Quality Report

⚠ **Important**: Click on the different icons for:

❓ Help to analyze the results in the Quality Report

ℹ Additional information about the sections

💡 Click here for additional tips to analyze the Quality Report

Summary ℹ

Project	stan_3k_2_re
Processed	2019-01-23 08:12:55
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)	8.31 cm / 3.27 in
Area Covered	0.417 km^2 / 41.7305 ha / 0.16 sq. mi. / 103.1718 acres
Time for Initial Processing (without report)	08h:26m:55s

Quality Check ℹ

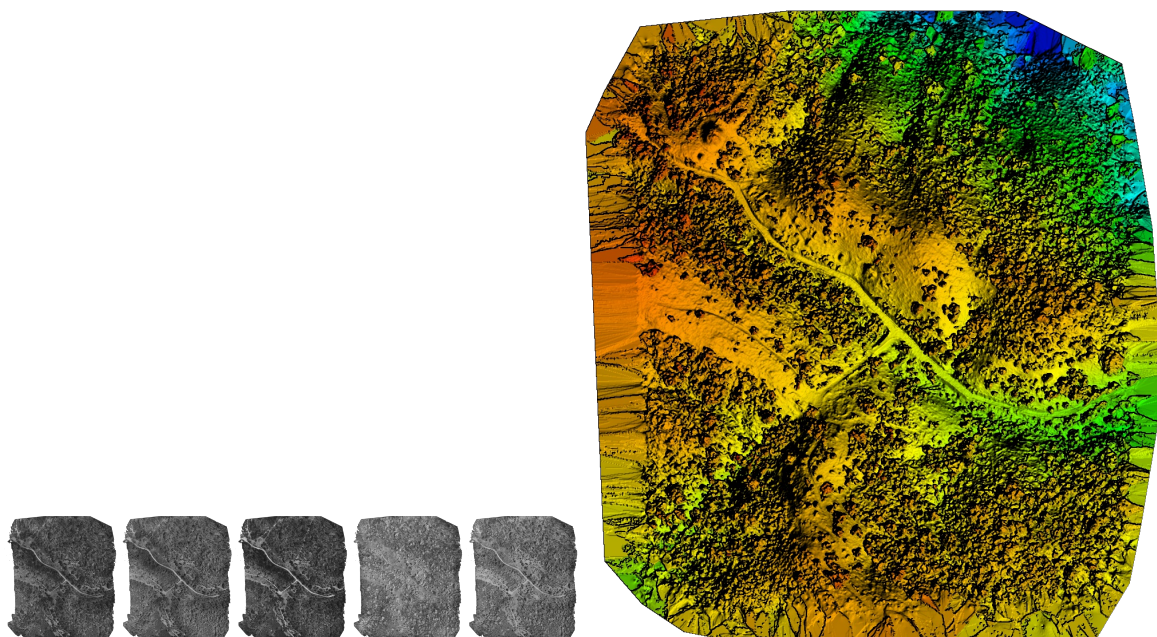|		
❓ **Images**	median of 34730 keypoints per image	✓
❓ **Dataset**	7180 out of 7185 images calibrated (99%), 5 images disabled	✓
❓ **Camera Optimization**	1.34% relative difference between initial and optimized internal camera parameters	✓
❓ **Matching**	median of 9622.92 matches per calibrated image	✓
❓ **Georeferencing**	yes, no 3D GCP	⚠

❓ Preview ℹ

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

Calibration Details

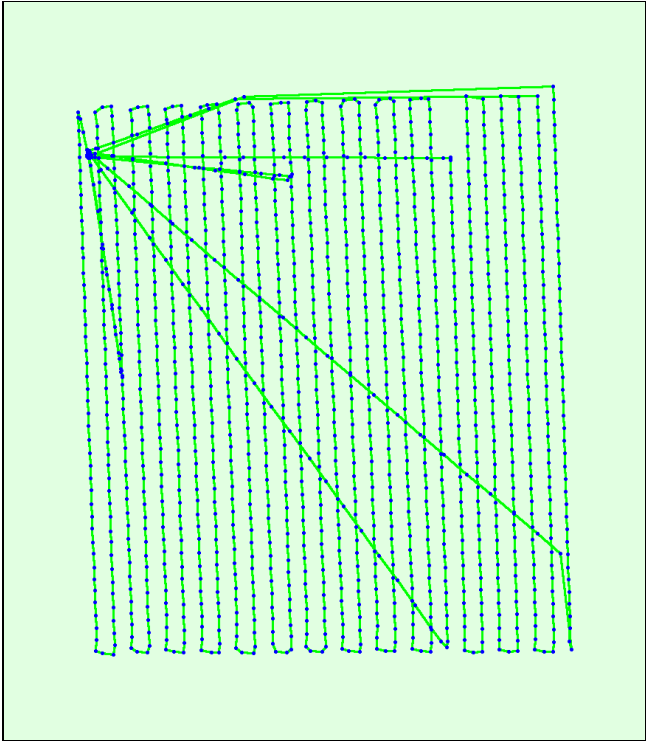| Number of Calibrated Images	7180 out of 7190
Number of Geolocated Images	7190 out of 7190

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 50x 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.

⑦ Absolute camera position and orientation uncertainties   ⓘ

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.074	0.074	0.172	0.038	0.042	0.015
Sigma	0.012	0.011	0.037	0.002	0.001	0.003

⑦ Overlap   ⓘ

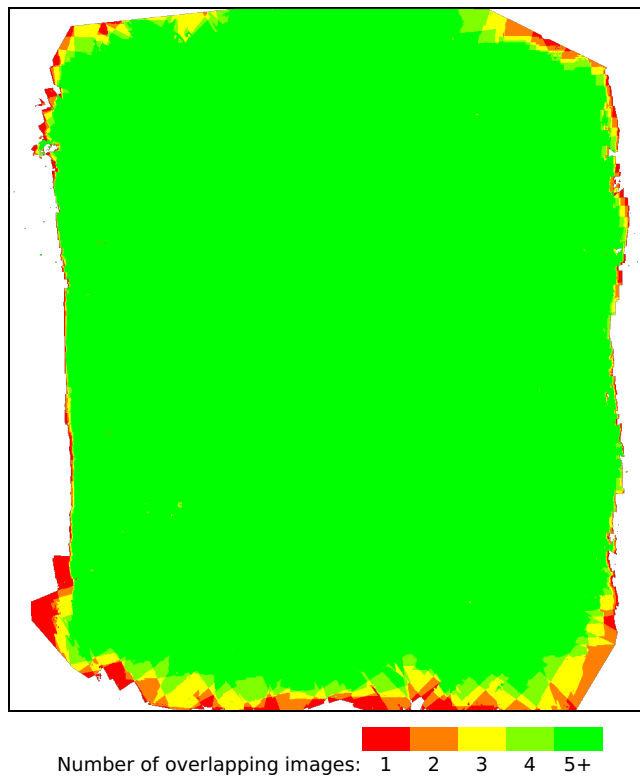Number of overlapping images: 1 2 3 4 5+

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).
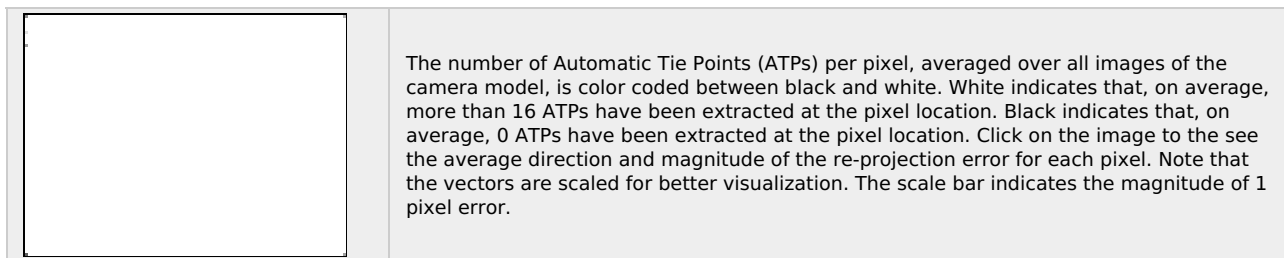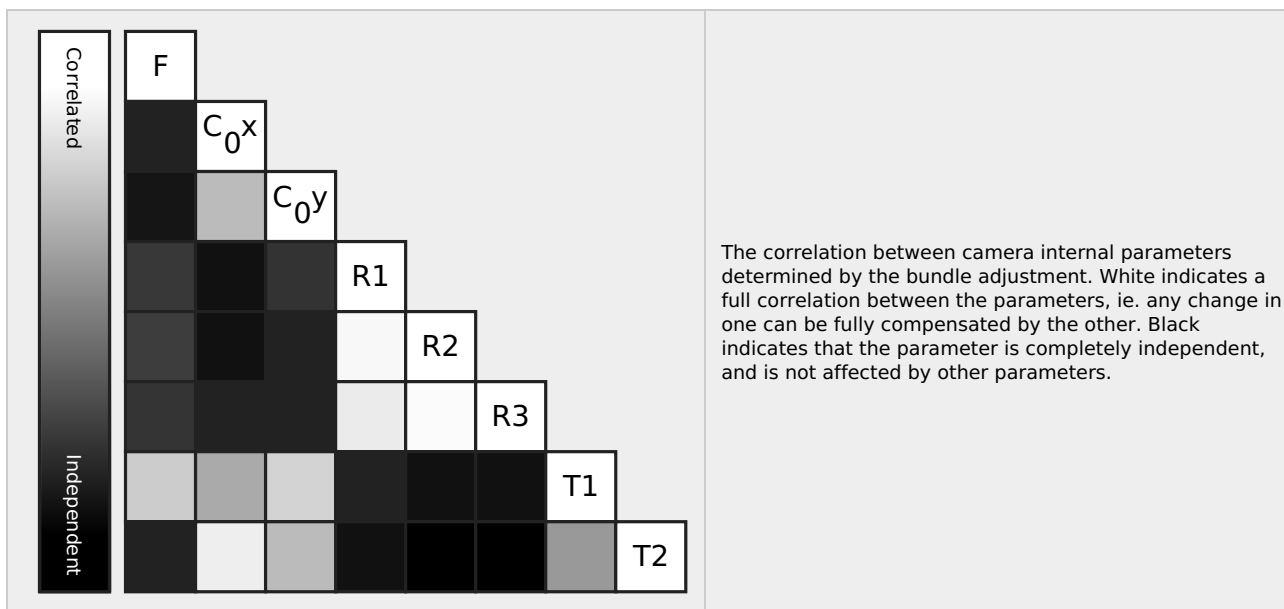
Bundle Block Adjustment Details

Number of 2D Keypoint Observations for Bundle Block Adjustment	19860388
Number of 3D Points for Bundle Block Adjustment	5903434
Mean Reprojection Error [pixels]	0.196

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	1446.490 [pixel] 5.424 [mm]	654.535 [pixel] 2.455 [mm]	495.208 [pixel] 1.857 [mm]	-0.098	0.165	-0.065	0.000	-0.000
Uncertainties (Sigma)	0.127 [pixel] 0.000 [mm]	0.091 [pixel] 0.000 [mm]	0.069 [pixel] 0.000 [mm]	0.001	0.004	0.010	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.
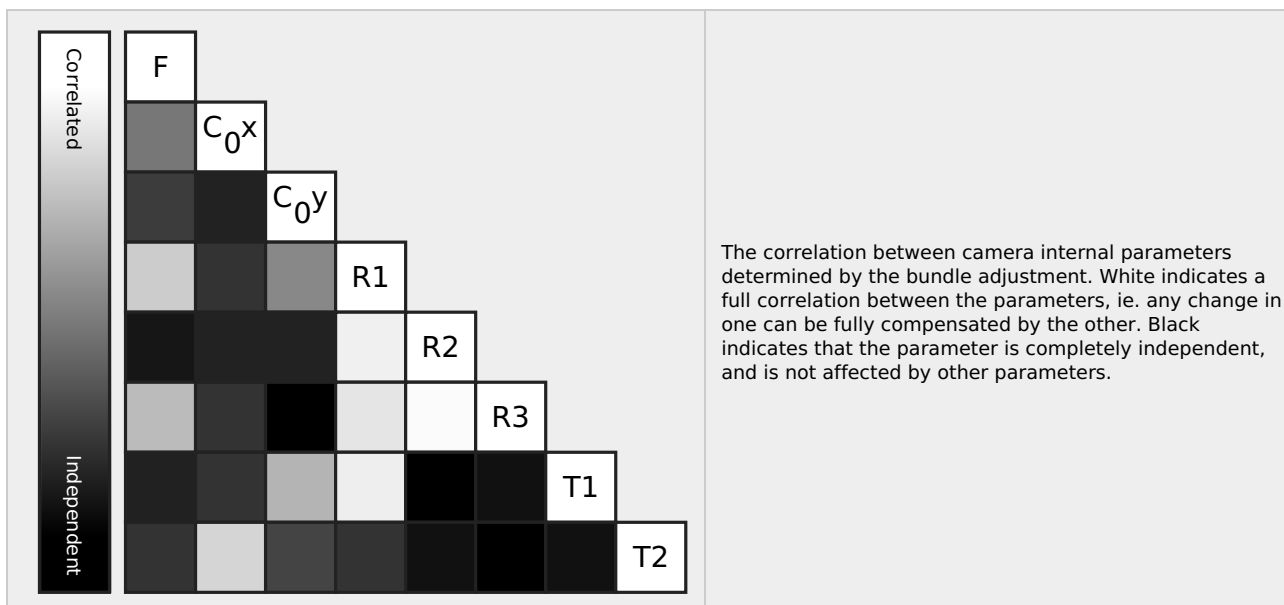
Internal Camera Parameters

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	1443.362 [pixel] 5.413 [mm]	655.546 [pixel] 2.458 [mm]	481.657 [pixel] 1.806 [mm]	-0.098	0.142	-0.016	0.000	0.000
Uncertainties (Sigma)	0.122 [pixel] 0.000 [mm]	0.028 [pixel] 0.000 [mm]	0.023 [pixel] 0.000 [mm]	0.000	0.001	0.003	0.000	0.000

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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	1448.416 [pixel] 5.432 [mm]	653.848 [pixel] 2.452 [mm]	493.975 [pixel] 1.852 [mm]	-0.098	0.121	0.016	-0.000	-0.000
Uncertainties (Sigma)	0.127 [pixel] 0.000 [mm]	0.094 [pixel] 0.000 [mm]	0.071 [pixel] 0.000 [mm]	0.001	0.005	0.010	0.000	0.000

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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.
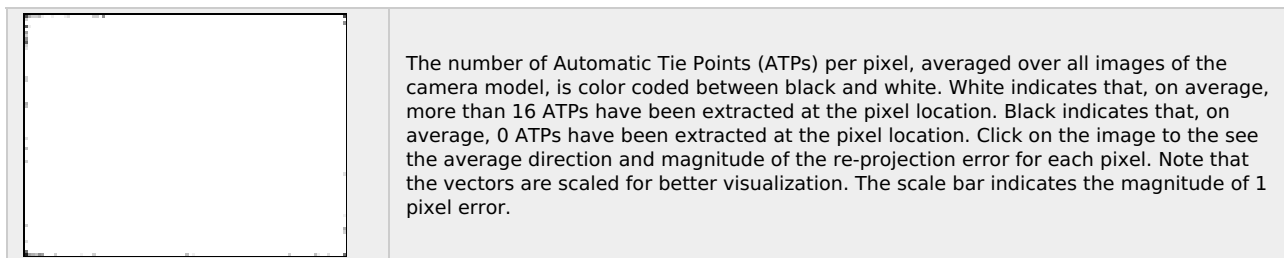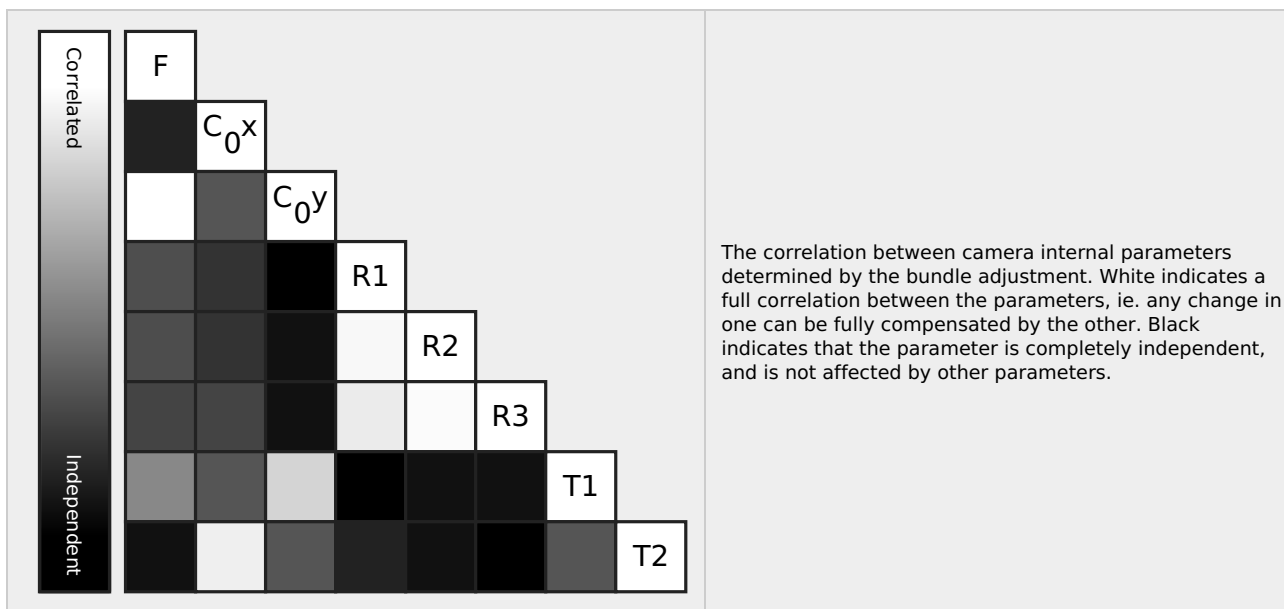
Internal Camera Parameters

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	1449.229 [pixel] 5.435 [mm]	662.261 [pixel] 2.483 [mm]	482.890 [pixel] 1.811 [mm]	-0.104	0.146	-0.026	0.000	-0.000
Uncertainties (Sigma)	0.131 [pixel] 0.000 [mm]	0.122 [pixel] 0.000 [mm]	0.092 [pixel] 0.000 [mm]	0.001	0.006	0.013	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.
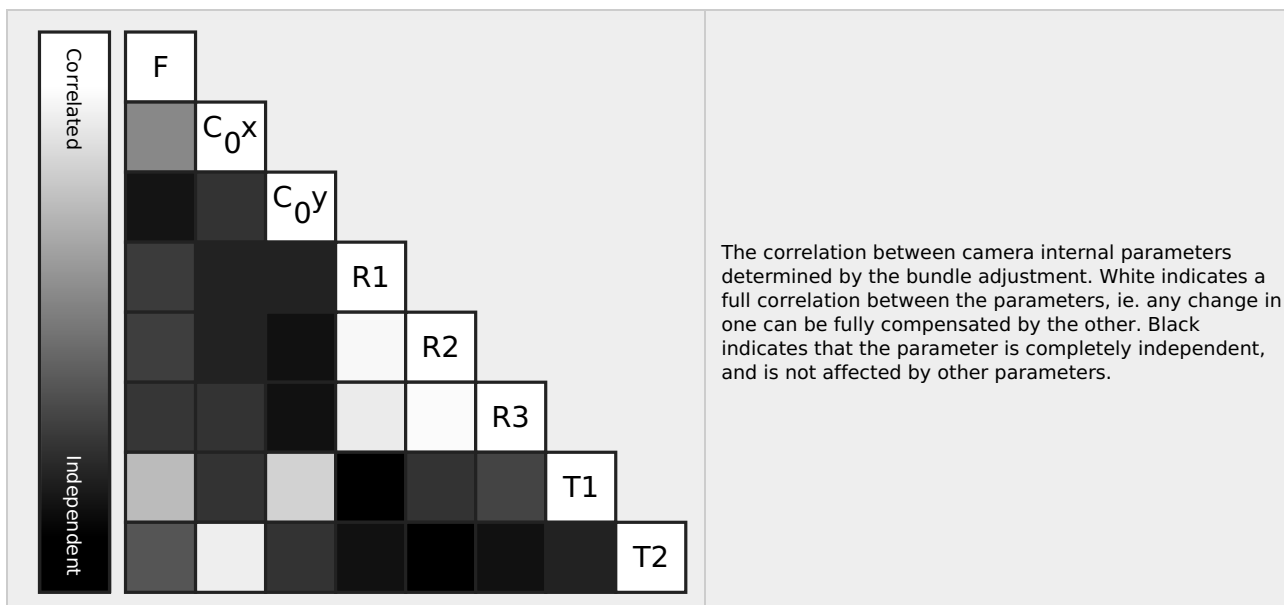
Internal Camera Parameters

RedEdge_5.5_1280x960 (Red 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	1446.890 [pixel] 5.426 [mm]	657.465 [pixel] 2.465 [mm]	494.564 [pixel] 1.855 [mm]	-0.101	0.146	-0.031	0.000	-0.000
Uncertainties (Sigma)	0.127 [pixel] 0.000 [mm]	0.096 [pixel] 0.000 [mm]	0.073 [pixel] 0.000 [mm]	0.001	0.005	0.010	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 «MicaSense 5 band» Relatives. Images: 7185

	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	-0.104	0.126	-0.373
Uncertainties (sigma)				0.003	0.004	0.000
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	0.050	0.094	-0.063
Uncertainties (sigma)				0.003	0.004	0.000
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	-0.159	-0.140	0.119
Uncertainties (sigma)				0.004	0.005	0.000
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	-0.073	-0.576	-0.321
Uncertainties (sigma)				0.003	0.004	0.000

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	34730	9623
Min	20059	694
Max	44741	22631
Mean	34312	9851

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	31846	6685
Min	20059	1169
Max	38354	13413
Mean	30634	7251

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	35834	10203
Min	21209	1351
Max	44741	22631
Mean	35128	10494

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	30996	6982

Min	20971	798
Max	38462	17277
Mean	30324	7659

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	31944	8609
Min	20622	694
Max	39344	19481
Mean	31861	8866

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	36673	9387
Min	22900	1788
Max	43953	19735
Mean	36343	9261

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)	80 / 634 / 9140	69 / 345 / 5586	95 / 697 / 6746	33 / 167 / 1781	48 / 306 / 2997
RedEdge_5.5_1280x960 (Green)		114 / 554 / 13528	65 / 319 / 5794	24 / 108 / 3043	45 / 228 / 6378
RedEdge_5.5_1280x960 (Red)			86 / 661 / 11790	35 / 172 / 2433	52 / 336 / 4401
RedEdge_5.5_1280x960 (NIR)				76 / 626 / 14280	68 / 519 / 5796
RedEdge_5.5_1280x960 (Red edge)					53 / 454 / 12257

ⓘ 3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	3680393
In 3 Images	995344
In 4 Images	440797
In 5 Images	219051
In 6 Images	133964
In 7 Images	86412
In 8 Images	61235
In 9 Images	45011
In 10 Images	35660
In 11 Images	28103
In 12 Images	23014
In 13 Images	18742
In 14 Images	15737
In 15 Images	13494
In 16 Images	11497
In 17 Images	9856
In 18 Images	8697
In 19 Images	7732
In 20 Images	6751
In 21 Images	6049
In 22 Images	5365
In 23 Images	4848
In 24 Images	4194

In 25 Images	3692
In 26 Images	3401
In 27 Images	2956
In 28 Images	2707
In 29 Images	2518
In 30 Images	2406
In 31 Images	2146
In 32 Images	1929
In 33 Images	1770
In 34 Images	1724
In 35 Images	1435
In 36 Images	1378
In 37 Images	1248
In 38 Images	1074
In 39 Images	1023
In 40 Images	915
In 41 Images	838
In 42 Images	715
In 43 Images	686
In 44 Images	589
In 45 Images	551
In 46 Images	434
In 47 Images	383
In 48 Images	313
In 49 Images	298
In 50 Images	304
In 51 Images	275
In 52 Images	241
In 53 Images	225
In 54 Images	201
In 55 Images	194
In 56 Images	176
In 57 Images	151
In 58 Images	148
In 59 Images	142
In 60 Images	117
In 61 Images	119
In 62 Images	111
In 63 Images	93
In 64 Images	81
In 65 Images	97
In 66 Images	66
In 67 Images	86
In 68 Images	78
In 69 Images	75
In 70 Images	56
In 71 Images	46
In 72 Images	68
In 73 Images	56
In 74 Images	55
In 75 Images	58
In 76 Images	43
In 77 Images	50
In 78 Images	35
In 79 Images	35
In 80 Images	41
In 81 Images	39
In 82 Images	32
In 83 Images	36

In 84 Images	33
In 85 Images	35
In 86 Images	34
In 87 Images	21
In 88 Images	25
In 89 Images	25
In 90 Images	18
In 91 Images	17
In 92 Images	26
In 93 Images	21
In 94 Images	21
In 95 Images	21
In 96 Images	22
In 97 Images	16
In 98 Images	14
In 99 Images	20
In 100 Images	19
In 101 Images	19
In 102 Images	11
In 103 Images	19
In 104 Images	12
In 105 Images	16
In 106 Images	19
In 107 Images	11
In 108 Images	13
In 109 Images	10
In 110 Images	12
In 111 Images	16
In 112 Images	9
In 113 Images	12
In 114 Images	8
In 115 Images	11
In 116 Images	10
In 117 Images	3
In 118 Images	11
In 119 Images	10
In 120 Images	5
In 121 Images	5
In 122 Images	7
In 123 Images	10
In 124 Images	7
In 125 Images	8
In 126 Images	5
In 127 Images	6
In 128 Images	11
In 129 Images	5
In 130 Images	2
In 131 Images	6
In 132 Images	1
In 133 Images	6
In 134 Images	2
In 135 Images	1
In 137 Images	5
In 138 Images	2
In 139 Images	2
In 140 Images	2
In 141 Images	2
In 142 Images	1
In 146 Images	1

In 147 Images	1
In 149 Images	1
In 150 Images	1
In 151 Images	1
In 153 Images	2
In 155 Images	1

2D Keypoint Matches

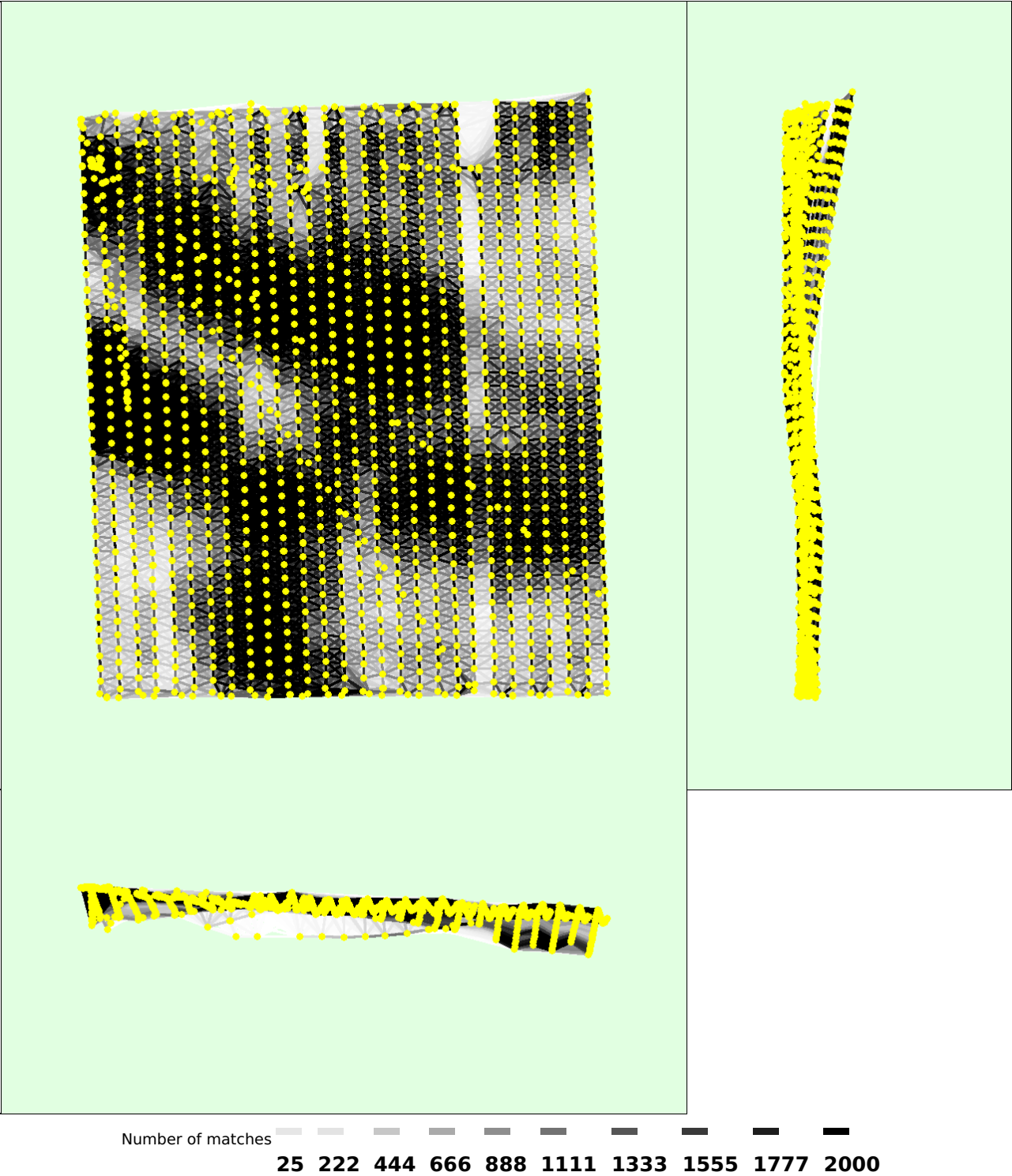| Number of matches									
25	222	444	666	888	1111	1333	1555	1777	2000

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

ⓘ 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	59.64	53.69	36.11
0.00	3.00	40.36	46.24	63.89
3.00	6.00	0.00	0.07	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]		0.006882	0.003929	0.005481
Sigma [m]		0.499761	0.987960	0.840769
RMS Error [m]		0.499808	0.987968	0.840787

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	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) Xeon(R) Platinum 8124M CPU @ 3.00GHz RAM: 69GB GPU: no info (Driver: unknown)
Operating System	Linux 4.15.0-1031-aws x86_64

Coordinate Systems ⓘ

Image Coordinate System	WGS 84 (EGM 96 Geoid)
Output Coordinate System	WGS 84 / UTM zone 10N (EGM 96 Geoid)

Processing Options ⓘ

Detected Template	No Template Available
Keypoints Image Scale	Custom, Image Scale: 2
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

Point Cloud Densification details

Processing Options

Image Scale	multiscale, 1/2 (Half image size, Default)
Point Density	Optimal
Minimum Number of Matches	3
3D Textured Mesh Generation	yes
3D Textured Mesh Settings:	Resolution: Medium Resolution (default) Color Balancing: no
LOD	Generated: no
Advanced: 3D Textured Mesh Settings	Sample Density Divider: 1
Advanced: Image Groups	Blue, Green, Red, NIR, Red edge
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	06m:06s
Time for Point Cloud Classification	43s
Time for 3D Textured Mesh Generation	06m:56s

Results

Number of Generated Tiles	1
Number of 3D Densified Points	7190714
Average Density (per m^3)	6.35

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (8.31 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Sharp
Raster DSM	Generated: yes Method: Triangulation Merge Tiles: yes
Orthomosaic	Generated: yes Merge Tiles: yes GeoTIFF Without Transparency: no Google Maps Tiles and KML: no
Radiometric calibration with reflectance target	yes
Index Calculator: Reflectance Map	Generated: yes Resolution: 1 x GSD (8.31 [cm/pixel]) Merge Tiles: yes
Index Calculator: Indices	ndvi
Index Calculator: Index Values	Polygon Shapefile [cm/grid]: 400
Time for DSM Generation	31s
Time for Orthomosaic Generation	35m:19s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	44m:26s

Time for Index Map Generation	25s

Camera Radiometric Correction

Camera Name	Band	Radiometric Correction Type	Reflectance target
RedEdge_5.5_1280x960	Blue	Camera and Sun Irradiance	✓
RedEdge_5.5_1280x960	Green	Camera and Sun Irradiance	✓
RedEdge_5.5_1280x960	Red	Camera and Sun Irradiance	✓
RedEdge_5.5_1280x960	NIR	Camera and Sun Irradiance	✓
RedEdge_5.5_1280x960	Red edge	Camera and Sun Irradiance	✓