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_2_re
Processed	2018-12-31 15:32:58
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)
Rig name(s)	«MicaSense 5 band»
Average Ground Sampling Distance (GSD)	8.41 cm / 3.31 in
Area Covered	0.578 km^2 / 57.7819 ha / 0.22 sq. mi. / 142.8560 acres

Quality Check

Images	median of 1482 keypoints per image	⚠
Dataset	10335 out of 10500 images calibrated (98%), 5 images disabled, 2 blocks	⚠
Camera Optimization	1.55% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 555.047 matches per calibrated image	⚠
Georeferencing	yes, no 3D GCP	⚠

Preview

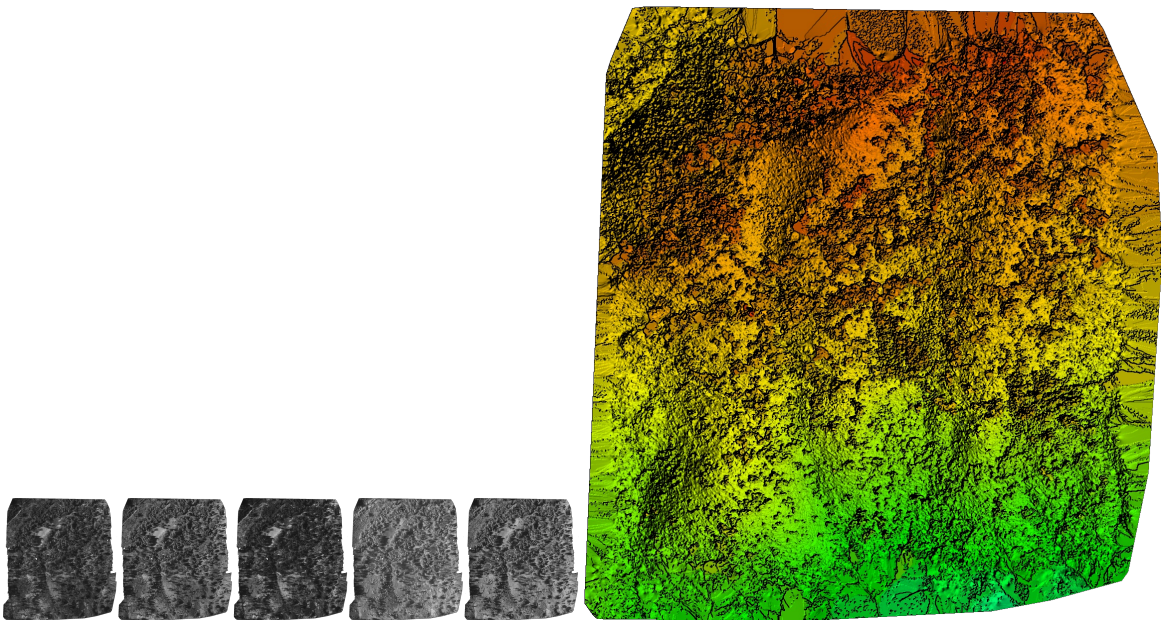


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	10335 out of 10505
Number of Geolocated Images	10505 out of 10505

Initial Image Positions

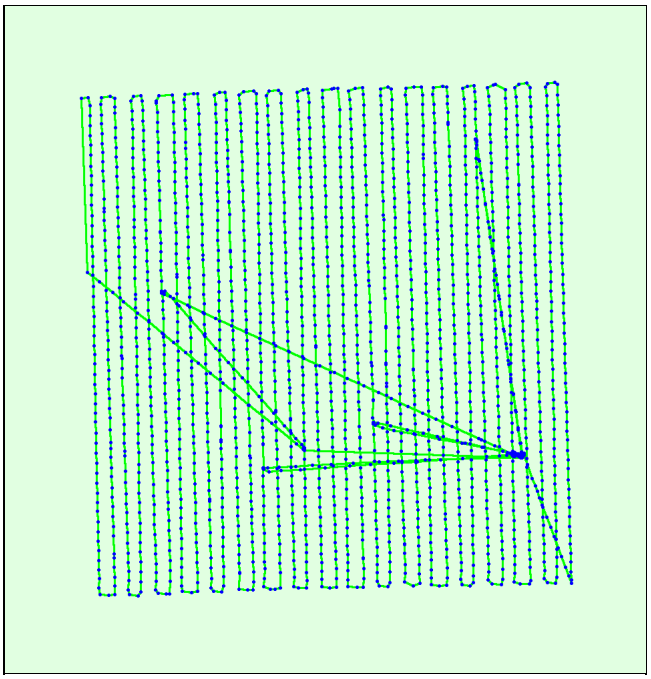
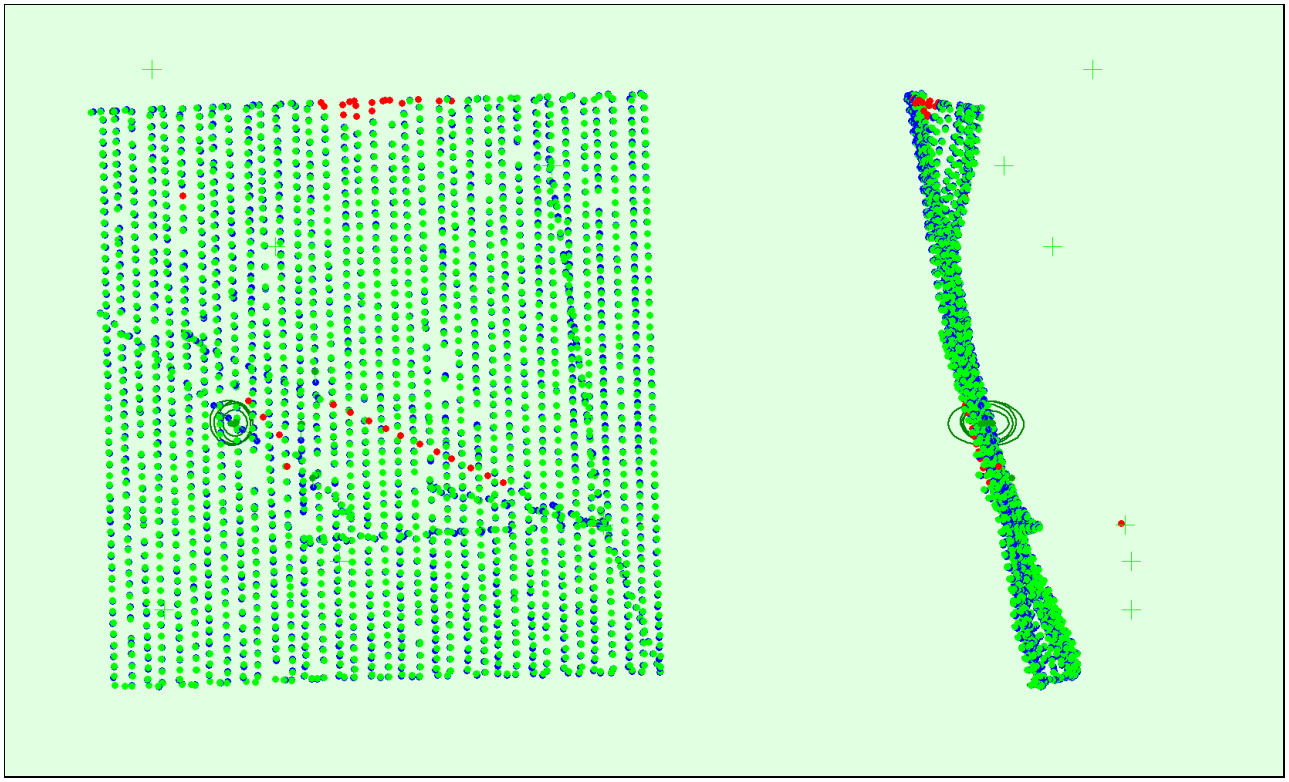
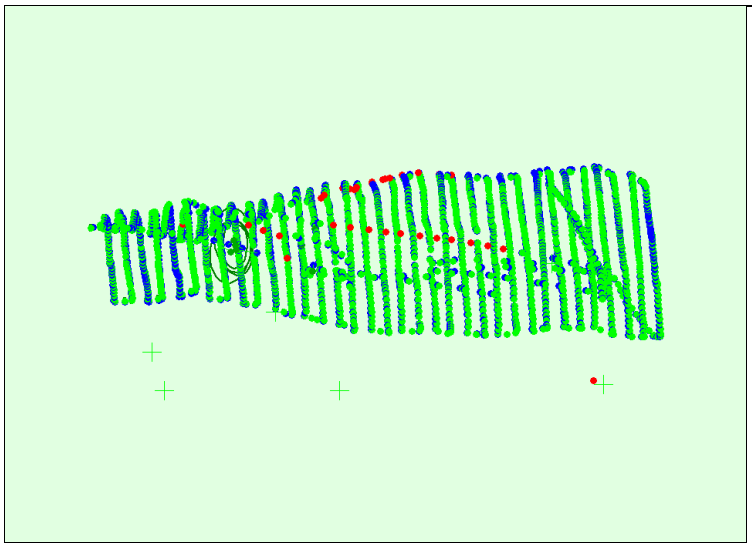


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

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	0.117	0.123	0.195	0.087	0.101	0.048
Sigma	0.070	0.076	0.115	0.694	1.167	0.682

Overlap

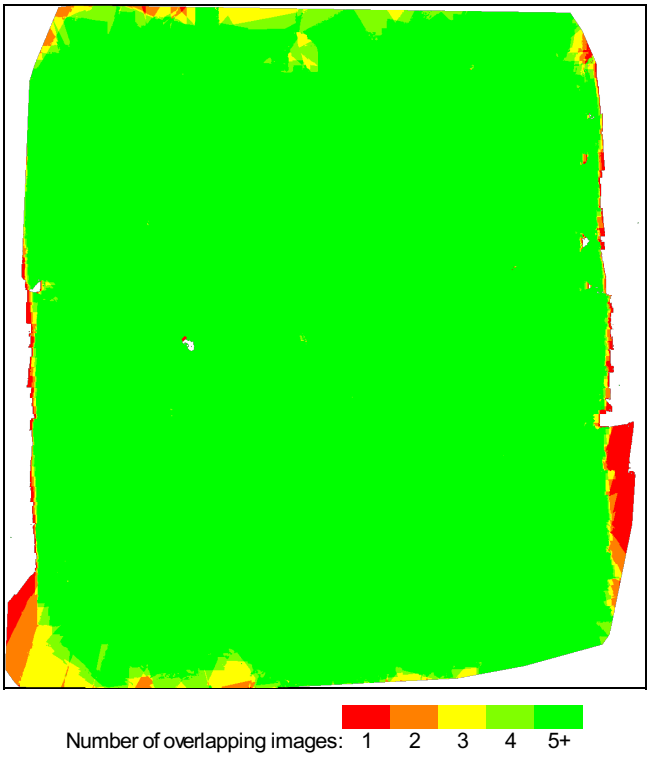


**Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

Bundle Block Adjustment Details

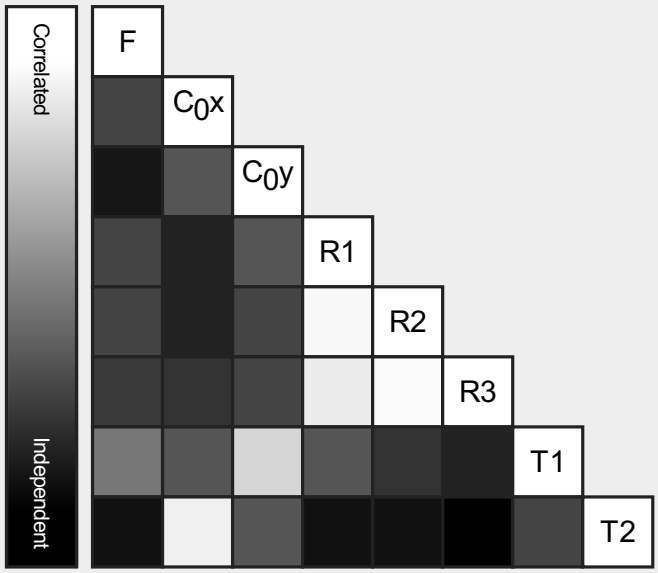
Number of 2D Keypoint Observations for Bundle Block Adjustment	1740837
Number of 3D Points for Bundle Block Adjustment	460698
Mean Reprojection Error [pixels]	0.157

Internal Camera Parameters

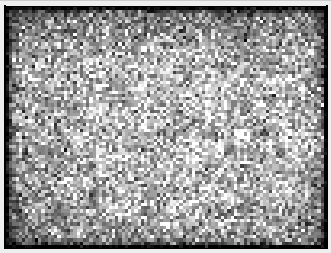
RedEdge_5.5_1280x960 (Blue). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

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	1443.610 [pixel] 5.414 [mm]	653.872 [pixel] 2.452 [mm]	495.111 [pixel] 1.857 [mm]	-0.097	0.147	-0.019	0.000	-0.001
Uncertainties (Sigma)	0.494 [pixel] 0.002 [mm]	0.405 [pixel] 0.002 [mm]	0.302 [pixel] 0.001 [mm]	0.003	0.020	0.046	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.



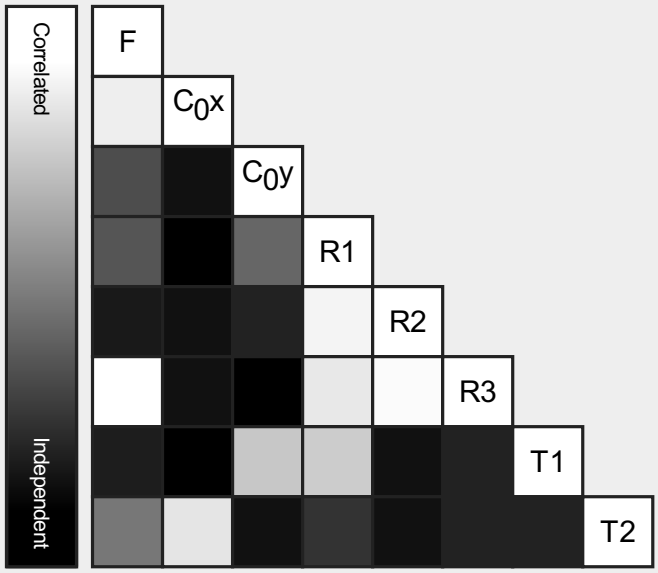
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the 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	1440.371 [pixel] 5.401 [mm]	656.544 [pixel] 2.462 [mm]	481.671 [pixel] 1.806 [mm]	-0.097	0.130	0.007	0.000	0.000
Uncertainties (Sigma)	0.472 [pixel] 0.002 [mm]	0.122 [pixel] 0.000 [mm]	0.099 [pixel] 0.000 [mm]	0.001	0.006	0.014	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.

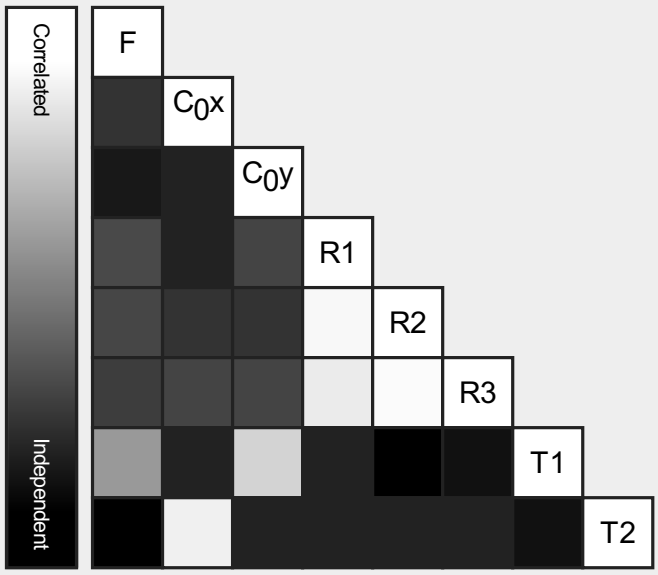
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

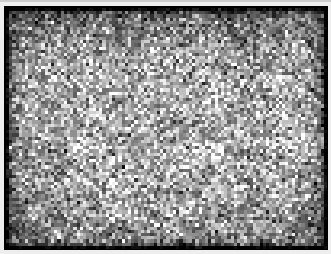
RedEdge_5.5_1280x960 (Red). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

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	1445.500 [pixel] 5.421 [mm]	653.820 [pixel] 2.452 [mm]	492.605 [pixel] 1.847 [mm]	-0.096	0.089	0.113	-0.000	-0.000
Uncertainties (Sigma)	0.498 [pixel] 0.002 [mm]	0.428 [pixel] 0.002 [mm]	0.319 [pixel] 0.001 [mm]	0.003	0.021	0.048	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.



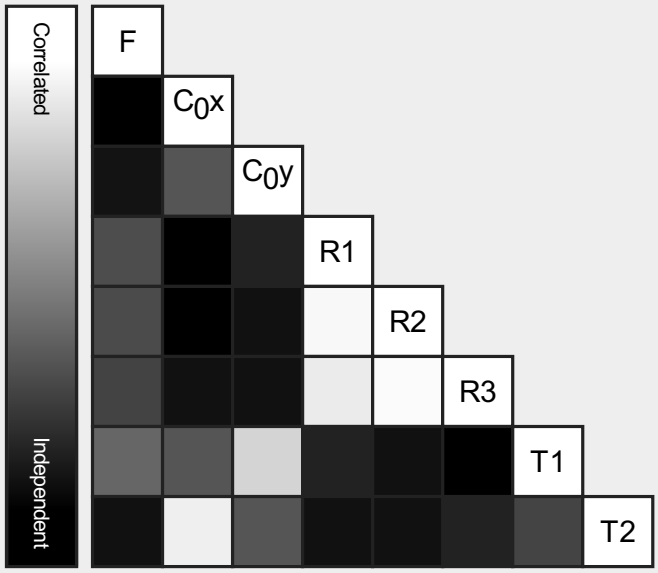
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the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

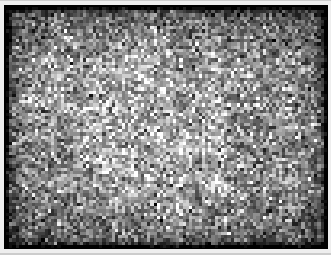
RedEdge_5.5_1280x960 (NIR). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

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	1446.162 [pixel] 5.423 [mm]	662.866 [pixel] 2.486 [mm]	482.474 [pixel] 1.809 [mm]	-0.109	0.187	-0.117	0.000	-0.000
Uncertainties (Sigma)	0.501 [pixel] 0.002 [mm]	0.464 [pixel] 0.002 [mm]	0.345 [pixel] 0.001 [mm]	0.003	0.022	0.050	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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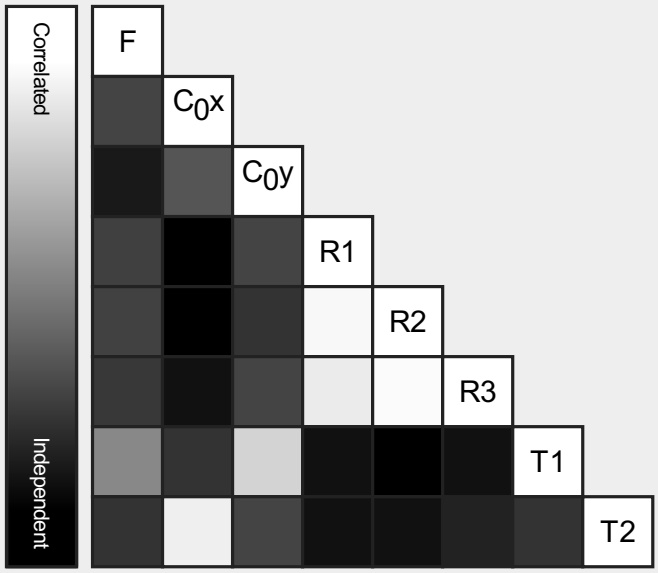
Internal Camera Parameters

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	1443.836 [pixel] 5.414 [mm]	657.939 [pixel] 2.467 [mm]	494.239 [pixel] 1.853 [mm]	-0.104	0.163	-0.074	0.000	-0.000
Uncertainties (Sigma)	0.492 [pixel] 0.002 [mm]	0.378 [pixel] 0.001 [mm]	0.282 [pixel] 0.001 [mm]	0.002	0.019	0.042	0.000	0.000



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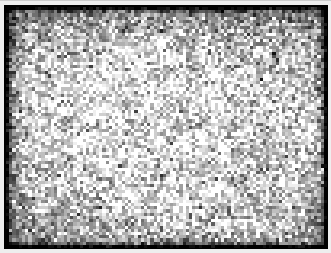

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Camera Rig «MicaSense 5 band» Relatives. Images: 10500

	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	-0.098	0.076	-0.376
Uncertainties (sigma)				0.012	0.017	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	0.101	0.059	-0.066
Uncertainties (sigma)				0.013	0.018	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	-0.141	-0.136	0.116
Uncertainties (sigma)				0.014	0.019	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	-0.059	-0.581	-0.323
Uncertainties (sigma)				0.012	0.016	0.001

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	1482	555
Min	1138	53
Max	2124	1383
Mean	1505	600

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image

Median	1403	424
Min	1163	65
Max	1802	1025
Mean	1427	480

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	1484	593
Min	1138	53
Max	2124	1383
Mean	1507	633

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	1406	431
Min	1178	57
Max	1782	987
Mean	1438	478

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	1540	477
Min	1219	76
Max	2029	1117
Mean	1568	545

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	1538	511
Min	1200	76
Max	2012	1133
Mean	1562	564

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)
RedEdge_5.5_1280x960 (Blue)	15 / 64 / 746	8 / 26 / 507	18 / 86 / 488	9 / 31 / 189	12 / 43 / 351
RedEdge_5.5_1280x960 (Green)		12 / 43 / 989	7 / 23 / 394	6 / 19 / 322	9 / 29 / 625
RedEdge_5.5_1280x960 (Red)			17 / 78 / 736	9 / 27 / 191	12 / 40 / 282
RedEdge_5.5_1280x960 (NIR)				16 / 95 / 940	14 / 77 / 456
RedEdge_5.5_1280x960 (Red edge)					13 / 59 / 838

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	260783
In 3 Images	73015
In 4 Images	37739
In 5 Images	21485
In 6 Images	14687

In 7 Images	10447
In 8 Images	7797
In 9 Images	5794
In 10 Images	4886
In 11 Images	3831
In 12 Images	3074
In 13 Images	2551
In 14 Images	2086
In 15 Images	1748
In 16 Images	1452
In 17 Images	1179
In 18 Images	1070
In 19 Images	881
In 20 Images	845
In 21 Images	664
In 22 Images	552
In 23 Images	512
In 24 Images	407
In 25 Images	364
In 26 Images	327
In 27 Images	270
In 28 Images	240
In 29 Images	222
In 30 Images	204
In 31 Images	187
In 32 Images	142
In 33 Images	140
In 34 Images	119
In 35 Images	118
In 36 Images	100
In 37 Images	91
In 38 Images	76
In 39 Images	54
In 40 Images	59
In 41 Images	54
In 42 Images	47
In 43 Images	43
In 44 Images	39
In 45 Images	38
In 46 Images	30
In 47 Images	27
In 48 Images	26
In 49 Images	18
In 50 Images	19
In 51 Images	20
In 52 Images	12
In 53 Images	25
In 54 Images	14
In 55 Images	13
In 56 Images	15
In 57 Images	11
In 58 Images	8
In 59 Images	9
In 60 Images	5
In 61 Images	5
In 62 Images	4
In 63 Images	3
In 64 Images	5
In 65 Images	1

In 66 Images	1
In 67 Images	2
In 70 Images	1
In 71 Images	2
In 75 Images	1
In 77 Images	2

2D Keypoint Matches

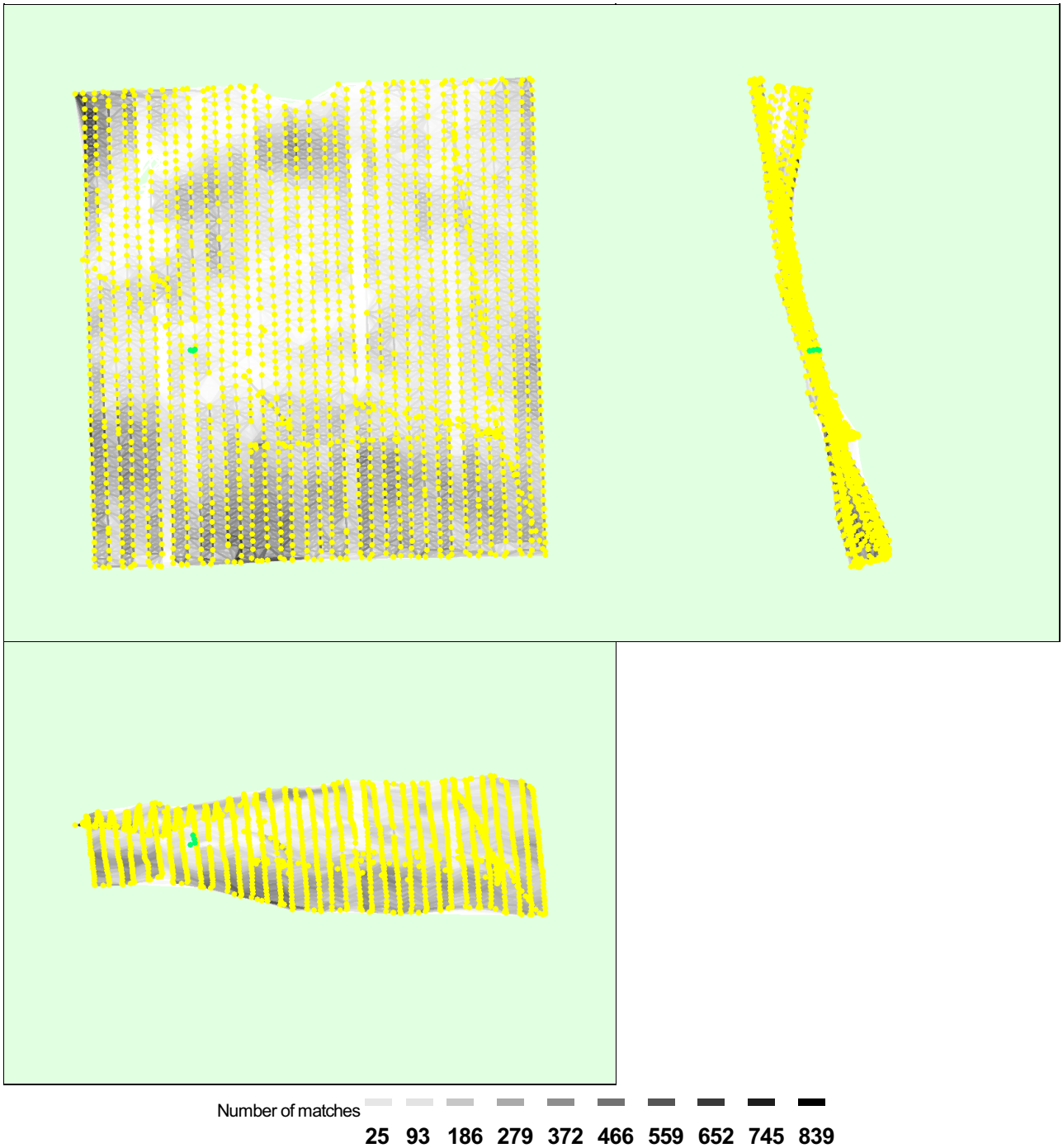

Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

Manual Tie Points

MTP Name	Projection Error [pixel]	Verified/Marked
mtp1	0.579	18 / 18
mtp2	0.459	9 / 9
mtp3	0.337	10 / 10

mtp4	0.330	15 / 15
mtp5	0.468	15 / 15
mtp6	1.821	15 / 15

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	0.01	0.02	0.00
-15.00	-12.00	0.00	0.00	0.00
-12.00	-9.00	0.00	0.02	0.00
-9.00	-6.00	0.00	0.01	0.00
-6.00	-3.00	0.25	0.10	0.32
-3.00	0.00	54.98	48.77	45.28
0.00	3.00	44.64	50.37	54.28
3.00	6.00	0.10	0.69	0.10
6.00	9.00	0.01	0.01	0.01
9.00	12.00	0.00	0.00	0.01
12.00	15.00	0.00	0.00	0.00
15.00	-	0.01	0.01	0.00
Mean [m]		-0.000057	0.009748	-0.002119
Sigma [m]		0.834745	1.386635	1.007004
RMS Error [m]		0.834745	1.386670	1.007006

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]	99.96	99.93	99.99
[-2.00, 2.00]	99.98	99.95	100.00
[-3.00, 3.00]	99.98	99.97	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) i7-8700K 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: 0.5
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» processing	optimize relative rotation using a subset of secondary cameras