Quality Report

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	sier_3k_1_re
Processed	2019-01-23 13:56:16
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)	7.92 cm / 3.12 in
Area Covered	0.590 km^2 / 58.9688 ha / 0.23 sq. mi. / 145.7906 acres
Time for Initial Processing (without report)	12h:01m:28s

Quality Check

Images	median of 37346 keypoints per image		✓
Dataset	11680 out of 11765 images calibrated (99%), 5 images disabled		✓
Camera Optimization	1.4% relative difference between initial and optimized internal camera parameters		✓
Matching	median of 5130.41 matches per calibrated image		✓
Georeferencing	yes, no 3D GCP		⚠

Preview

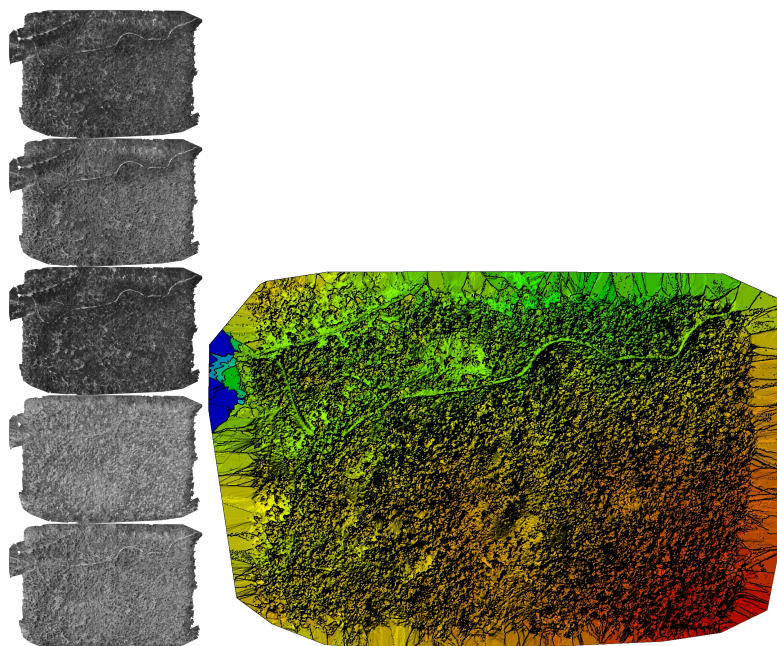**Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.**

Calibration Details

Number of Calibrated Images	11680 out of 11770
Number of Geolocated Images	11770 out of 11770

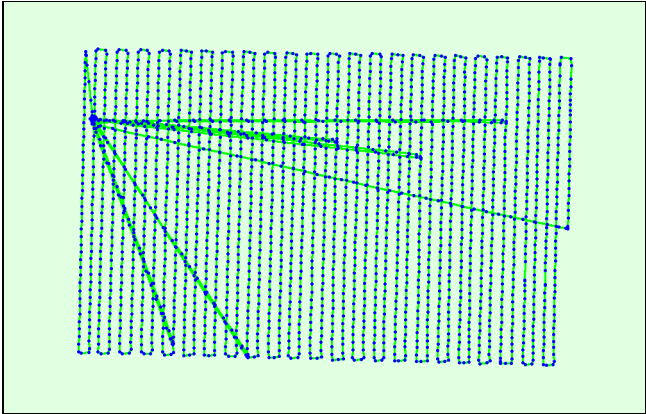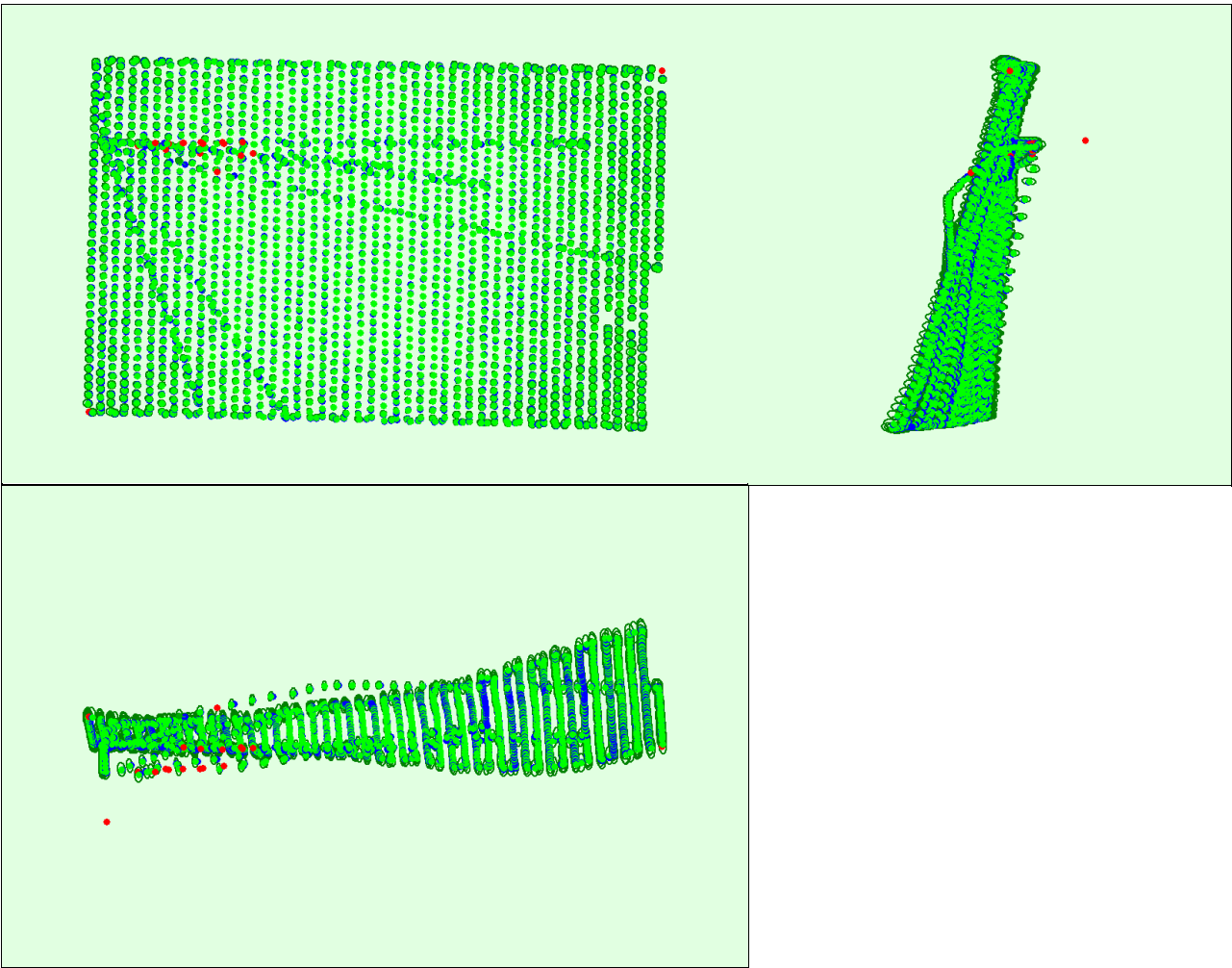### Initial Image Positions

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

Absolute camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.082	0.082	0.182	0.041	0.031	0.014
Sigma	0.014	0.014	0.037	0.003	0.004	0.003

Overlap
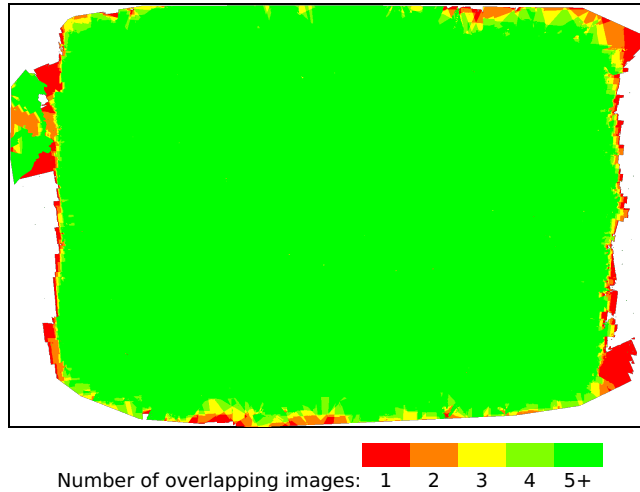

Number of overlapping images: 1 2 3 4 5+

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

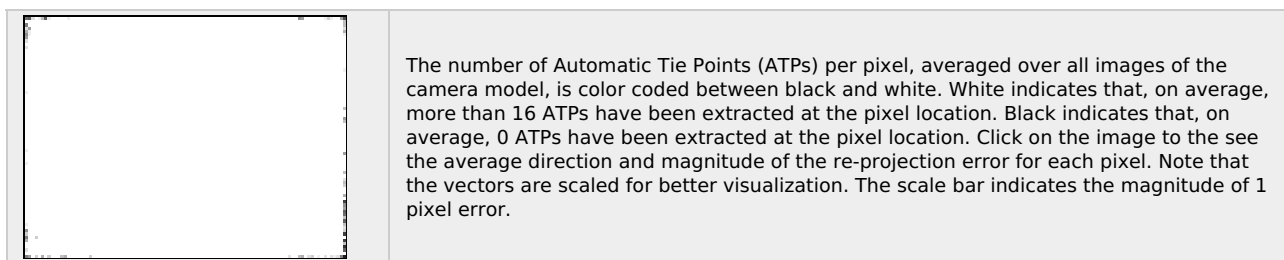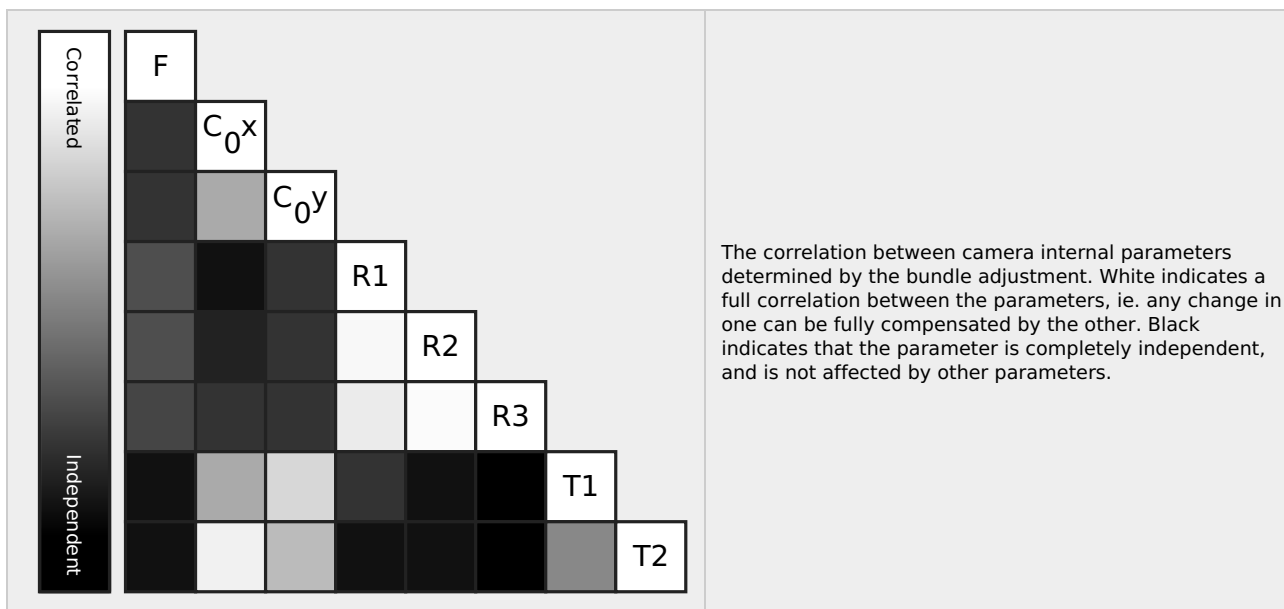|	
Number of 2D Keypoint Observations for Bundle Block Adjustment	18496441
Number of 3D Points for Bundle Block Adjustment	6814543
Mean Reprojection Error [pixels]	0.207

Internal Camera Parameters

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

EXIF ID: RedEdge_5.5_1280x960

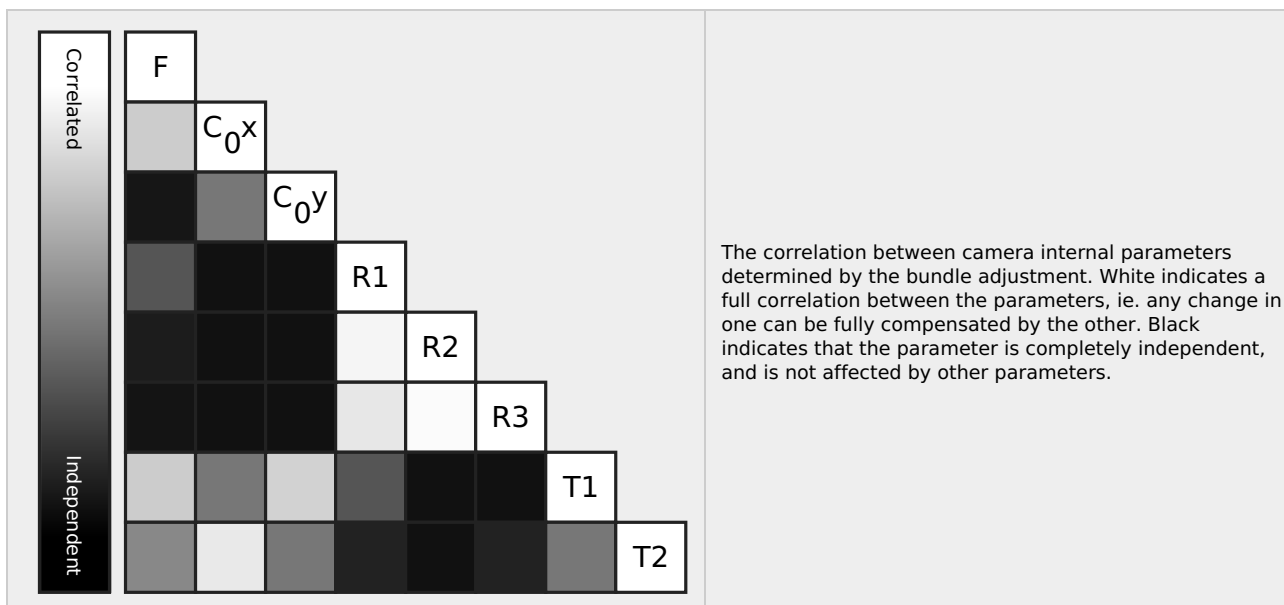|	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	657.605 [pixel] 2.466 [mm]	495.123 [pixel] 1.857 [mm]	-0.097	0.149	-0.017	0.000	0.000
Optimized Values	1445.685 [pixel] 5.421 [mm]	654.826 [pixel] 2.456 [mm]	494.973 [pixel] 1.856 [mm]	-0.099	0.166	-0.062	0.000	-0.000
Uncertainties (Sigma)	0.110 [pixel] 0.000 [mm]	0.110 [pixel] 0.000 [mm]	0.083 [pixel] 0.000 [mm]	0.001	0.005	0.011	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.
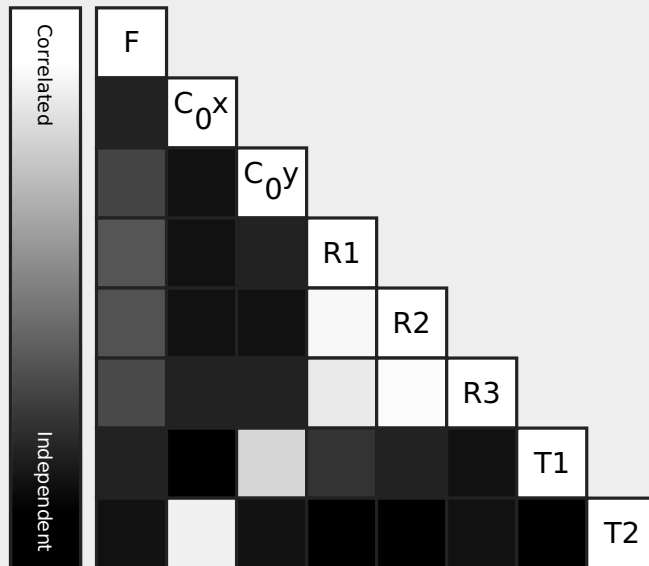
Internal Camera Parameters

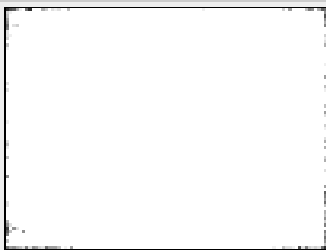### RedEdge_5.5_1280x960 (Green). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

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	1442.538 [pixel] 5.410 [mm]	655.778 [pixel] 2.459 [mm]	481.510 [pixel] 1.806 [mm]	-0.100	0.151	-0.036	0.000	0.000
Uncertainties (Sigma)	0.104 [pixel] 0.000 [mm]	0.034 [pixel] 0.000 [mm]	0.027 [pixel] 0.000 [mm]	0.000	0.002	0.003	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.
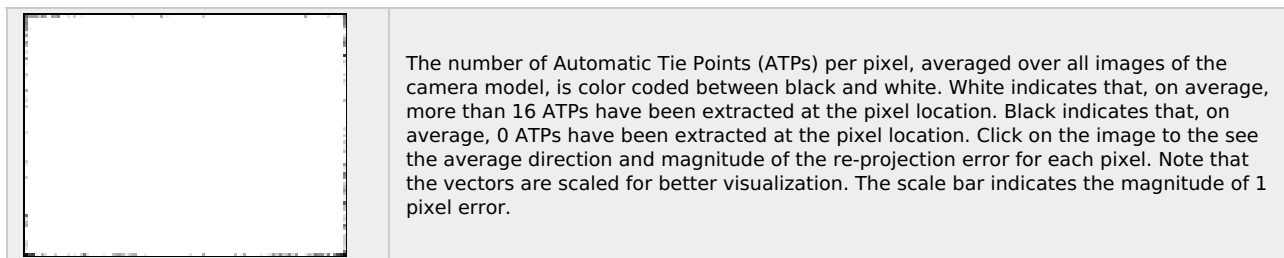
⑦ Internal Camera Parameters

📄 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	1447.663 [pixel] 5.429 [mm]	654.207 [pixel] 2.453 [mm]	493.761 [pixel] 1.852 [mm]	-0.099	0.123	0.022	-0.000	-0.000
Uncertainties (Sigma)	0.112 [pixel] 0.000 [mm]	0.121 [pixel] 0.000 [mm]	0.091 [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.
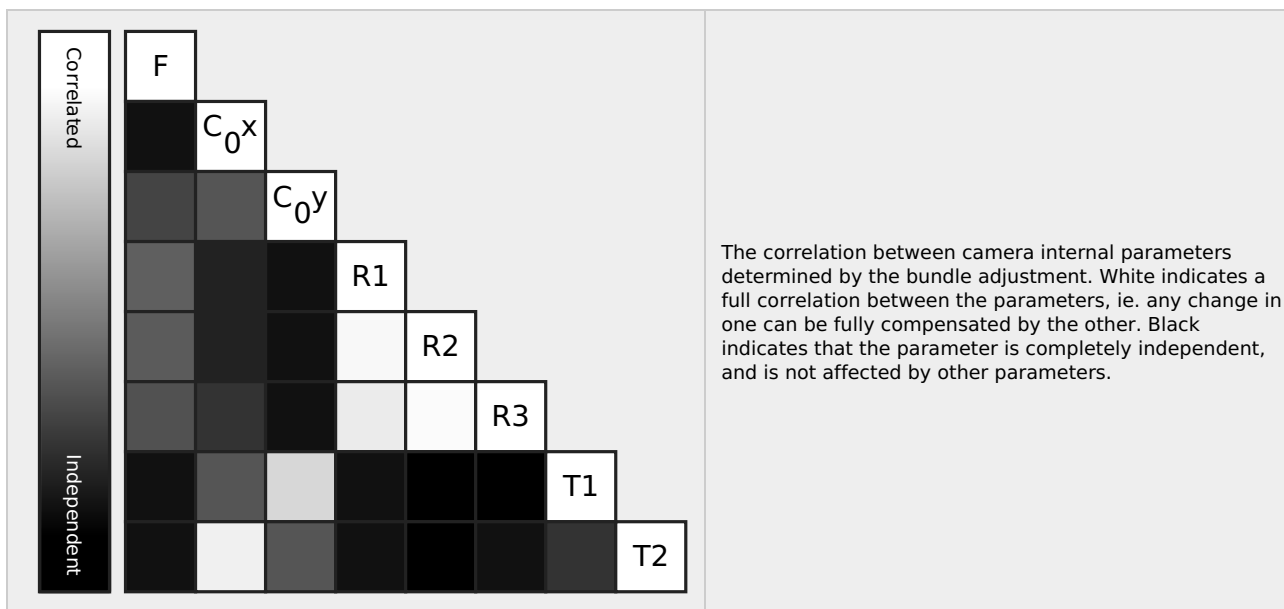
⑦ Internal Camera Parameters

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

EXIF ID: RedEdge_5.5_1280x960

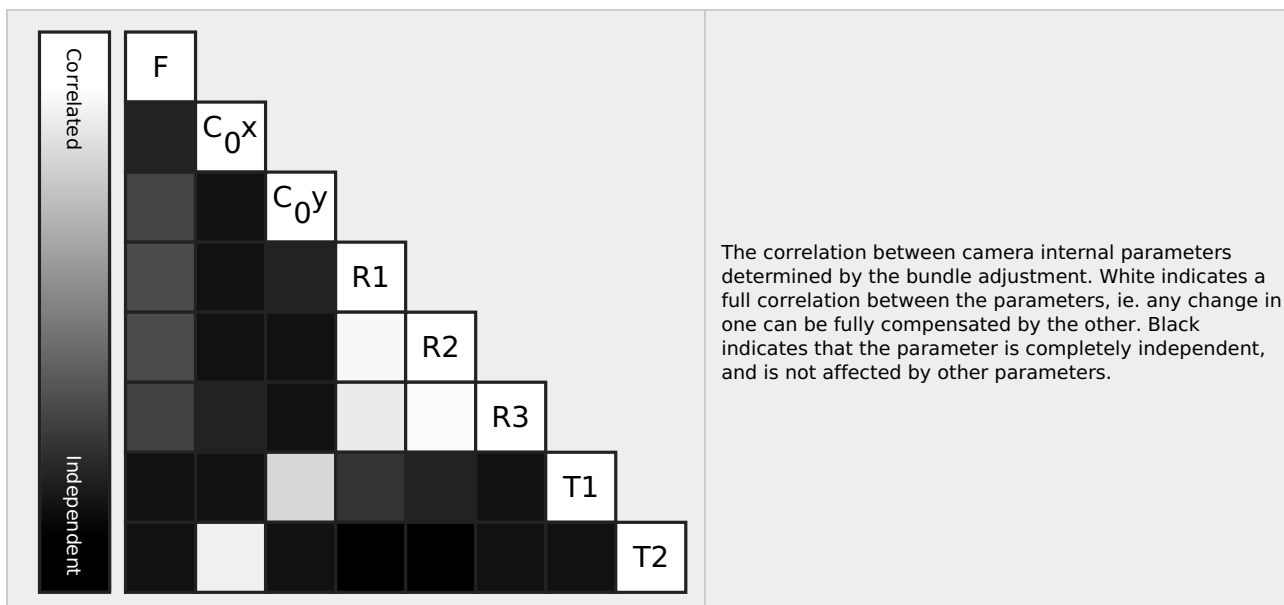|	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	1466.667 [pixel] 5.500 [mm]	666.605 [pixel] 2.500 [mm]	482.221 [pixel] 1.808 [mm]	-0.105	0.153	-0.045	0.000	0.000
Optimized Values	1448.434 [pixel] 5.432 [mm]	662.400 [pixel] 2.484 [mm]	482.477 [pixel] 1.809 [mm]	-0.106	0.155	-0.041	0.000	-0.000
Uncertainties (Sigma)	0.114 [pixel] 0.000 [mm]	0.127 [pixel] 0.000 [mm]	0.096 [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.

⑦ Internal Camera Parameters

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

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	1446.160 [pixel] 5.423 [mm]	657.598 [pixel] 2.466 [mm]	494.291 [pixel] 1.854 [mm]	-0.104	0.160	-0.058	0.000	-0.000
Uncertainties (Sigma)	0.110 [pixel] 0.000 [mm]	0.101 [pixel] 0.000 [mm]	0.076 [pixel] 0.000 [mm]	0.001	0.005	0.011	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: 11765

	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	-0.097	0.137	-0.373
Uncertainties (sigma)				0.003	0.005	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	0.057	0.107	-0.062
Uncertainties (sigma)				0.004	0.005	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	-0.145	-0.132	0.118
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	-0.066	-0.568	-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	37346	5130
Min	19904	114
Max	44174	25460
Mean	36222	5646

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	31975	3652
Min	20227	122
Max	40263	14147
Mean	30909	3725

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	38066	5452
Min	20730	840
Max	44090	25460
Mean	37459	6137

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	28549	3500

Min	19904	114
Max	37542	13511
Mean	27756	3531

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	35257	4522
Min	23678	123
Max	42231	21043
Mean	35012	4850

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	39350	5203
Min	25195	246
Max	44174	21313
Mean	38909	5595

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)	26 / 181 / 8191	18 / 75 / 5275	34 / 292 / 6048	12 / 79 / 828	18 / 126 / 2309
RedEdge_5.5_1280x960 (Green)		24 / 111 / 20804	15 / 62 / 3140	8 / 39 / 2762	14 / 64 / 10764
RedEdge_5.5_1280x960 (Red)			26 / 204 / 8099	12 / 71 / 594	18 / 122 / 1728
RedEdge_5.5_1280x960 (NIR)				16 / 202 / 12657	21 / 295 / 5072
RedEdge_5.5_1280x960 (Red edge)					18 / 155 / 11062

ⓘ 3D Points from 2D Keypoint Matches

|	Number of 3D Points Observed
In 2 Images	4825108
In 3 Images	1069795
In 4 Images	411426
In 5 Images	184474
In 6 Images	100327
In 7 Images	59169
In 8 Images	39259
In 9 Images	27037
In 10 Images	19383
In 11 Images	14617
In 12 Images	11670
In 13 Images	9243
In 14 Images	7050
In 15 Images	5584
In 16 Images	4465
In 17 Images	3692
In 18 Images	3091
In 19 Images	2556
In 20 Images	2152
In 21 Images	1812
In 22 Images	1618
In 23 Images	1401
In 24 Images	1126

In 25 Images	1017
In 26 Images	882
In 27 Images	819
In 28 Images	669
In 29 Images	617
In 30 Images	550
In 31 Images	406
In 32 Images	377
In 33 Images	333
In 34 Images	309
In 35 Images	262
In 36 Images	237
In 37 Images	176
In 38 Images	188
In 39 Images	166
In 40 Images	158
In 41 Images	139
In 42 Images	136
In 43 Images	78
In 44 Images	68
In 45 Images	86
In 46 Images	67
In 47 Images	63
In 48 Images	59
In 49 Images	54
In 50 Images	41
In 51 Images	33
In 52 Images	44
In 53 Images	34
In 54 Images	42
In 55 Images	33
In 56 Images	24
In 57 Images	19
In 58 Images	30
In 59 Images	22
In 60 Images	13
In 61 Images	15
In 62 Images	22
In 63 Images	16
In 64 Images	10
In 65 Images	19
In 66 Images	9
In 67 Images	9
In 68 Images	10
In 69 Images	7
In 70 Images	5
In 71 Images	4
In 72 Images	4
In 73 Images	5
In 74 Images	3
In 75 Images	4
In 76 Images	4
In 77 Images	3
In 78 Images	8
In 79 Images	5
In 80 Images	5
In 81 Images	2
In 82 Images	6
In 83 Images	2

In 84 Images	3
In 85 Images	3
In 86 Images	2
In 88 Images	7
In 89 Images	2
In 90 Images	1
In 91 Images	5
In 92 Images	3
In 93 Images	1
In 94 Images	1
In 95 Images	1
In 96 Images	1
In 97 Images	1
In 98 Images	1
In 99 Images	1
In 101 Images	2
In 102 Images	1
In 104 Images	1
In 106 Images	1
In 107 Images	1
In 108 Images	1
In 109 Images	1
In 110 Images	1
In 112 Images	1
In 113 Images	1
In 115 Images	2
In 116 Images	1
In 120 Images	2
In 121 Images	1
In 122 Images	1
In 136 Images	1
In 137 Images	1
In 139 Images	1
In 143 Images	1
In 149 Images	1
In 152 Images	1
In 155 Images	1
In 160 Images	1
In 164 Images	1

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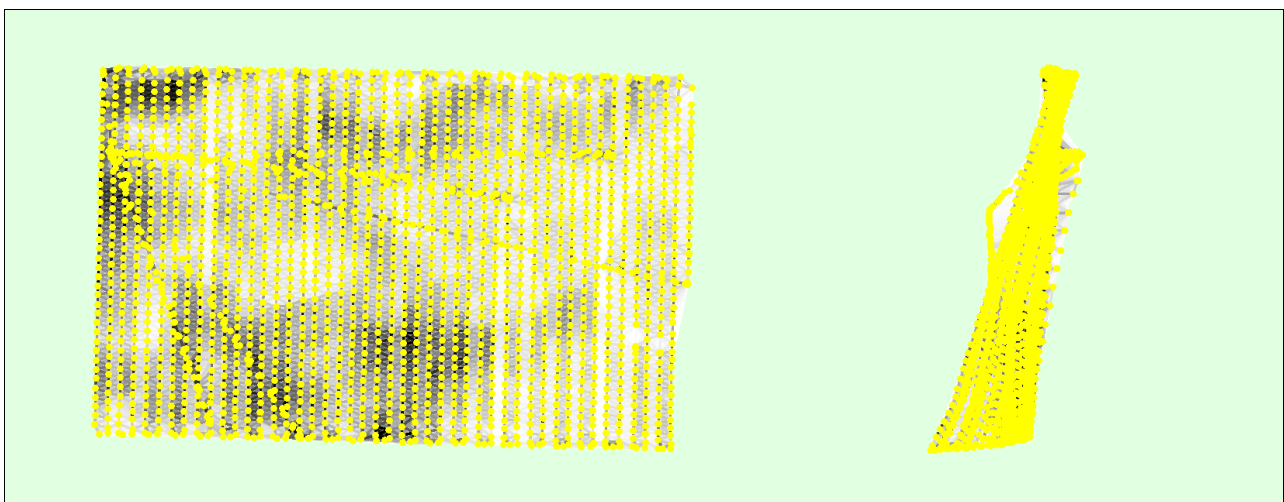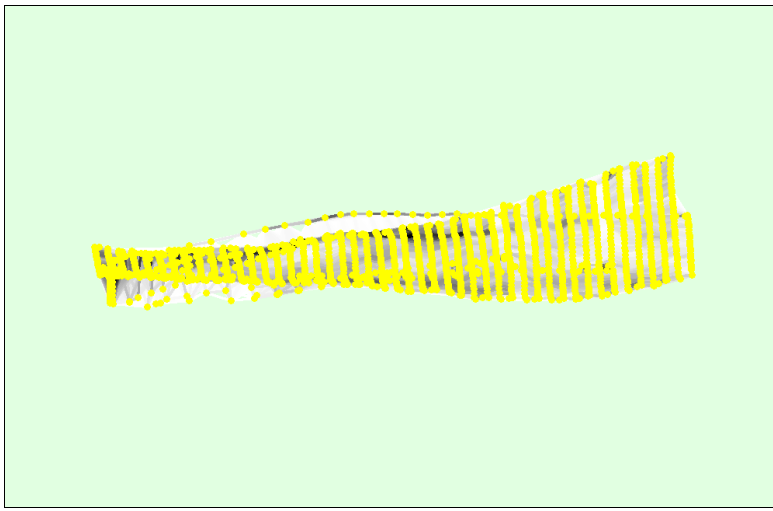
Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

Geolocation Details

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	0.01	0.00
-6.00	-3.00	0.11	0.09	2.01
-3.00	0.00	57.06	50.45	34.80
0.00	3.00	42.65	49.41	63.19
3.00	6.00	0.17	0.04	0.00
6.00	9.00	0.01	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]		-0.009704	0.010623	-0.001275
Sigma [m]		0.610093	1.076599	1.059079
RMS Error [m]		0.610170	1.076652	1.059080

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]	99.99	99.99	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

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 11N (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	10m:28s
Time for Point Cloud Classification	59s
Time for 3D Textured Mesh Generation	11m:58s

Results ⓘ

Number of Generated Tiles	1
Number of 3D Densified Points	12586228
Average Density (per m^3)	5.85

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (7.92 [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 (7.92 [cm/pixel]) Merge Tiles: yes
Index Calculator: Indices	ndvi
Index Calculator: Index Values	Polygon Shapefile [cm/grid]: 400
Time for DSM Generation	53s
Time for Orthomosaic Generation	01h:07m:05s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	01h:18m:51s
Time for Index Map Generation	42s

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	✔