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Summary



Project	23-013 Boulevard Mall 20230412
Processed	2023-04-12 13:08:59
Camera Model Name(s)	FC6310_8.8_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	2.72 cm / 1.07 in
Area Covered	0.582 km ² / 58.1830 ha / 0.22 sq. mi. / 143.8477 acres

Quality Check



Images	median of 41089 keypoints per image	
Dataset	321 out of 321 images calibrated (100%), 1 images disabled	
Camera Optimization	0.64% relative difference between initial and optimized internal camera parameters	
Matching	median of 18473.4 matches per calibrated image	
Georeferencing	yes, 6 GCPs (6 3D), mean RMS error = 0.268 US survey foot	

Preview



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

Calibration Details



Number of Calibrated Images	321 out of 322
Number of Geolocated Images	322 out of 322

? Initial Image Positions

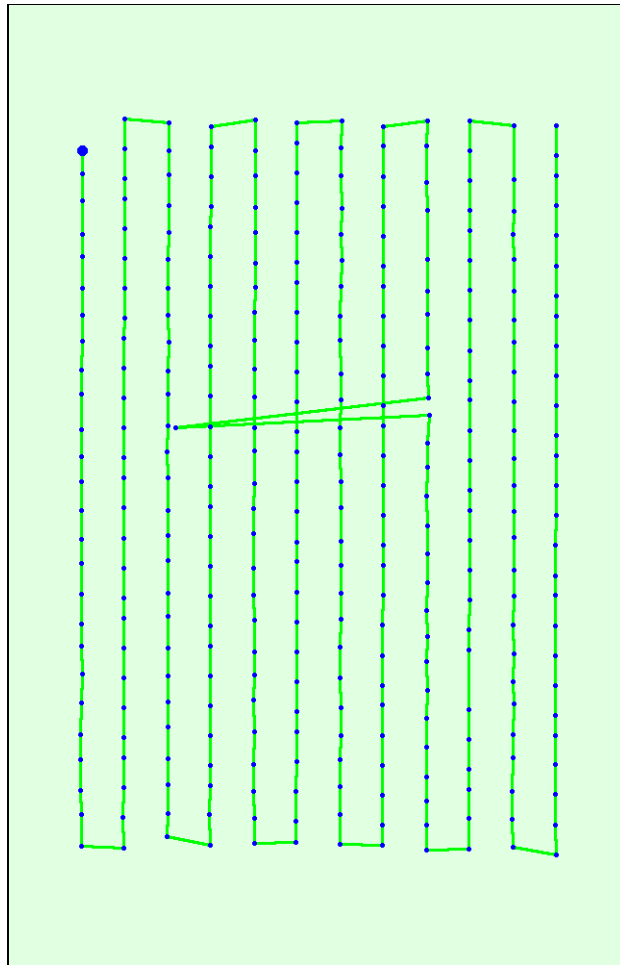
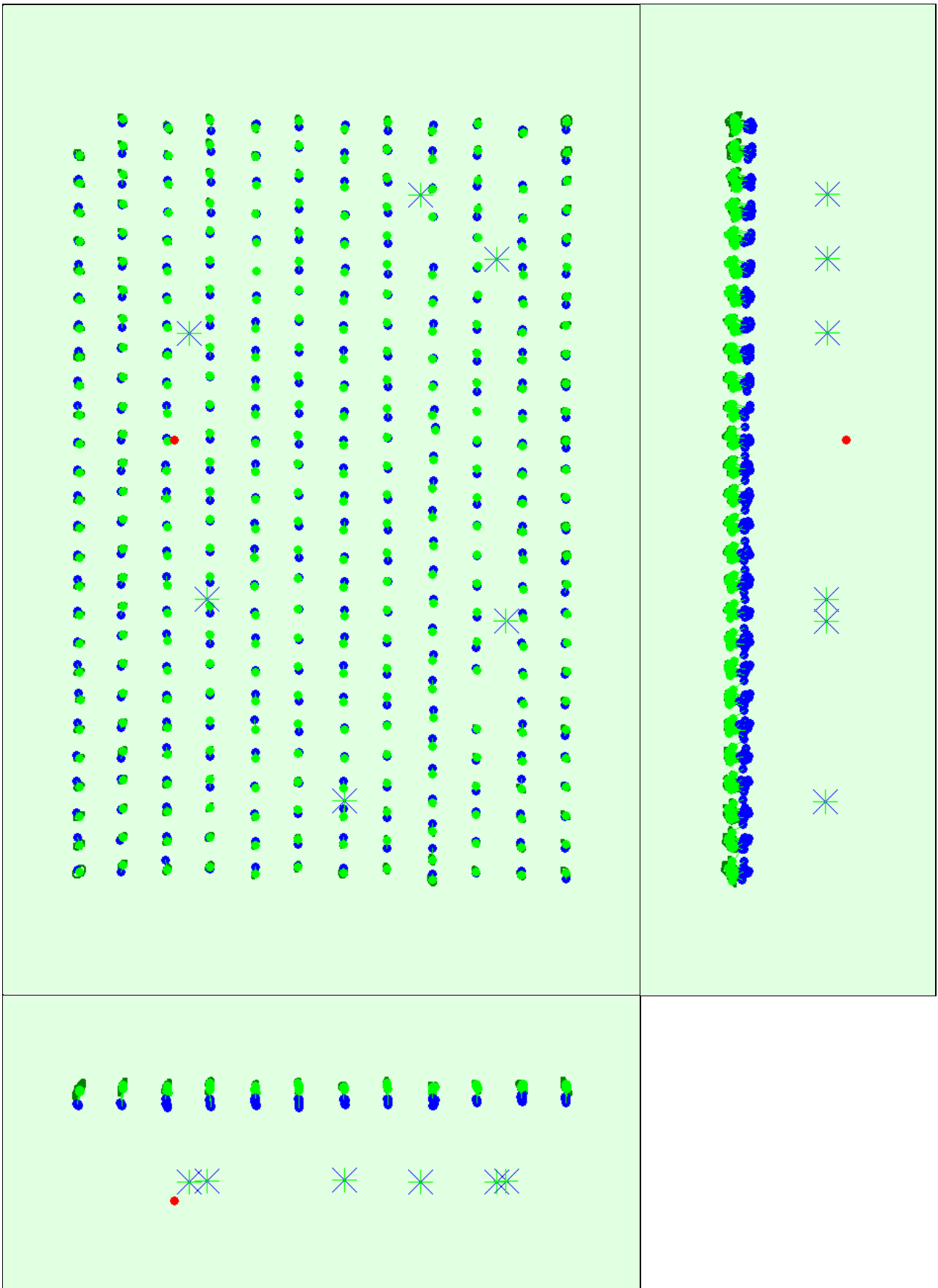


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

? Computed Image/GCPs/Manual Tie Points Positions





Uncertainty ellipses 100x 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.

	X [US survey foot]	Y [US survey foot]	Z [US survey foot]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.116	0.119	0.137	0.019	0.018	0.005
Sigma	0.033	0.029	0.047	0.005	0.006	0.001

Overlap

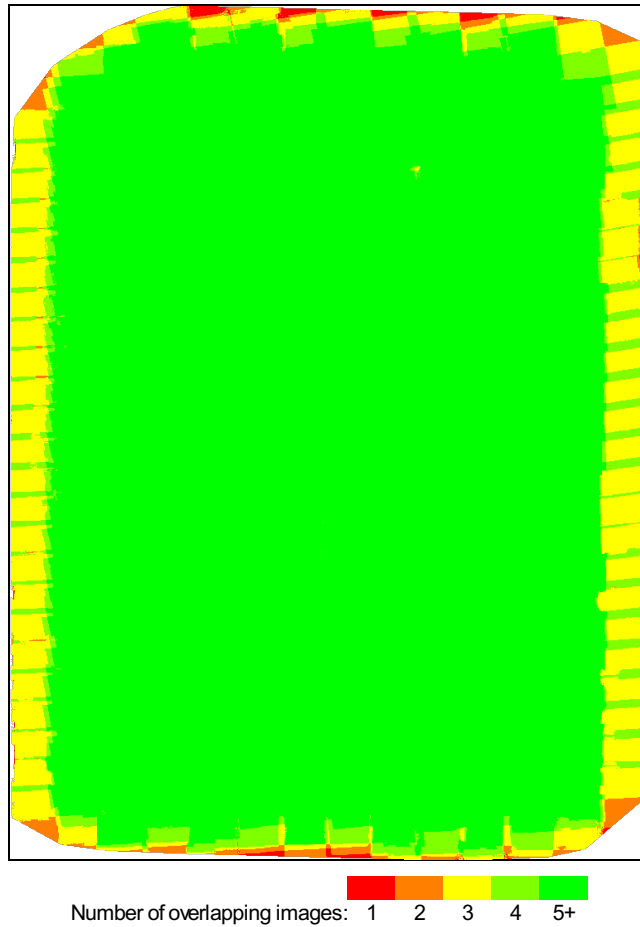


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic. Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint 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	6062542
Number of 3D Points for Bundle Block Adjustment	2070751
Mean Reprojection Error [pixels]	0.274

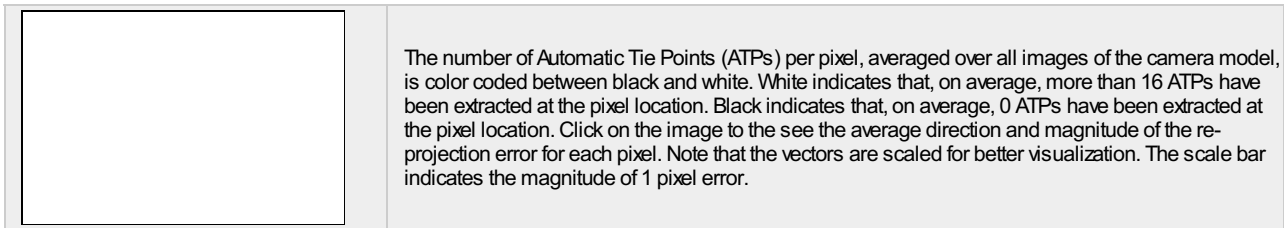
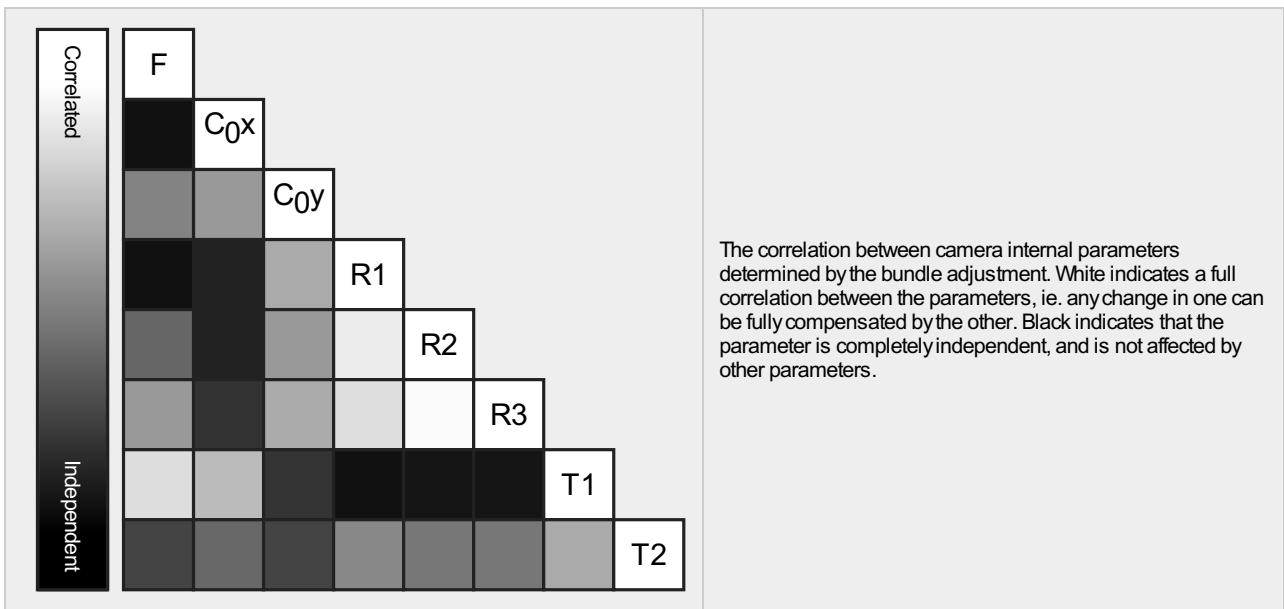
Internal Camera Parameters

FC6310_8.8_5472x3648 (RGB). Sensor Dimensions: 12.833 [mm] x 8.556 [mm]



EXIF ID: FC6310_8.8_5472x3648

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	3668.759 [pixel] 8.604 [mm]	2736.001 [pixel] 6.417 [mm]	1823.999 [pixel] 4.278 [mm]	0.003	-0.008	0.008	-0.000	0.000
Optimized Values	3692.556 [pixel] 8.660 [mm]	2721.327 [pixel] 6.382 [mm]	1823.881 [pixel] 4.277 [mm]	0.003	-0.016	0.014	0.001	-0.001
Uncertainties (Sigma)	0.959 [pixel] 0.002 [mm]	0.268 [pixel] 0.001 [mm]	0.280 [pixel] 0.001 [mm]	0.000	0.001	0.001	0.000	0.000



? 2D Keypoints Table



	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	41089	18473
Mn	20108	4702
Max	60435	40634
Mean	40837	18886

? 3D Points from 2D Keypoint Matches



	Number of 3D Points Observed
In 2 Images	1259901
In 3 Images	389433
In 4 Images	154283
In 5 Images	90815
In 6 Images	65523
In 7 Images	40373
In 8 Images	29236
In 9 Images	24338
In 10 Images	12119
In 11 Images	3657
In 12 Images	843
In 13 Images	202
In 14 Images	24
In 15 Images	4

? 2D Keypoint Matches



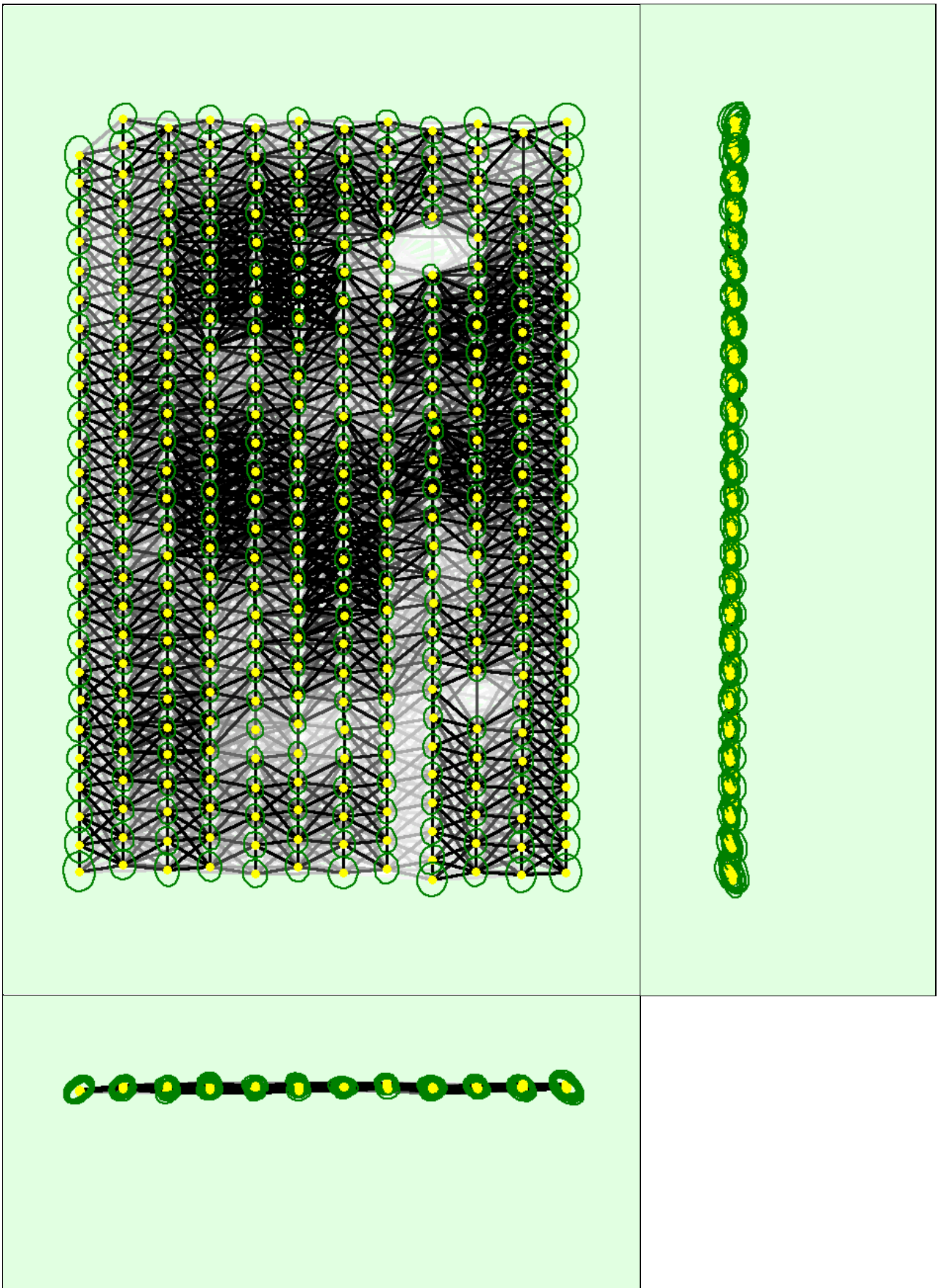


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty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

Relative camera position and orientation uncertainties



	X [US survey foot]	Y [US survey foot]	Z [US survey foot]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.069	0.085	0.055	0.013	0.011	0.005
Sigma	0.014	0.014	0.016	0.002	0.002	0.001

Geolocation Details



Ground Control Points



GCP Name	Accuracy XYZ [US survey foot]	Error X [US survey foot]	Error Y [US survey foot]	Error Z [US survey foot]	Projection Error [pixel]	Verified/Marked
CB100 (3D)	0.020/ 0.020	-0.001	-0.297	-0.021	0.829	10 / 10
CB101 (3D)	0.020/ 0.020	0.392	0.094	-0.021	1.689	10 / 10
CB104 (3D)	0.020/ 0.020	0.541	0.058	0.245	1.078	9 / 9
CB106 (3D)	0.020/ 0.020	0.031	0.360	0.041	0.762	9 / 9
CB109 (3D)	0.020/ 0.020	-0.547	0.245	0.186	1.139	9 / 9
CB111 (3D)	0.020/ 0.020	-0.464	-0.368	0.342	0.982	8 / 8
Mean [US survey foot]		-0.008030	0.015285	0.128522		
Sigma [US survey foot]		0.400249	0.265825	0.138426		
RMS Error [US survey foot]		0.400330	0.266264	0.188891		

0 out of 8 check points have been labeled as inaccurate.

Check Point Name	Accuracy XYZ [US survey foot]	Error X [US survey foot]	Error Y [US survey foot]	Error Z [US survey foot]	Projection Error [pixel]	Verified/Marked
CB1		-0.3595	-1.4587	0.0245	0.8615	10 / 10
CB2		-0.4142	-1.4590	0.4568	0.7765	8 / 8
CB102		2.0785	-0.0373	-0.4708	0.7793	10 / 10
CB103		1.6453	-0.4256	-0.5464	0.9465	10 / 10
CB105		0.3044	0.3656	-0.7938	0.6245	11 / 11
CB107		-1.2621	0.5424	-0.2464	0.6236	8 / 8
CB108		-1.4463	0.5126	-0.3052	0.8718	9 / 9
CB110		-1.1275	-0.0079	0.7274	0.8782	10 / 10
Mean [US survey foot]		-0.072660	-0.245983	-0.144272		
Sigma [US survey foot]		1.241695	0.762027	0.484262		
RMS Error [US survey foot]		1.243819	0.800745	0.505296		

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



Mn Error [US survey foot]	Max Error [US survey foot]	Geolocation Error X [%]	Geolocation Error Y [%]	Geolocation Error Z [%]
-	-49.21	0.00	0.00	0.00
-49.21	-39.37	0.00	0.31	0.00
-39.37	-29.53	0.00	6.23	0.00
-29.53	-19.68	0.00	13.40	0.00
-19.68	-9.84	0.00	13.71	10.28
-9.84	0.00	47.66	13.40	33.33
0.00	9.84	52.34	17.76	43.30

9.84	19.69	0.00	18.07	13.08
19.69	29.53	0.00	14.64	0.00
29.53	39.37	0.00	2.49	0.00
39.37	49.21	0.00	0.00	0.00
49.21	-	0.00	0.00	0.00
Mean [US survey foot]		-1.305210	1.218973	-48.750088
Sigma [US survey foot]		3.037837	18.617247	7.703439
RMS Error [US survey foot]		3.306361	18.657111	49.354980

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 [US survey foot]	-1.305210	1.218973	-48.750088

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]	100.00	52.65	100.00
[-2.00, 2.00]	100.00	96.26	100.00
[-3.00, 3.00]	100.00	100.00	100.00
Mean of Geolocation Accuracy [US survey foot]	16.404167	16.404167	32.808333
Sigma of Geolocation Accuracy [US survey foot]	0.000002	0.000002	0.000003

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

Geolocation Orientational Variance	RMS [degree]
Omega	0.587
Phi	0.743
Kappa	6.426

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) i7-6700HQ CPU @ 2.60GHz RAM: 64GB GPU: NMDIA GeForce GTX 1070 (Driver: 31.0.15.3141)
Operating System	Windows 10 Home, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84 (EGM96 Geoid)
Ground Control Point (GCP) Coordinate System	NAD83(2011) / New York West (ftUS) (EGM96 Geoid)
Output Coordinate System	NAD83(2011) / New York West (ftUS) (EGM96 Geoid)

Processing Options

Detected Template	No Template Available
Keypoints Image Scale	Full, Image Scale: 1
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 prior External Parameters Optimization: All Rematch: Auto, yes