

# Quality Report



Generated with Pix4Dmapper version 4.6.4



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Additional information about the sections



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## Summary



Project	flaam_med_gcp
Processed	2021-04-14 20:59:15
Camera Model Name(s)	FC6310R_8.8_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	4.85 cm / 1.91 in

## Quality Check



<b>Images</b>	median of 73177 keypoints per image	
<b>Dataset</b>	545 out of 550 images calibrated (99%), all images enabled	
<b>Camera Optimization</b>	0.96% relative difference between initial and optimized internal camera parameters	
<b>Matching</b>	median of 13943.7 matches per calibrated image	
<b>Georeferencing</b>	yes, 4 GCPs (4 3D), mean RMS error = 0.019 m	

## Calibration Details



Number of Calibrated Images	545 out of 550
Number of Geolocated Images	550 out of 550



## Initial Image Positions



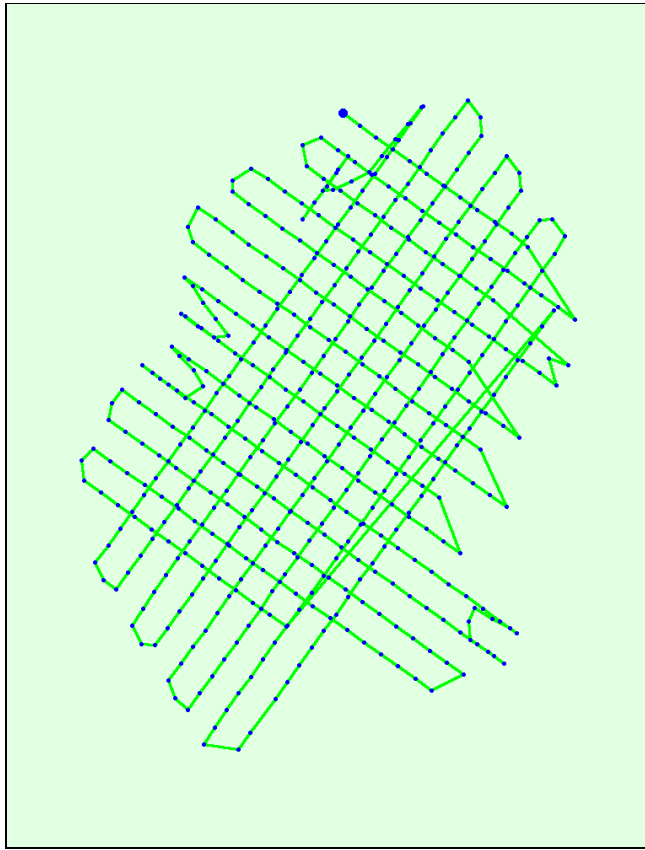
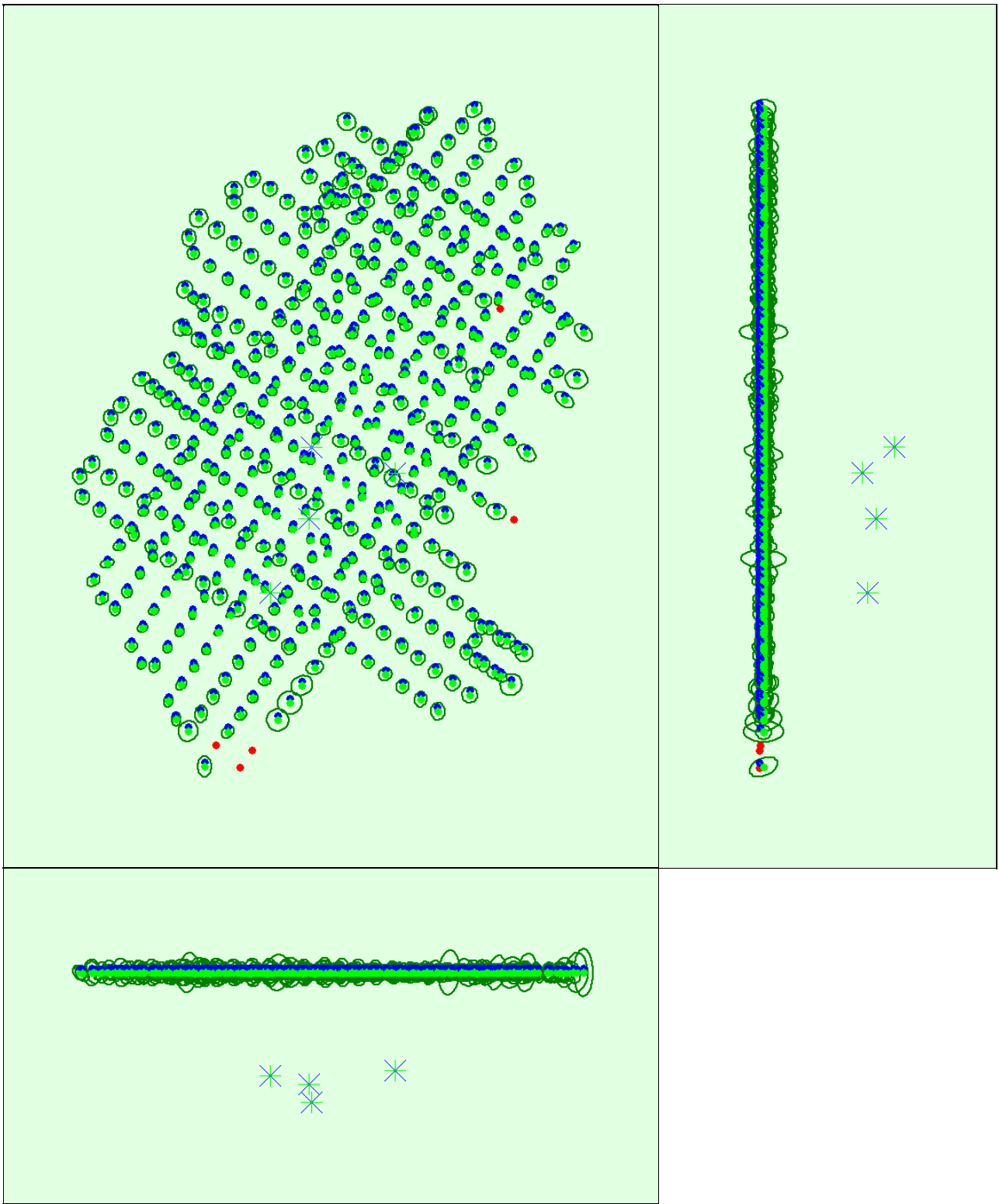


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

 **Computed Image/GCPs/Manual Tie Points Positions**





Uncertainty ellipses 1000x 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	0.002	0.002	0.002	0.002	0.002	0.002
Sigma	0.000	0.000	0.001	0.002	0.002	0.002

# Bundle Block Adjustment Details



Number of 2D Keypoint Observations for Bundle Block Adjustment	7608355
Number of 3D Points for Bundle Block Adjustment	2074561
Mean Reprojection Error [pixels]	0.100

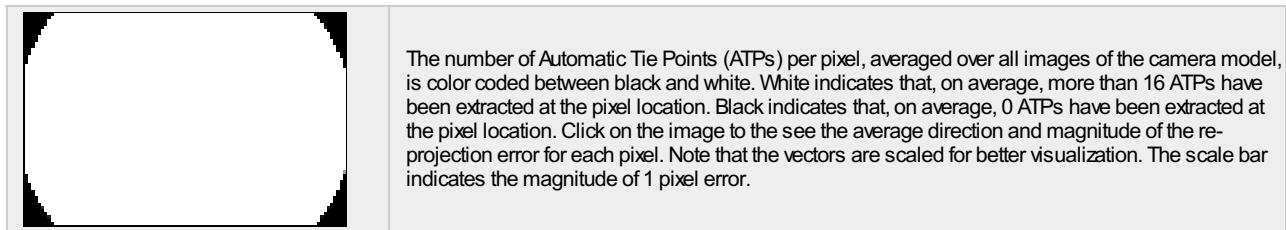
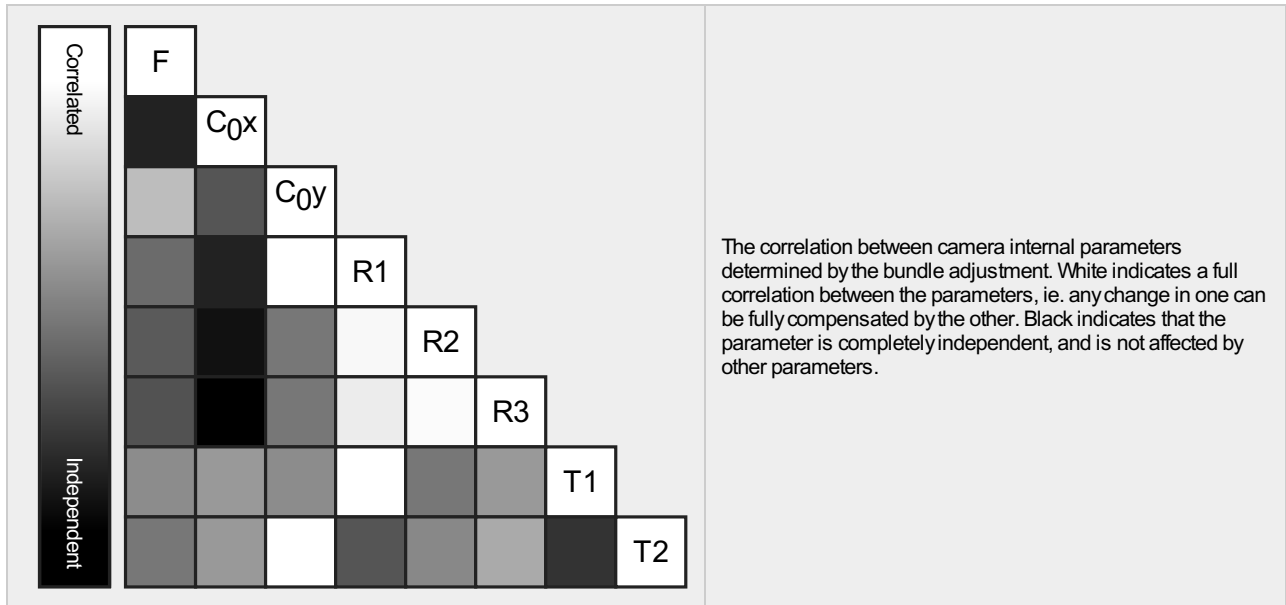
## Internal Camera Parameters

FC6310R\_8.8\_5472x3648 (RGB). Sensor Dimensions: 12.833 [mm] x 8.556 [mm]



EXIF ID: FC6310R\_8.8\_5472x3648

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	3658.300 [pixel] 8.580 [mm]	2722.500 [pixel] 6.385 [mm]	1835.100 [pixel] 4.304 [mm]	-0.269	0.112	-0.033	0.000	-0.001
Optimized Values	3623.009 [pixel] 8.497 [mm]	2745.039 [pixel] 6.438 [mm]	1819.732 [pixel] 4.268 [mm]	-0.269	0.114	-0.034	0.000	-0.000
Uncertainties (Sigma)	0.040 [pixel] 0.000 [mm]	0.044 [pixel] 0.000 [mm]	0.052 [pixel] 0.000 [mm]	0.000	0.000	0.000	0.000	0.000



## 2D Keypoints Table



	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	73177	13944
Mn	57412	102
Max	79970	32747
Mean	71841	13960

## 3D Points from 2D Keypoint Matches



	Number of 3D Points Observed
In 2 Images	1117449
In 3 Images	390186

In 4 Images	192067
In 5 Images	108615
In 6 Images	67643
In 7 Images	44696
In 8 Images	31358
In 9 Images	22863
In 10 Images	17500
In 11 Images	13327
In 12 Images	10437
In 13 Images	8485
In 14 Images	6905
In 15 Images	5698
In 16 Images	4651
In 17 Images	4060
In 18 Images	3302
In 19 Images	2863
In 20 Images	2406
In 21 Images	2073
In 22 Images	1836
In 23 Images	1553
In 24 Images	1370
In 25 Images	1224
In 26 Images	1049
In 27 Images	938
In 28 Images	825
In 29 Images	737
In 30 Images	685
In 31 Images	655
In 32 Images	540
In 33 Images	457
In 34 Images	431
In 35 Images	359
In 36 Images	339
In 37 Images	330
In 38 Images	304
In 39 Images	282
In 40 Images	235
In 41 Images	228
In 42 Images	220
In 43 Images	186
In 44 Images	168
In 45 Images	151
In 46 Images	156
In 47 Images	135
In 48 Images	154
In 49 Images	127
In 50 Images	126
In 51 Images	101
In 52 Images	120
In 53 Images	88
In 54 Images	89
In 55 Images	80
In 56 Images	86
In 57 Images	68
In 58 Images	57
In 59 Images	66
In 60 Images	59
In 61 Images	49
In 62 Images	53

In 63 Images	45
In 64 Images	46
In 65 Images	53
In 66 Images	40
In 67 Images	31
In 68 Images	46
In 69 Images	35
In 70 Images	42
In 71 Images	36
In 72 Images	25
In 73 Images	28
In 74 Images	29
In 75 Images	31
In 76 Images	30
In 77 Images	27
In 78 Images	22
In 79 Images	26
In 80 Images	27
In 81 Images	18
In 82 Images	23
In 83 Images	23
In 84 Images	21
In 85 Images	27
In 86 Images	25
In 87 Images	20
In 88 Images	17
In 89 Images	23
In 90 Images	21
In 91 Images	14
In 92 Images	16
In 93 Images	18
In 94 Images	14
In 95 Images	11
In 96 Images	10
In 97 Images	15
In 98 Images	5
In 99 Images	12
In 100 Images	16
In 101 Images	13
In 102 Images	12
In 103 Images	15
In 104 Images	16
In 105 Images	13
In 106 Images	9
In 107 Images	12
In 108 Images	14
In 109 Images	7
In 110 Images	8
In 111 Images	7
In 112 Images	5
In 113 Images	7
In 114 Images	8
In 115 Images	10
In 116 Images	10
In 117 Images	7
In 118 Images	3
In 119 Images	6
In 120 Images	5
In 121 Images	6

In 122 Images	6
In 123 Images	3
In 124 Images	4
In 125 Images	9
In 126 Images	4
In 127 Images	8
In 128 Images	6
In 129 Images	5
In 130 Images	5
In 131 Images	7
In 132 Images	5
In 133 Images	4
In 134 Images	3
In 137 Images	2
In 138 Images	1
In 139 Images	1
In 140 Images	4
In 141 Images	1
In 142 Images	1
In 144 Images	1
In 145 Images	1
In 146 Images	1
In 147 Images	1
In 149 Images	1
In 150 Images	2
In 151 Images	2
In 153 Images	1
In 159 Images	1
In 160 Images	1
In 163 Images	2
In 166 Images	2
In 170 Images	1
In 176 Images	2
In 196 Images	2

 **2D Keypoint Matches**



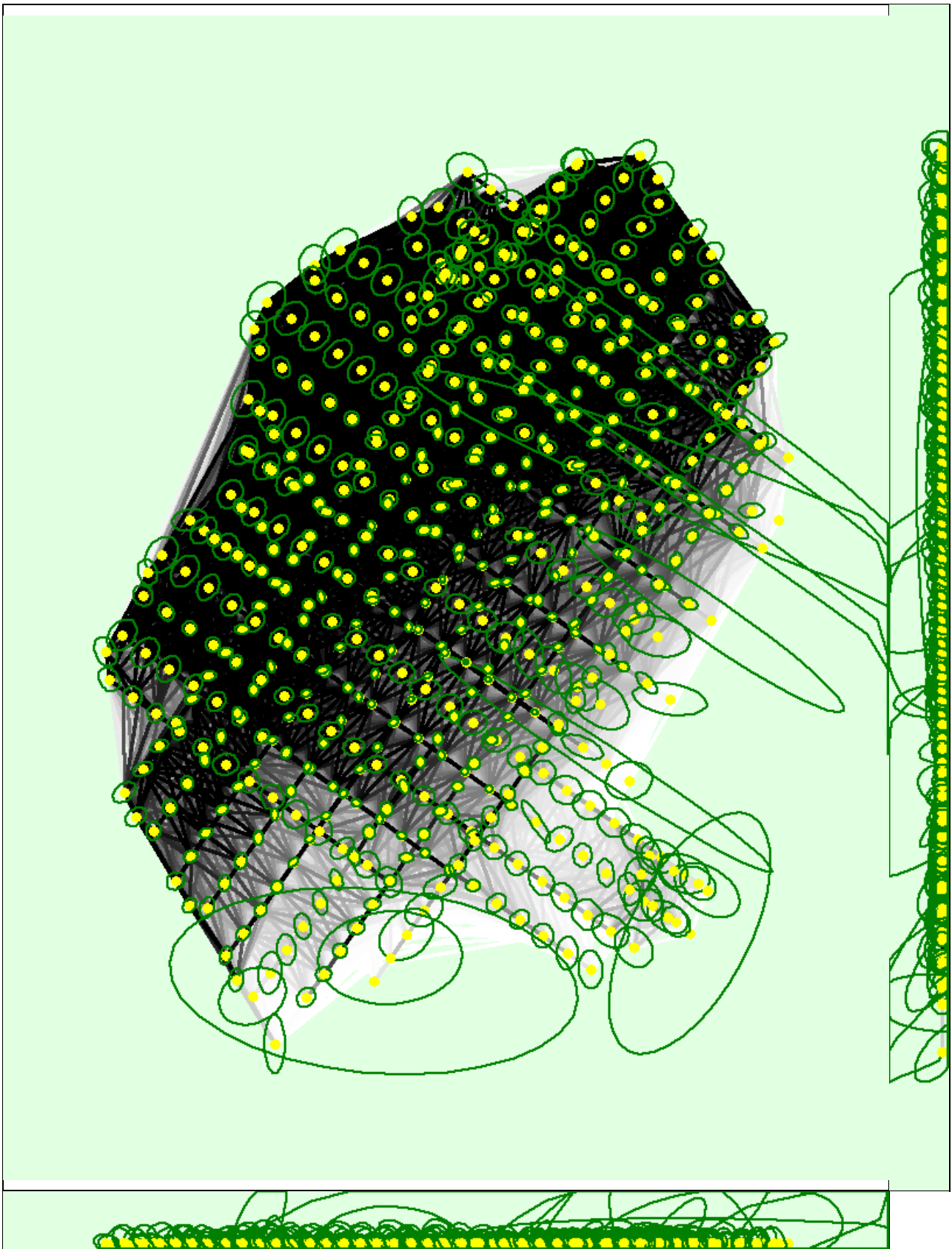


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty of the bundle block adjustment result.

**? Relative camera position and orientation uncertainties**

X[m]	Y[m]	Z[m]	Omega [degree]	Phi [degree]	Kappa [degree]
------	------	------	----------------	--------------	----------------



Mean	0.002	0.002	0.002	0.003	0.003	0.002
Sigma	0.005	0.003	0.003	0.006	0.006	0.004

## Geolocation Details

### Ground Control Points

GCP Name	Accuracy XY/Z [m]	Error X [m]	Error Y [m]	Error Z [m]	Projection Error [pixel]	Verified/Marked
GCP1 (3D)	0.009/ 0.017	0.030	-0.015	0.019	1.775	4 / 4
GCP2 (3D)	0.013/ 0.026	-0.021	-0.016	-0.031	1.163	4 / 4
GCP3 (3D)	0.012/ 0.022	-0.018	0.023	-0.031	0.700	4 / 4
GCP4 (3D)	0.011/ 0.021	-0.005	-0.000	0.006	0.688	4 / 4
<b>Mean [m]</b>		-0.003480	-0.002153	-0.009280		
<b>Sigma [m]</b>		0.020233	0.015797	0.022277		
<b>RMS Error [m]</b>		0.020531	0.015943	0.024132		

Localisation accuracy per GCP and mean errors in the three coordinate directions. The last column counts the number of calibrated images where the GCP has been automatically verified vs. manually marked.

### Absolute Geolocation Variance

Min Error [m]	Max Error [m]	Geolocation Error X [%]	Geolocation Error Y [%]	Geolocation Error Z [%]
-	-0.04	0.00	0.00	0.00
-0.04	-0.03	0.00	0.00	0.00
-0.03	-0.03	0.00	0.00	0.55
-0.03	-0.02	0.18	0.18	2.75
-0.02	-0.01	6.06	4.77	10.46
-0.01	0.00	46.06	43.12	36.51
0.00	0.01	39.27	47.52	38.17
0.01	0.02	8.26	4.40	11.01
0.02	0.03	0.18	0.00	0.55
0.03	0.03	0.00	0.00	0.00
0.03	0.04	0.00	0.00	0.00
0.04	-	0.00	0.00	0.00
<b>Mean [m]</b>		-0.035156	1.224245	1.092118
<b>Sigma [m]</b>		0.005807	0.005451	0.008023
<b>RMS Error [m]</b>		0.035633	1.224258	1.092148

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.

Geolocation Bias	X	Y	Z
Translation [m]	-0.035175	1.224255	1.092447

Bias between image initial and computed geolocation given in output coordinate system.

### Relative Geolocation Variance

Relative Geolocation Error	Images X [%]	Images Y [%]	Images Z [%]
[-1.00, 1.00]	97.06	98.90	99.63
[-2.00, 2.00]	100.00	100.00	100.00
[-3.00, 3.00]	100.00	100.00	100.00

<b>Mean of Geolocation Accuracy [m]</b>	0.012414	0.012414	0.025567
<b>Sigma of Geolocation Accuracy [m]</b>	0.000551	0.000551	0.001786

Images X, Y, Z represent the percentage of images with a relative geolocation error in X, Y, Z.

Geolocation Orientational Variance	RMS [degree]
Omega	1.468
Phi	1.467
Kappa	3.405

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) i7-8550U CPU @ 1.80GHz RAM: 16GB GPU: Intel(R) UHD Graphics 620 (Driver: 24.20.100.6286)
Operating System	Windows 10 Pro, 64-bit

### Coordinate Systems



Image Coordinate System	WGS 84
Ground Control Point (GCP) Coordinate System	WGS 84 / UTMzone 32N (EGM2008 Geoid)
Output Coordinate System	WGS 84 / UTMzone 32N (EGM2008 Geoid)

### Processing Options



Detected Template	3D Models
Keypoints Image Scale	Full, Image Scale: 1
Advanced: Matching Image Pairs	Free Flight or Terrestrial
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: Auto, no

## Point Cloud Densification details



### Processing Options



Image Scale	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	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	03h:41m:16s

Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	26m:12s

## Results



Number of Processed Clusters	3
Number of Generated Tiles	1
Number of 3D Densified Points	24832702
Average Density (per m <sup>3</sup> )	146.79