Quality Report



Generated with Pix4Denterprise 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 <u>here</u> for additional tips to analyze the Quality Report

Summary

6

Project	sequ_6k_2_re
Processed	2019-01-23 05:57:32
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)	8.55 cm / 3.37 in
Area Covered	0.309 km ² / 30.9465 ha / 0.12 sq. mi. / 76.5100 acres
Time for Initial Processing (without report)	04h:13m:14s

Quality Check



? Images	median of 32981 keypoints per image	②
O Dataset	5605 out of 5610 images calibrated (99%), 5 images disabled	②
? Camera Optimization	1.36% relative difference between initial and optimized internal camera parameters	②
Matching	median of 7692.3 matches per calibrated image	②
? Georeferencing	yes, no 3D GCP	<u> </u>





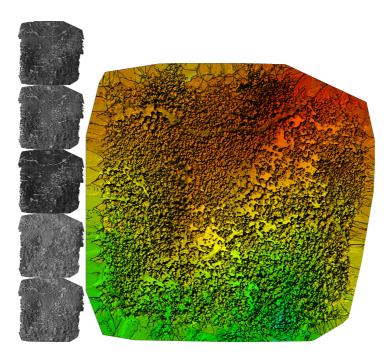


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	5605 out of 5615
Number of Geolocated Images	5615 out of 5615

Initial Image Positions



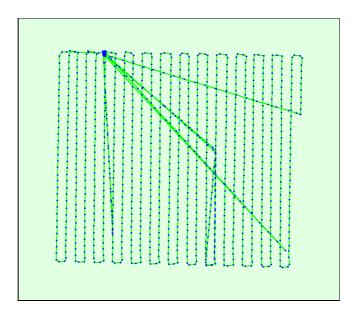
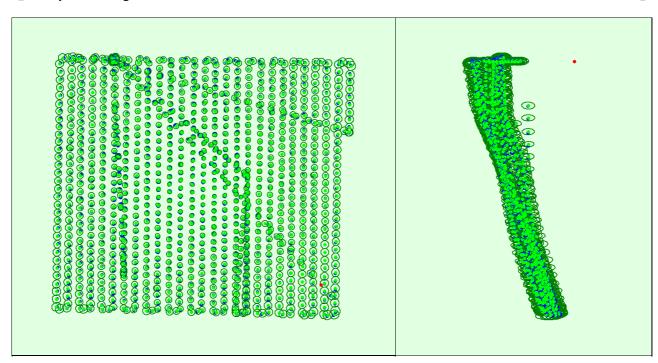
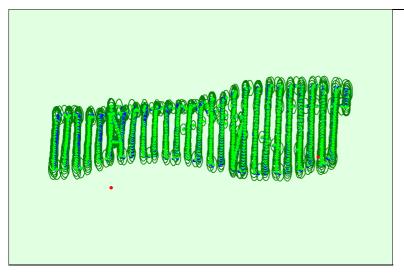


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

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.

Absolute camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.097	0.098	0.214	0.057	0.056	0.024
Sigma	0.016	0.016	0.043	0.001	0.002	0.003



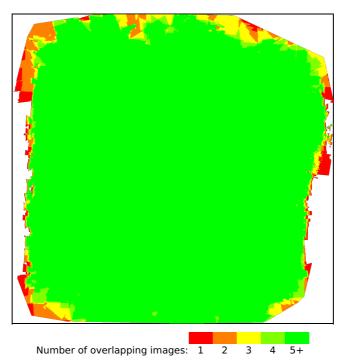


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.

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).

Number of 2D Keypoint Observations for Bundle Block Adjustment	13131308
Number of 3D Points for Bundle Block Adjustment	4384299
Mean Reprojection Error [pixels]	0.209

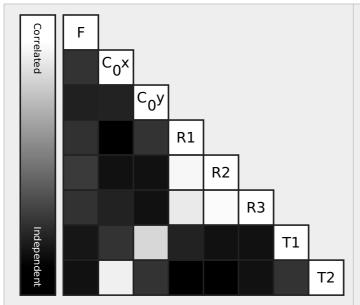
Internal Camera Parameters

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

1

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	1446.252 [pixel] 5.423 [mm]	654.572 [pixel] 2.455 [mm]	495.072 [pixel] 1.857 [mm]	-0.102	0.194	-0.121	0.000	-0.000
Uncertainties (Sigma)	0.159 [pixel] 0.001 [mm]	0.117 [pixel] 0.000 [mm]	0.089 [pixel] 0.000 [mm]	0.001	0.005	0.012	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.

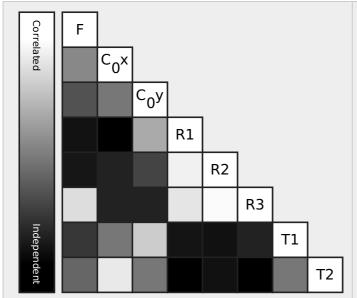
Internal Camera Parameters

☐ 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	1443.004 [pixel] 5.411 [mm]	655.986 [pixel] 2.460 [mm]	481.218 [pixel] 1.805 [mm]	-0.100	0.162	-0.061	0.000	0.000
Uncertainties (Sigma)	0.154 [pixel] 0.001 [mm]	0.040 [pixel] 0.000 [mm]	0.033 [pixel] 0.000 [mm]	0.000	0.002	0.004	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.



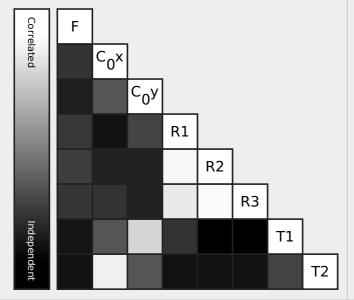
The number of Automatic Tie Points (ATPs) per pixel, averaged over all images of the camera model, is color coded between black and white. White indicates that, on average, more than 16 ATPs have been extracted at the pixel location. Black indicates that, on average, 0 ATPs have been extracted at the 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	1448.141 [pixel] 5.431 [mm]	653.694 [pixel] 2.451 [mm]	493.551 [pixel] 1.851 [mm]	-0.101	0.141	-0.017	-0.000	-0.000
Uncertainties (Sigma)	0.160 [pixel] 0.001 [mm]	0.129 [pixel] 0.000 [mm]	0.098 [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.

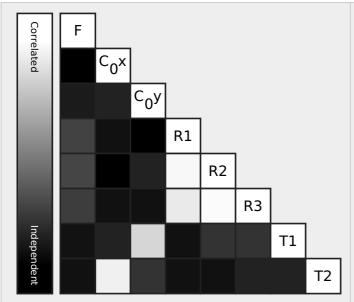
Internal Camera Parameters

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

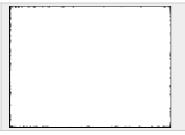
1

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	1449.131 [pixel] 5.434 [mm]	662.438 [pixel] 2.484 [mm]	482.555 [pixel] 1.810 [mm]	-0.108	0.179	-0.099	0.000	-0.000
Uncertainties (Sigma)	0.162 [pixel] 0.001 [mm]	0.143 [pixel] 0.001 [mm]	0.109 [pixel] 0.000 [mm]	0.001	0.007	0.015	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.

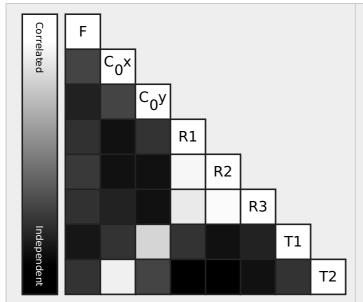
Internal Camera Parameters

RedEdge 5.5 1280x960 (Red edge). Sensor Dimensions: 4.800 [mm] x 3.600 [mm]

(1)

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	1446.712 [pixel] 5.425 [mm]	657.601 [pixel] 2.466 [mm]	494.439 [pixel] 1.854 [mm]	-0.104	0.166	-0.072	0.000	-0.000
Uncertainties (Sigma)	0.159 [pixel] 0.001 [mm]	0.116 [pixel] 0.000 [mm]	0.089 [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.

? Camera Rig «MicaSense 5 band» Relatives. Images: 5610



	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	-0.113	0.122	-0.374
Uncertainties (sigma)				0.004	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	0.050	0.079	-0.064
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	-0.162	-0.139	0.117
Uncertainties (sigma)				0.004	0.006	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	-0.085	-0.576	-0.322
Uncertainties (sigma)				0.004	0.005	0.000

2D Keypoints Table



	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	32981	7692
Min	17103	401
Max	43440	26143
Mean	32534	8327

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

Median	30481	5899
Min	21103	1073
Max	41067	19896
Mean	30304	6938

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	34175	7983
Min	17103	401
Max	43389	26143
Mean	33746	8846

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	24557	4576
Min	18607	1690
Max	36426	17004
Mean	25445	5349

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

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	28396	6559
Min	17485	1457
Max	41761	20358
Mean	29030	7298

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	33242	7706	
Min	25186	3316	
Max	43440	20770	
Mean	33430	8612	

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)	31 / 267 / 13053	33 / 157 / 10171	36 / 360 / 7792	26 / 218 / 3715	35 / 323 / 7249
RedEdge_5.5_1280x960 (Green)		37 / 181 / 16770	29 / 133 / 6435	19 / 89 / 5238	28 / 138 / 10960
RedEdge_5.5_1280x960 (Red)			28 / 253 / 11147	22 / 181 / 2446	33 / 275 / 5025
RedEdge_5.5_1280x960 (NIR)				20 / 273 / 14652	28 / 405 / 6970
RedEdge_5.5_1280x960 (Red edge)					25 / 261 / 12644

? 3D Points from 2D Keypoint Matches

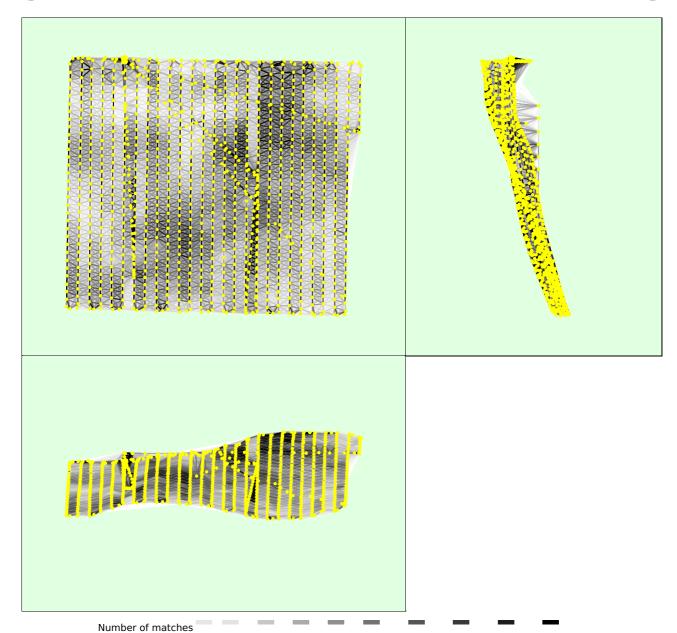


	Number of 3D Points Observed
In 2 Images	2911688
In 3 Images	713632
In 4 Images	300407
In 5 Images	150533
In 6 Images	85862

In 7 Images	53646
In 7 Images	52646
In 8 Images	36139
In 9 Images	25461
In 10 Images	19031
In 11 Images	14488
In 12 Images	11316
In 13 Images	9013
In 14 Images	7186
In 15 Images	5885
In 16 Images	5102
In 17 Images	4146
In 18 Images	3537
In 19 Images	3188
In 20 Images	2739
In 21 Images	2437
In 22 Images	2140
In 23 Images	1865
In 24 Images	1354
In 25 Images	1354
In 26 Images	1255
In 27 Images	1165
In 28 Images	955
In 29 Images	903
In 30 Images	795
In 31 Images	748
In 32 Images	675
In 33 Images	579
In 34 Images	521
In 35 Images	496
In 36 Images	449
In 37 Images	377
In 38 Images	340
In 39 Images	291
In 40 Images	281
In 41 Images	247
In 42 Images	214
In 43 Images	221
In 44 Images	184
In 45 Images	171
In 46 Images	169
In 47 Images	140
In 48 Images	112
In 49 Images	106
In 50 Images	93
In 51 Images	88
In 52 Images	96
In 53 Images	81
In 54 Images	74
In 55 Images	72
In 56 Images	64
In 57 Images	51
	43
In 58 Images	
In 59 Images	60
In 60 Images	42
In 61 Images	43
In 62 Images	41
In 63 Images	35
In 64 Images	29
In 65 Images	28

In 66 Images	37
In 67 Images	36
In 68 Images	37
In 69 Images	31
In 70 Images	34
In 71 Images	25
In 72 Images	26
In 73 Images	32
In 74 Images	22
In 75 Images	21
In 76 Images	10
In 77 Images	19
In 78 Images	17
In 79 Images	14
In 80 Images	17
In 81 Images	15
In 82 Images	8
In 83 Images	16
In 84 Images	11
In 85 Images	16
In 86 Images	7
In 87 Images	6
In 88 Images	10
In 89 Images	10
In 90 Images	11
	7
In 91 Images	
In 92 Images	8
In 93 Images	7
In 94 Images	7
In 95 Images	
In 96 Images	4
In 97 Images	5
In 98 Images	11
In 99 Images	4
In 100 Images	3
In 101 Images	6
In 102 Images	2
In 103 Images	2
In 104 Images	3
In 105 Images	2
In 106 Images	2
In 107 Images	4
In 108 Images	4
In 111 Images	1
In 112 Images	2
In 113 Images	1
In 114 Images	2
In 115 Images	4
In 116 Images	2
In 117 Images	2
In 118 Images	3
In 119 Images	3
In 121 Images	1
In 122 Images	2
In 123 Images	1
In 124 Images	1
In 126 Images	1





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.

@ 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	0.09	0.00
-3.00	0.00	50.04	51.19	48.17
0.00	3.00	49.96	48.64	51.83
3.00	6.00	0.00	0.09	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]		0.000559	0.000546	0.000080
Sigma [m]		0.584668	1.005788	0.711641
RMS Error [m]		0.584668	1.005788	0.711641

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

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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

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System Information

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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	05m:11s
Time for Point Cloud Classification	27s
Time for 3D Textured Mesh Generation	06m:11s

Results

(1)

Number of Generated Tiles	1
Number of 3D Densified Points	5932728
Average Density (per m ³)	5.2

DSM, Orthomosaic and Index Details

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Processing Options

6

DSM and Orthomosaic Resolution	1 x GSD (8.55 [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 (8.55 [cm/pixel]) Merge Tiles: yes
Index Calculator: Indices	ndvi
Index Calculator: Index Values	Polygon Shapefile [cm/grid]: 400
Time for DSM Generation	24s
Time for Orthomosaic Generation	28m:48s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	35m:21s
Time for Index Map Generation	16s

Camera Radiometric Correction

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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	②
RedEdge_5.5_1280x960	NIR	Camera and Sun Irradiance	•
RedEdge_5.5_1280x960	Red edge	Camera and Sun Irradiance	•