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_4k_1
Processed	2018-12-30 12:10:38
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_4k_1_re»
Average Ground Sampling Distance (GSD)	7.91 cm / 3.12 in
Area Covered	0.000 km^2 / 0.0000 ha / 0.00 sq. mi. / 0.0001 acres

Quality Check

Images	median of 7631 keypoints per image	⚠
Dataset	12291 out of 12361 images calibrated (99%), 5 images disabled	✓
Camera Optimization	1.11% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 1465.86 matches per calibrated image	✓
Georeferencing	yes, no 3D GCP	⚠

Preview

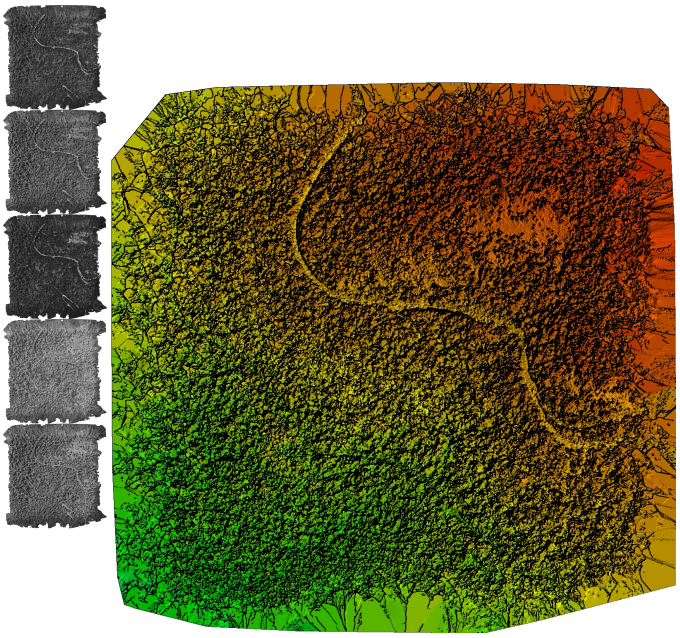


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	12291 out of 12366
Number of Geolocated Images	12366 out of 12366

Initial Image Positions

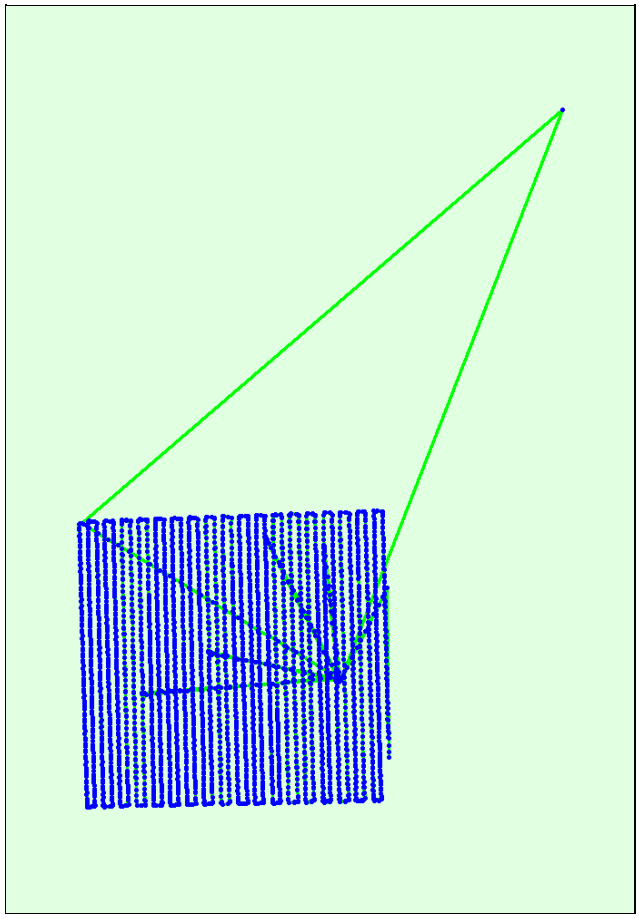
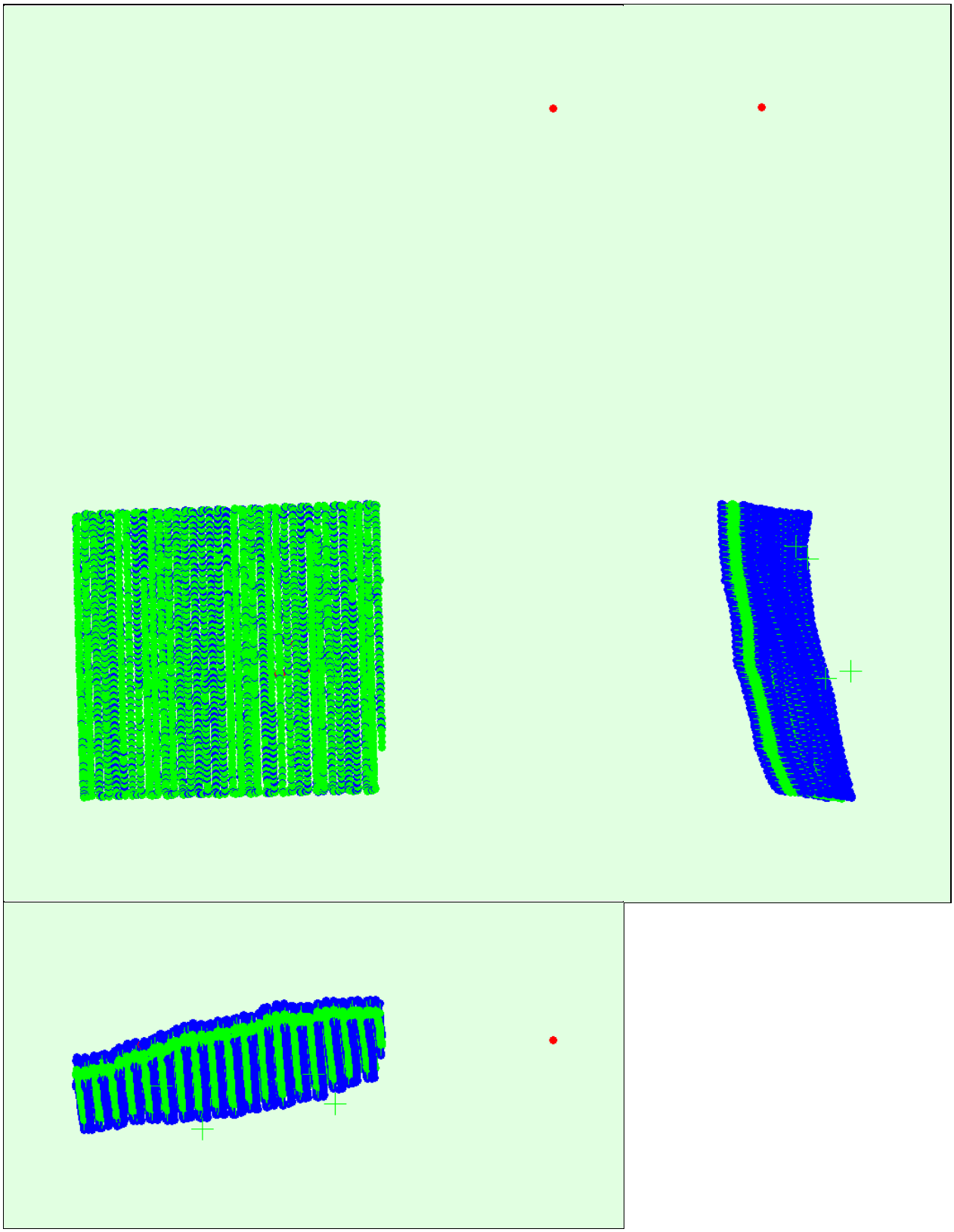


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

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	0.068	0.069	0.122	0.028	0.027	0.013
Sigma	0.011	0.011	0.021	0.004	0.004	0.003

Overlap

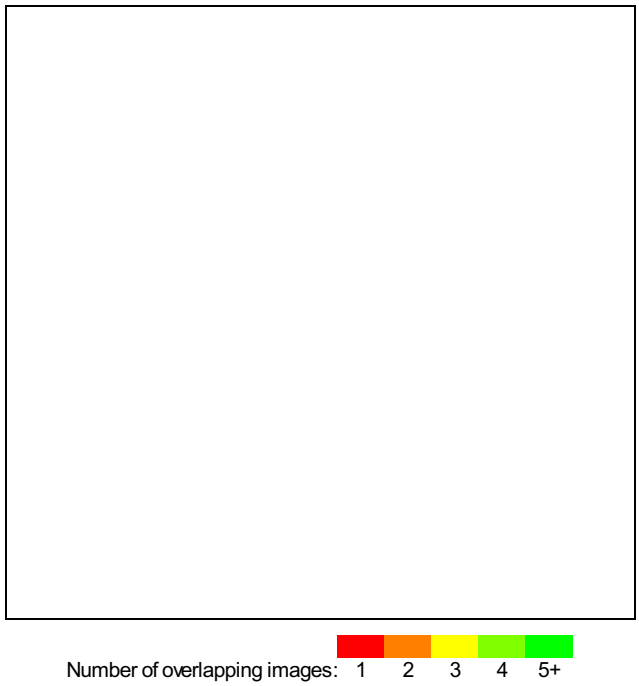


**Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

Bundle Block Adjustment Details

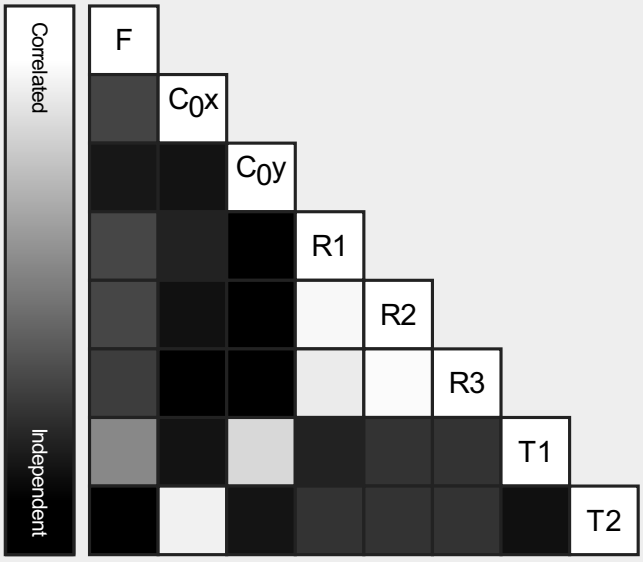
Number of 2D Keypoint Observations for Bundle Block Adjustment	7471313
Number of 3D Points for Bundle Block Adjustment	2663112
Mean Reprojection Error [pixels]	0.166

Internal Camera Parameters

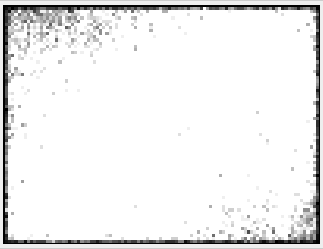
RedEdge_5.5_1280x960 (Blue). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

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	1448.300 [pixel] 5.431 [mm]	654.684 [pixel] 2.455 [mm]	495.215 [pixel] 1.857 [mm]	-0.096	0.149	-0.029	0.000	-0.000
Uncertainties (Sigma)	0.223 [pixel] 0.001 [mm]	0.192 [pixel] 0.001 [mm]	0.145 [pixel] 0.001 [mm]	0.001	0.009	0.021	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.



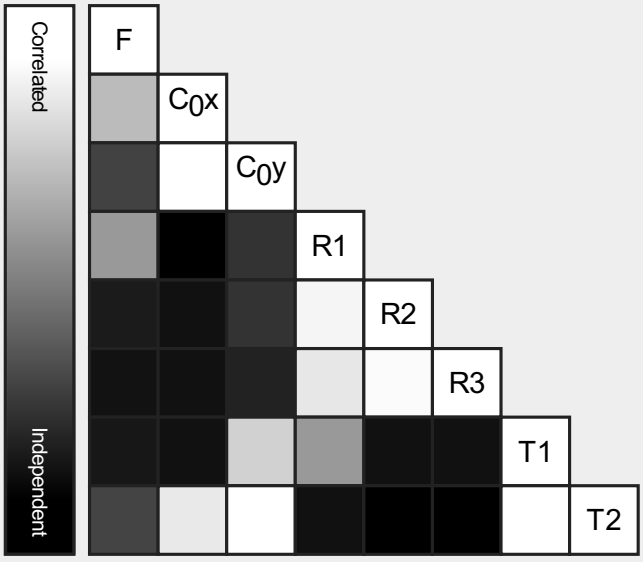
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the 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	1445.197 [pixel] 5.419 [mm]	656.032 [pixel] 2.460 [mm]	481.062 [pixel] 1.804 [mm]	-0.100	0.151	-0.032	0.000	0.000
Uncertainties (Sigma)	0.212 [pixel] 0.001 [mm]	0.067 [pixel] 0.000 [mm]	0.054 [pixel] 0.000 [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.

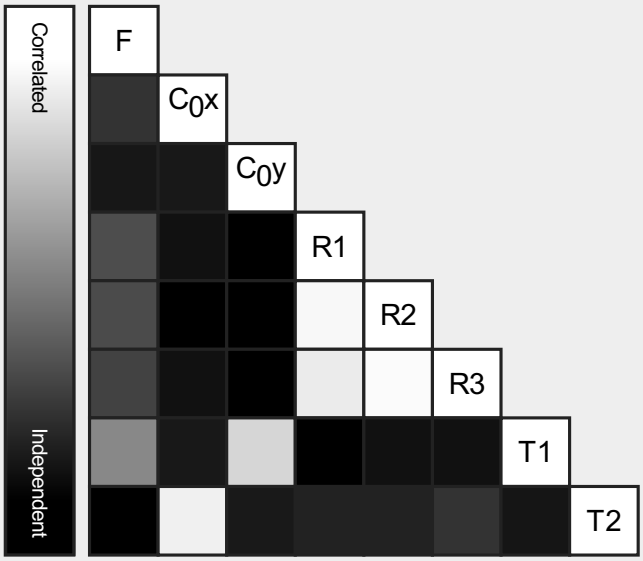
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

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	1450.465 [pixel] 5.439 [mm]	653.978 [pixel] 2.452 [mm]	493.686 [pixel] 1.851 [mm]	-0.100	0.132	-0.003	-0.000	-0.000
Uncertainties (Sigma)	0.225 [pixel] 0.001 [mm]	0.210 [pixel] 0.001 [mm]	0.158 [pixel] 0.001 [mm]	0.001	0.010	0.023	0.000	0.000



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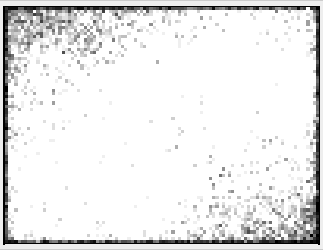

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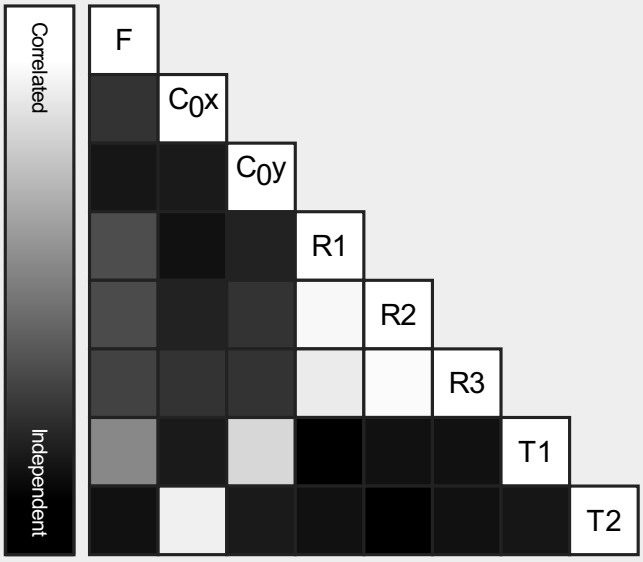
Internal Camera Parameters

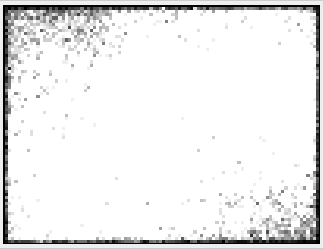
RedEdge_5.5_1280x960 (NIR). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

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	1450.961 [pixel] 5.441 [mm]	662.712 [pixel] 2.485 [mm]	482.257 [pixel] 1.808 [mm]	-0.103	0.140	-0.012	0.000	-0.000
Uncertainties (Sigma)	0.225 [pixel] 0.001 [mm]	0.208 [pixel] 0.001 [mm]	0.156 [pixel] 0.001 [mm]	0.001	0.010	0.022	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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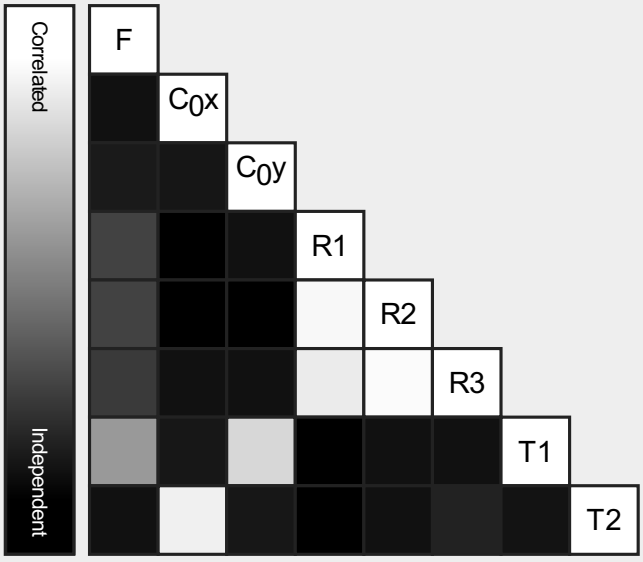
Internal Camera Parameters

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	1448.660 [pixel] 5.432 [mm]	657.606 [pixel] 2.466 [mm]	494.252 [pixel] 1.853 [mm]	-0.102	0.149	-0.034	0.000	-0.000
Uncertainties (Sigma)	0.222 [pixel] 0.001 [mm]	0.180 [pixel] 0.001 [mm]	0.135 [pixel] 0.001 [mm]	0.001	0.009	0.020	0.000	0.000



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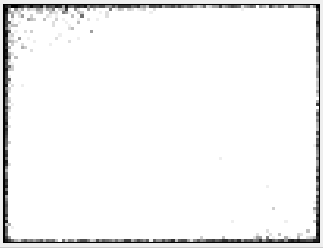

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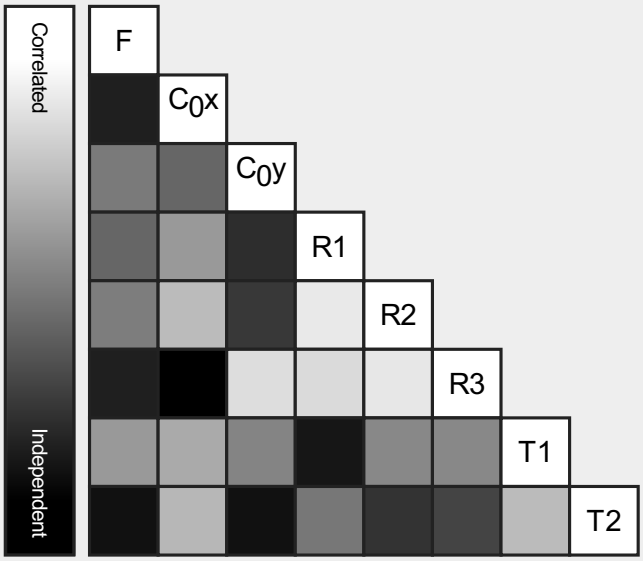
Internal Camera Parameters

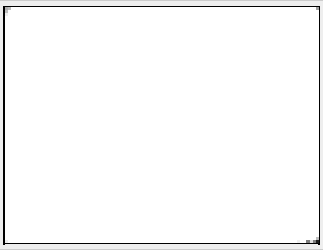
FC350_3.6_4000x3000 (RGB). Sensor Dimensions: 6.317 [mm] x 4.738 [mm]

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	2273.119 [pixel] 3.590 [mm]	1985.852 [pixel] 3.136 [mm]	1504.306 [pixel] 2.376 [mm]	-0.122	0.100	-0.011	0.001	0.000
Uncertainties (Sigma)	0.600 [pixel] 0.001 [mm]	0.038 [pixel] 0.000 [mm]	0.040 [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_4k_1_re» Relatives. Images: 10490

	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	-0.125	0.129	-0.372
Uncertainties (sigma)				0.006	0.008	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	0.032	0.085	-0.061
Uncertainties (sigma)				0.006	0.009	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	-0.161	-0.122	0.119
Uncertainties (sigma)				0.006	0.009	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	-0.086	-0.572	-0.321
Uncertainties (sigma)				0.006	0.007	0.000

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7631	1466
Min	5637	118
Max	14607	5723
Mean	9403	1561

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6499	1208
Min	5691	253
Max	8210	3671
Mean	6581	1315

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7003	1645
Min	5917	118
Max	9207	5723
Mean	7069	1759

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	6531	1090
Min	5780	169
Max	8183	3315
Mean	6627	1201

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	7775	1461
Min	6283	234
Max	9393	4586
Mean	7791	1548

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	7499	1594
Min	5637	348
Max	9082	5027
Mean	7528	1691

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	12975	1386
Min	11851	364
Max	14607	2980
Mean	13013	1394

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)	21 / 126 / 2142	12 / 55 / 1787	21 / 185 / 1575	10 / 90 / 884	12 / 114 / 1411	
RedEdge_5.5_1280x960 (Green)		13 / 63 / 3966	10 / 41 / 1200	7 / 24 / 1530	9 / 35 / 2996	
RedEdge_5.5_1280x960 (Red)			22 / 119 / 2141	12 / 74 / 746	14 / 104 / 1130	
RedEdge_5.5_1280x960 (NIR)				18 / 110 / 3085	16 / 223 / 1836	
RedEdge_5.5_1280x960 (Red edge)					13 / 74 / 2514	
FC350_3.6_4000x3000 (RGB)						6 / 25 / 2188

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	1836839
In 3 Images	423979
In 4 Images	169909
In 5 Images	83309
In 6 Images	47064
In 7 Images	27752
In 8 Images	18019
In 9 Images	12628
In 10 Images	9271
In 11 Images	6747
In 12 Images	4994
In 13 Images	3815
In 14 Images	2817
In 15 Images	2244
In 16 Images	1825
In 17 Images	1500
In 18 Images	1257
In 19 Images	1092
In 20 Images	929
In 21 Images	771
In 22 Images	733
In 23 Images	578
In 24 Images	498
In 25 Images	425
In 26 Images	381
In 27 Images	356
In 28 Images	269
In 29 Images	269
In 30 Images	232
In 31 Images	193
In 32 Images	187
In 33 Images	189
In 34 Images	158
In 35 Images	132
In 36 Images	135
In 37 Images	113
In 38 Images	115

In 39 Images	95
In 40 Images	101
In 41 Images	87
In 42 Images	92
In 43 Images	70
In 44 Images	68
In 45 Images	63
In 46 Images	43
In 47 Images	54
In 48 Images	40
In 49 Images	33
In 50 Images	35
In 51 Images	36
In 52 Images	31
In 53 Images	28
In 54 Images	31
In 55 Images	28
In 56 Images	24
In 57 Images	24
In 58 Images	26
In 59 Images	16
In 60 Images	19
In 61 Images	15
In 62 Images	8
In 63 Images	16
In 64 Images	14
In 65 Images	16
In 66 Images	14
In 67 Images	6
In 68 Images	12
In 69 Images	13
In 70 Images	7
In 71 Images	5
In 72 Images	5
In 73 Images	14
In 74 Images	2
In 75 Images	3
In 76 Images	6
In 77 Images	9
In 78 Images	7
In 79 Images	11
In 80 Images	3
In 81 Images	6
In 82 Images	3
In 83 Images	5
In 84 Images	5
In 85 Images	5
In 86 Images	5
In 87 Images	6
In 88 Images	6
In 89 Images	1
In 90 Images	5
In 91 Images	3
In 92 Images	7
In 93 Images	6
In 94 Images	2
In 95 Images	5
In 96 Images	2
In 97 Images	3
In 98 Images	3

In 99 Images	4
In 100 Images	1
In 101 Images	2
In 102 Images	5
In 103 Images	3
In 104 Images	8
In 105 Images	4
In 107 Images	7
In 108 Images	2
In 109 Images	2
In 110 Images	3
In 111 Images	1
In 112 Images	2
In 113 Images	3
In 114 Images	1
In 115 Images	3
In 117 Images	2
In 118 Images	2
In 119 Images	1
In 120 Images	1
In 121 Images	1
In 122 Images	1
In 123 Images	2
In 125 Images	2
In 126 Images	1
In 127 Images	1
In 128 Images	1
In 131 Images	1
In 133 Images	1
In 134 Images	1
In 135 Images	1
In 136 Images	2
In 138 Images	1
In 141 Images	1
In 149 Images	1
In 151 Images	1
In 152 Images	1
In 157 Images	1
In 163 Images	1
In 167 Images	1

2D Keypoint Matches

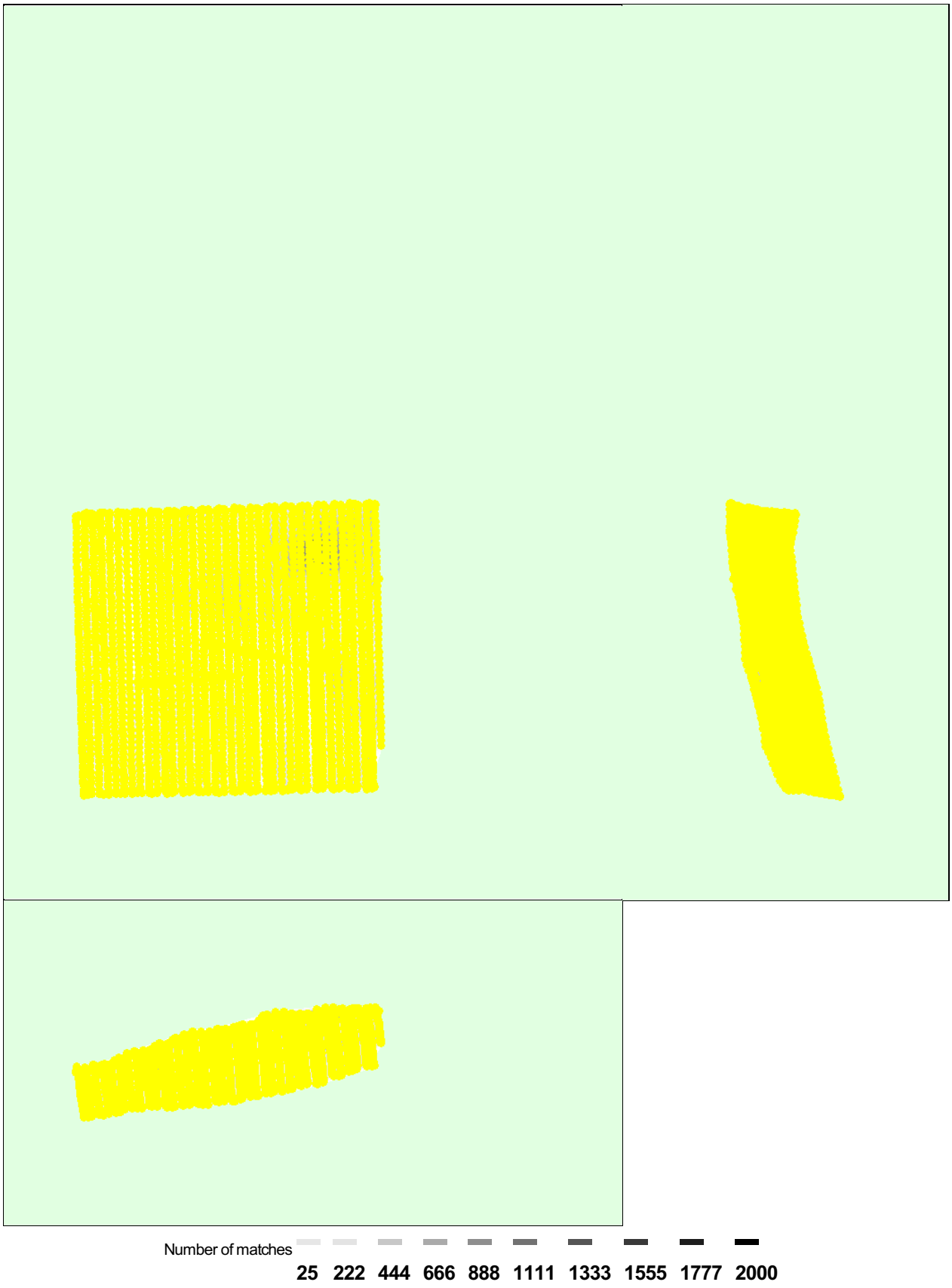

Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

Manual Tie Points

MTP Name	Projection Error [pixel]	Verified/Marked
mtp1	0.763	45 / 45
mtp2	1.388	40 / 40
mtp3	3.649	22 / 22
mtp4	1.336	32 / 32

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	15.24
-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	0.11	1.97	0.00
-3.00	0.00	53.33	55.59	0.00
0.00	3.00	46.51	40.04	0.00
3.00	6.00	0.05	2.36	0.00
6.00	9.00	0.00	0.02	0.00
9.00	12.00	0.00	0.00	0.00
12.00	15.00	0.00	0.01	0.00
15.00	-	0.00	0.01	84.76
Mean [m]		-0.092676	-0.146025	14.554457
Sigma [m]		0.594632	1.369381	16.410109
RMS Error [m]		0.601810	1.377144	21.934536

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	99.69	0.00
[-2.00, 2.00]	100.00	99.98	17.16
[-3.00, 3.00]	100.00	99.99	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	0.725
Phi	1.089
Kappa	5.567

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_4k_1_re» processing	optimize relative rotation using a subset of secondary cameras