]	-0.105	0.153	-0.045	0.000	0.000
Optimized Values	1448.201 [pixel] 5.431 [mm]	661.383 [pixel] 2.480 [mm]	481.893 [pixel] 1.807 [mm]	-0.103	0.139	-0.016	0.000	-0.000
Uncertainties (Sigma)	0.244 [pixel] 0.001 [mm]	0.247 [pixel] 0.001 [mm]	0.185 [pixel] 0.001 [mm]	0.002	0.012	0.027	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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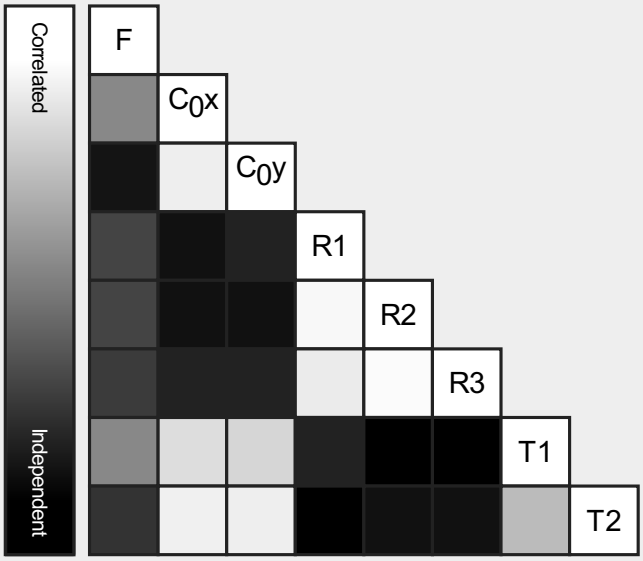
Internal Camera Parameters

RedEdge_5.5_1280x960 (Red edge). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

EXIF ID: RedEdge_5.5_1280x960

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	661.440 [pixel] 2.480 [mm]	495.379 [pixel] 1.858 [mm]	-0.103	0.155	-0.049	0.000	0.001
Optimized Values	1445.843 [pixel] 5.422 [mm]	656.838 [pixel] 2.463 [mm]	494.013 [pixel] 1.853 [mm]	-0.100	0.134	-0.009	0.000	-0.000
Uncertainties (Sigma)	0.238 [pixel] 0.001 [mm]	0.200 [pixel] 0.001 [mm]	0.152 [pixel] 0.001 [mm]	0.001	0.010	0.023	0.000	0.000



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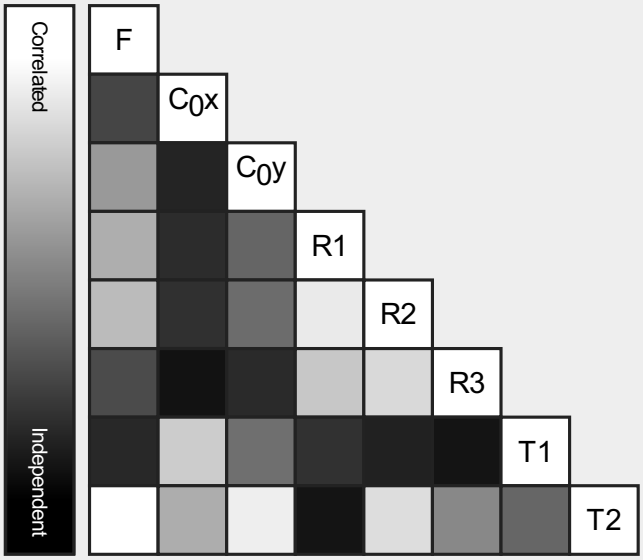
Internal Camera Parameters

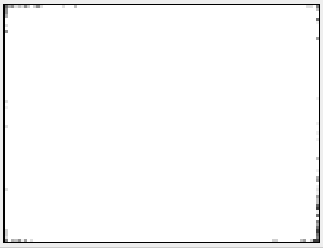
FC350_3.6_4000x3000 (RGB). Sensor Dimensions: 6.317 [mm] x 4.738 [mm]

EXIF ID: FC350_3.6_4000x3000

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	2285.722 [pixel] 3.610 [mm]	2000.006 [pixel] 3.159 [mm]	1500.003 [pixel] 2.369 [mm]	-0.130	0.106	-0.016	-0.000	0.000
Optimized Values	2242.162 [pixel] 3.541 [mm]	1986.471 [pixel] 3.137 [mm]	1505.059 [pixel] 2.377 [mm]	-0.120	0.097	-0.012	0.001	0.000
Uncertainties (Sigma)	1.327 [pixel] 0.002 [mm]	0.055 [pixel] 0.000 [mm]	0.059 [pixel] 0.000 [mm]	0.000	0.000	0.000	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 «MicaSense 5 band_merge_eldo_3k_1_re_merge_eldo_3k_1_re_merge_eldo_3k_2_re_merge_eldo_3k_3_re» Relatives. Images: 11315

	Transl X [m]	Transl Y [m]	Transl Z [m]	Rot X [degree]	Rot Y [degree]	Rot Z [degree]
RedEdge_5.5_1280x960 (Green)	Reference Camera					
RedEdge_5.5_1280x960 (Blue)						
Initial Values	0.030	0.000	0.000	0.000	0.000	0.000
Optimized values	0.030	0.000	0.000	-0.100	0.097	-0.374
Uncertainties (sigma)				0.007	0.009	0.001
RedEdge_5.5_1280x960 (Red)						
Initial Values	0.000	0.022	0.000	0.000	0.000	0.000
Optimized values	0.000	0.022	0.000	0.054	0.065	-0.062
Uncertainties (sigma)				0.007	0.010	0.001
RedEdge_5.5_1280x960 (NIR)						
Initial Values	0.030	0.022	0.000	0.000	0.000	0.000
Optimized values	0.030	0.022	0.000	-0.132	-0.165	0.119
Uncertainties (sigma)				0.008	0.010	0.001
RedEdge_5.5_1280x960 (Red edge)						
Initial Values	0.015	0.011	0.000	0.000	0.000	0.000
Optimized values	0.015	0.011	0.000	-0.063	-0.597	-0.321
Uncertainties (sigma)				0.006	0.008	0.001

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7816	1201
Min	5601	21
Max	14790	6076
Mean	9308	1296

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (Blue)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6531	1086
Min	5601	21
Max	7938	4425
Mean	6544	1231

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (Green)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7307	1388
Min	5805	184
Max	9448	6076
Mean	7233	1567

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (Red)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6711	1057

Min	5626	24
Max	8142	4278
Mean	6665	1198

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (NIR)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7919	1149
Min	6622	46
Max	9398	5413
Mean	7888	1387

2D Keypoints Table for Camera RedEdge_5.5_1280x960 (Red edge)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7718	1267
Min	6450	45
Max	9269	5538
Mean	7676	1515

2D Keypoints Table for Camera FC350_3.6_4000x3000 (RGB)

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	12635	961
Min	10669	260
Max	14790	2735
Mean	12596	975

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

	RedEdge_5.5_12... (Blue)	RedEdge_5.5_1... (Green)	RedEdge_5.5_128... (Red)	RedEdge_5.5_128... (NIR)	RedEdge_5.... (Red edge)	FC350_3.6_4000x300 (RGB)
RedEdge_5.5_1280x960 (Blue)	28 / 93 / 3411	12 / 43 / 1981	22 / 91 / 2134	8 / 38 / 935	10 / 44 / 1537	
RedEdge_5.5_1280x960 (Green)		14 / 54 / 4698	10 / 31 / 1331	6 / 21 / 1923	10 / 32 / 3666	
RedEdge_5.5_1280x960 (Red)			30 / 99 / 3453	12 / 36 / 660	14 / 44 / 1062	
RedEdge_5.5_1280x960 (NIR)				31 / 111 / 4511	18 / 84 / 2212	
RedEdge_5.5_1280x960 (Red edge)					17 / 63 / 3812	
FC350_3.6_4000x3000 (RGB)						5 / 18 / 2046

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	1503932
In 3 Images	351145
In 4 Images	152104
In 5 Images	78588
In 6 Images	47194
In 7 Images	30023
In 8 Images	20821
In 9 Images	14808
In 10 Images	10947
In 11 Images	8397
In 12 Images	6375
In 13 Images	4871
In 14 Images	4055
In 15 Images	3193

In 16 Images	2643
In 17 Images	2131
In 18 Images	1835
In 19 Images	1445
In 20 Images	1250
In 21 Images	1034
In 22 Images	943
In 23 Images	806
In 24 Images	656
In 25 Images	537
In 26 Images	481
In 27 Images	424
In 28 Images	362
In 29 Images	312
In 30 Images	290
In 31 Images	243
In 32 Images	234
In 33 Images	186
In 34 Images	185
In 35 Images	139
In 36 Images	111
In 37 Images	123
In 38 Images	103
In 39 Images	78
In 40 Images	74
In 41 Images	61
In 42 Images	72
In 43 Images	48
In 44 Images	51
In 45 Images	41
In 46 Images	41
In 47 Images	35
In 48 Images	30
In 49 Images	33
In 50 Images	27
In 51 Images	25
In 52 Images	22
In 53 Images	22
In 54 Images	18
In 55 Images	18
In 56 Images	8
In 57 Images	18
In 58 Images	11
In 59 Images	10
In 60 Images	10
In 61 Images	10
In 62 Images	8
In 63 Images	8
In 64 Images	5
In 65 Images	7
In 66 Images	4
In 67 Images	8
In 68 Images	6
In 69 Images	1
In 70 Images	5
In 71 Images	3
In 72 Images	3
In 73 Images	1
In 74 Images	5
In 75 Images	3

In 76 Images	2
In 77 Images	4
In 78 Images	1
In 79 Images	3
In 80 Images	3
In 81 Images	2
In 82 Images	6
In 83 Images	3
In 84 Images	2
In 85 Images	2
In 86 Images	2
In 87 Images	6
In 88 Images	2
In 89 Images	2
In 90 Images	2
In 91 Images	1
In 92 Images	4
In 93 Images	4
In 95 Images	2
In 96 Images	1
In 97 Images	1
In 98 Images	4
In 100 Images	2
In 101 Images	2
In 103 Images	1
In 104 Images	3
In 105 Images	3
In 106 Images	1
In 108 Images	4
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In 111 Images	1
In 113 Images	1
In 114 Images	3
In 115 Images	2
In 116 Images	2
In 122 Images	1
In 123 Images	1
In 124 Images	1
In 126 Images	1
In 127 Images	1
In 128 Images	3
In 129 Images	2
In 131 Images	1
In 132 Images	1
In 133 Images	1
In 135 Images	1
In 136 Images	2
In 137 Images	1
In 142 Images	2
In 143 Images	1
In 145 Images	1
In 146 Images	2
In 147 Images	1
In 150 Images	1
In 154 Images	1
In 178 Images	1
In 190 Images	1
In 194 Images	1
In 195 Images	1
In 204 Images	1

In 220 Images	1

2D Keypoint Matches

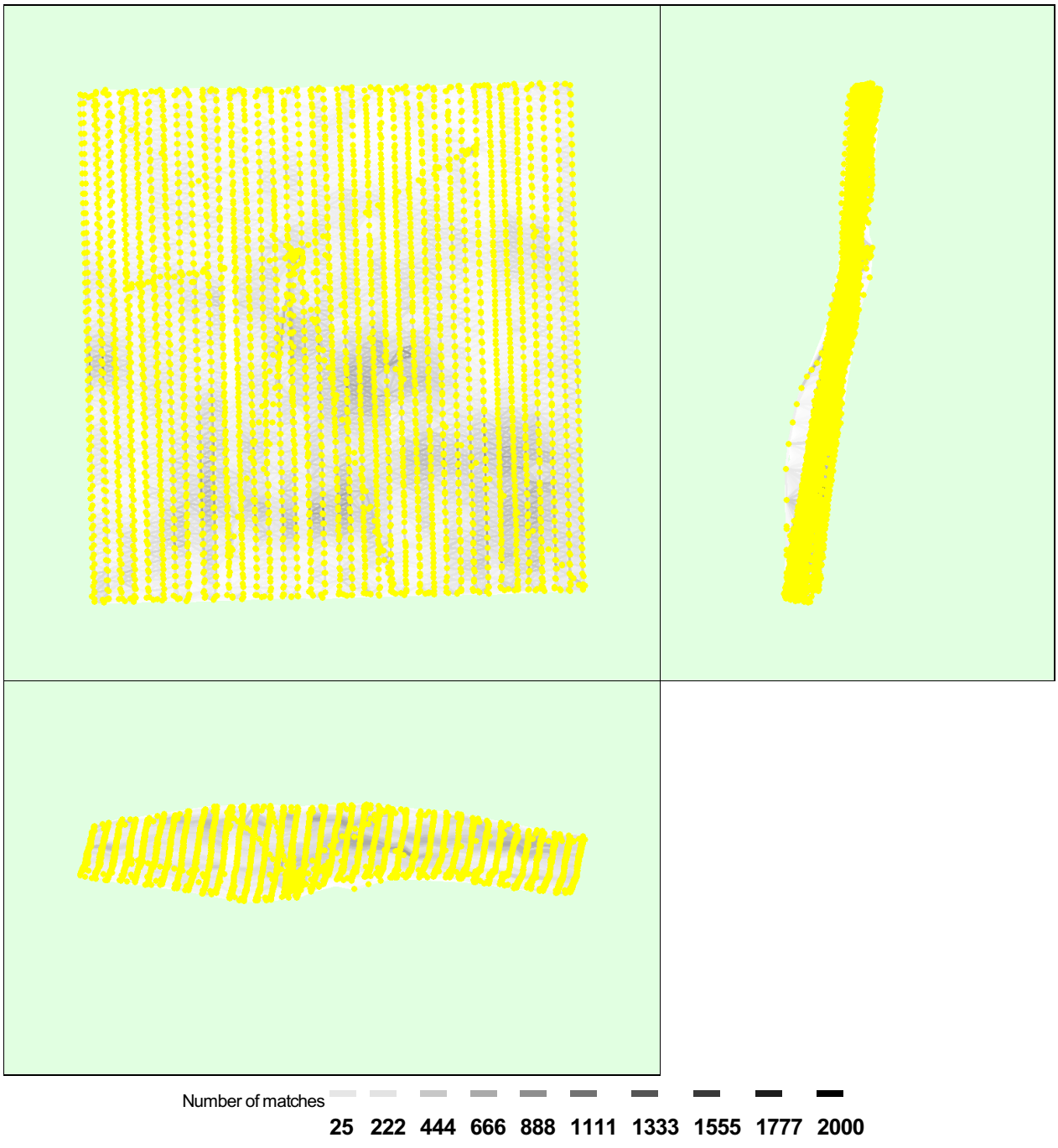

Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

Manual Tie Points

MTP Name	Projection Error [pixel]	Verified/Marked
mtp1	0.661	41 / 41
mtp2	1.035	41 / 41
mtp3	4.045	29 / 29
mtp4	6.186	15 / 20

Projection errors for manual tie points.The last column counts the number of images where the manual tie point has been automatically verified vs. manually marked.

Geolocation Details

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	0.03
-12.00	-9.00	0.00	0.01	8.72
-9.00	-6.00	0.00	0.02	6.35
-6.00	-3.00	0.02	3.35	0.05
-3.00	0.00	37.64	35.71	0.00
0.00	3.00	62.15	58.72	0.00
3.00	6.00	0.11	2.17	2.68
6.00	9.00	0.08	0.00	63.42
9.00	12.00	0.00	0.02	18.75
12.00	15.00	0.00	0.00	0.00
15.00	-	0.00	0.02	0.00
Mean [m]		0.244376	0.269869	5.529996
Sigma [m]		0.780259	1.562472	6.282829
RMS Error [m]		0.817634	1.585607	8.369874

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]	99.92	99.22	96.21
[-2.00, 2.00]	100.00	99.96	100.00
[-3.00, 3.00]	100.00	99.98	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.

Geolocation Orientational Variance	RMS [degree]
Omega	0.762
Phi	0.849
Kappa	4.790

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) i7-8700K CPU @ 3.70GHz RAM: 64GB GPU: NVIDIA GeForce GTX 1080 Ti (Driver: 24.21.13.9882), Intel(R) UHD Graphics 630 (Driver: 22.20.16.4758)
Operating System	Windows 10 Education, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84 (EGM96 Geoid)
Output Coordinate System	WGS 84 / UTM zone 10N (EGM96 Geoid)

Processing Options

Detected Template	No Template Available
Keypoints Image Scale	Custom, 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: Automatic
Advanced: Calibration	Calibration Method: Standard Internal Parameters Optimization: All External Parameters Optimization: All Rematch: Custom, yes
Rig «MicaSense 5 band_merge_eldo_3k_1_re_merge_eldo_3k_1_re_merge_eldo_3k_2_re_merge_eldo_3k_3_re» processing	optimize relative rotation using a subset of secondary cameras