Quality Report

Generated with Pix4Dmapper version 4.6.4

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	319Crew4_040521
Processed	2021-04-19 16:07:22
Camera Model Name(s)	L1D-20c_10.3_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	2.55 cm / 1.01 in
Area Covered	0.059 km^2 / 5.9381 ha / 0.02 sq. mi. / 14.6810 acres

Quality Check

Images	median of 75916 keypoints per image	✓
Dataset	50 out of 50 images calibrated (100%), all images enabled	✓
Camera Optimization	81.8% relative difference between initial and optimized internal camera parameters	⚠
Matching	median of 32502.3 matches per calibrated image	✓
Georeferencing	yes, 7 GCPs (7 3D), mean RMS error = 0.048 m	✓

Preview

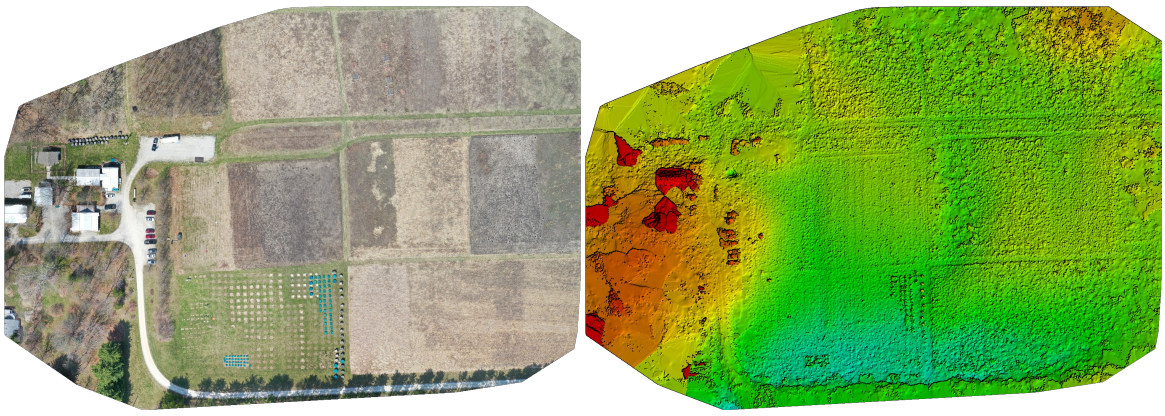


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	50 out of 50
Number of Geolocated Images	50 out of 50

Initial Image Positions

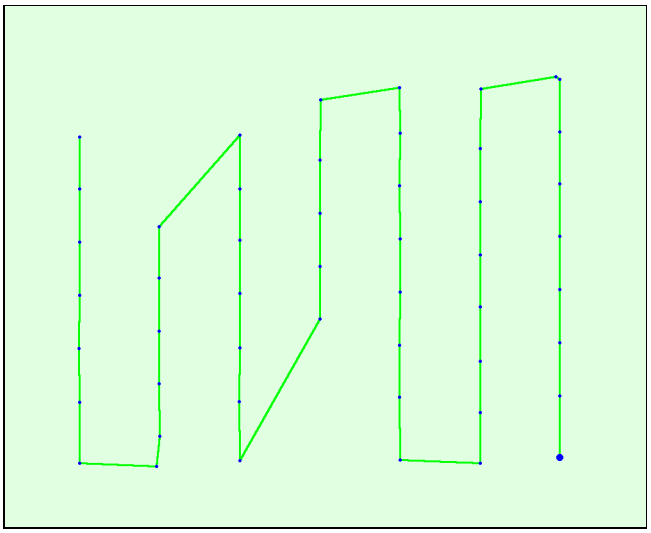


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions

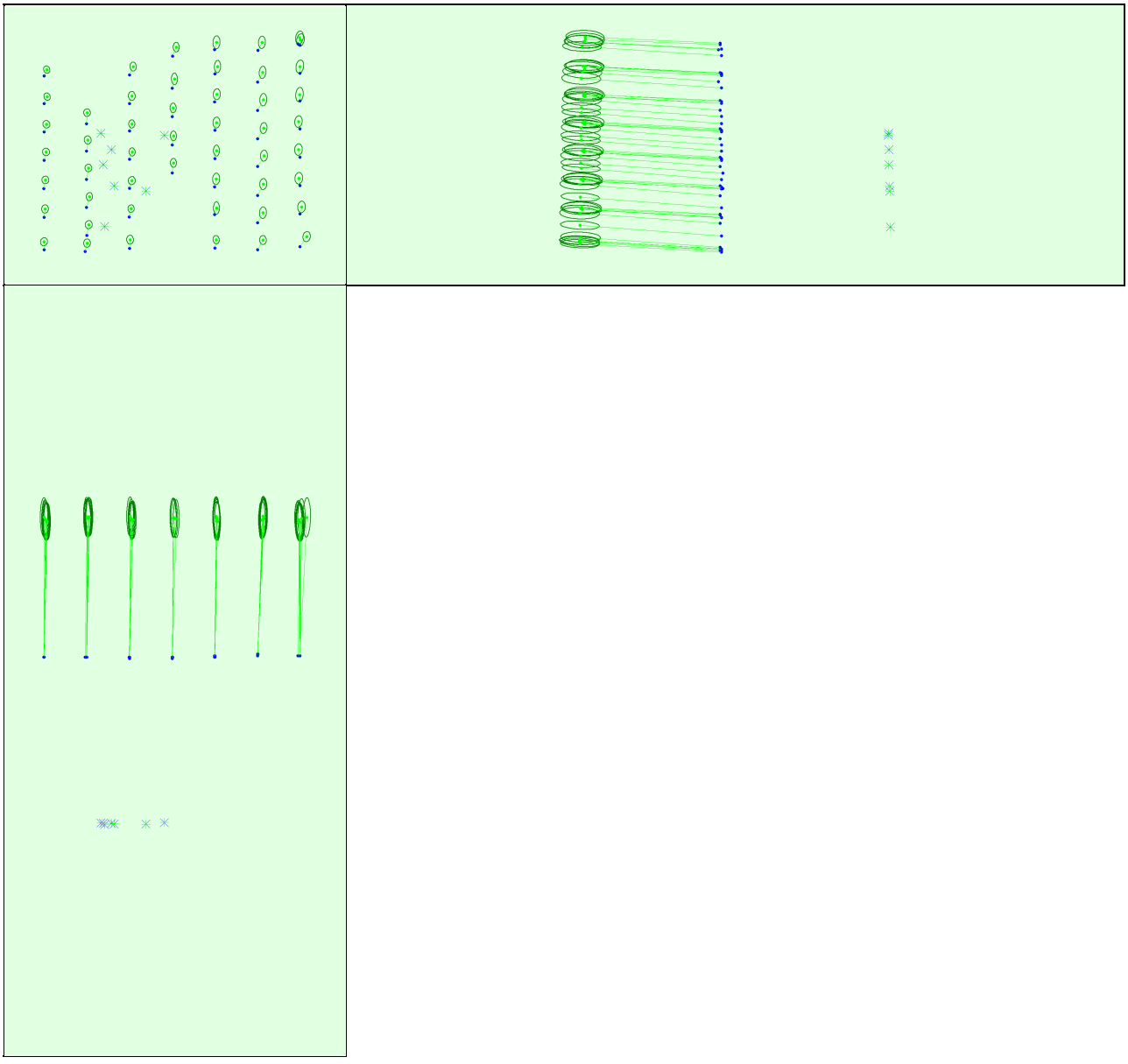


Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and their computed positions (green crosses) in the top-view (XY plane), front-view (XZ plane), and side-view (YZ plane). Dark green ellipses 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]	Camera Displacement X [m]	Camera Displacement Y [m]	Camera Displacement Z [m]
Mean	0.234	0.341	1.318	0.101	0.066	0.011	0.013	0.015	0.085
Sigma	0.014	0.066	0.018	0.018	0.004	0.003	0.004	0.005	0.015

Overlap

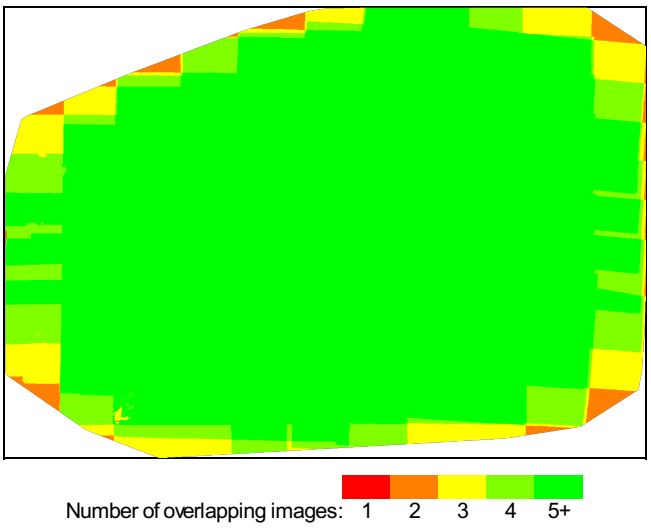


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint matches is also sufficient for these areas (see Figure 5 for keypoint matches).

Bundle Block Adjustment Details

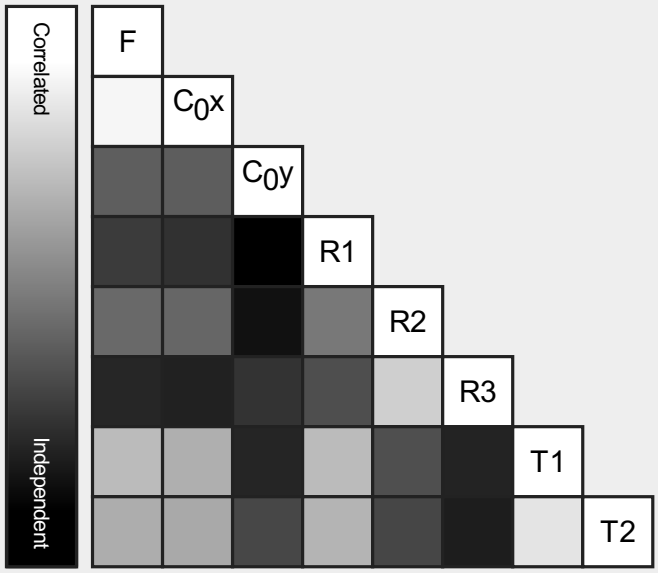
Number of 2D Keypoint Observations for Bundle Block Adjustment	1581833
Number of 3D Points for Bundle Block Adjustment	394912
Mean Reprojection Error [pixels]	0.164

Internal Camera Parameters

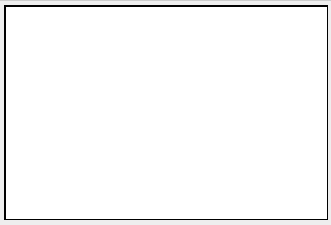
L1D-20c_10.3_5472x3648 (RGB). Sensor Dimensions: 12.825 [mm] x 8.550 [mm]

EXIF ID: L1D-20c_10.3_5472x3648

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	4470.830 [pixel] 10.479 [mm]	2736.000 [pixel] 6.412 [mm]	1824.000 [pixel] 4.275 [mm]	0.009	0.040	-0.050	-0.003	0.002
Optimized Values	8128.112 [pixel] 19.050 [mm]	2472.287 [pixel] 5.794 [mm]	1364.610 [pixel] 3.198 [mm]	0.004	-0.060	-0.144	-0.006	-0.005
Uncertainties (Sigma)	51.216 [pixel] 0.120 [mm]	3.900 [pixel] 0.009 [mm]	6.542 [pixel] 0.015 [mm]	0.001	0.005	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.

2D Keypoints Table

	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	75916	32502
Min	67675	13460
Max	79947	43119
Mean	75030	31637

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	165352
In 3 Images	79959
In 4 Images	44755
In 5 Images	28235
In 6 Images	19236
In 7 Images	13904
In 8 Images	10656
In 9 Images	8127
In 10 Images	6215
In 11 Images	4218
In 12 Images	3279
In 13 Images	2595
In 14 Images	1960
In 15 Images	1585
In 16 Images	1379
In 17 Images	1111
In 18 Images	729
In 19 Images	499
In 20 Images	426
In 21 Images	337
In 22 Images	253
In 23 Images	92

In 24 Images	7
In 25 Images	3

2D Keypoint Matches

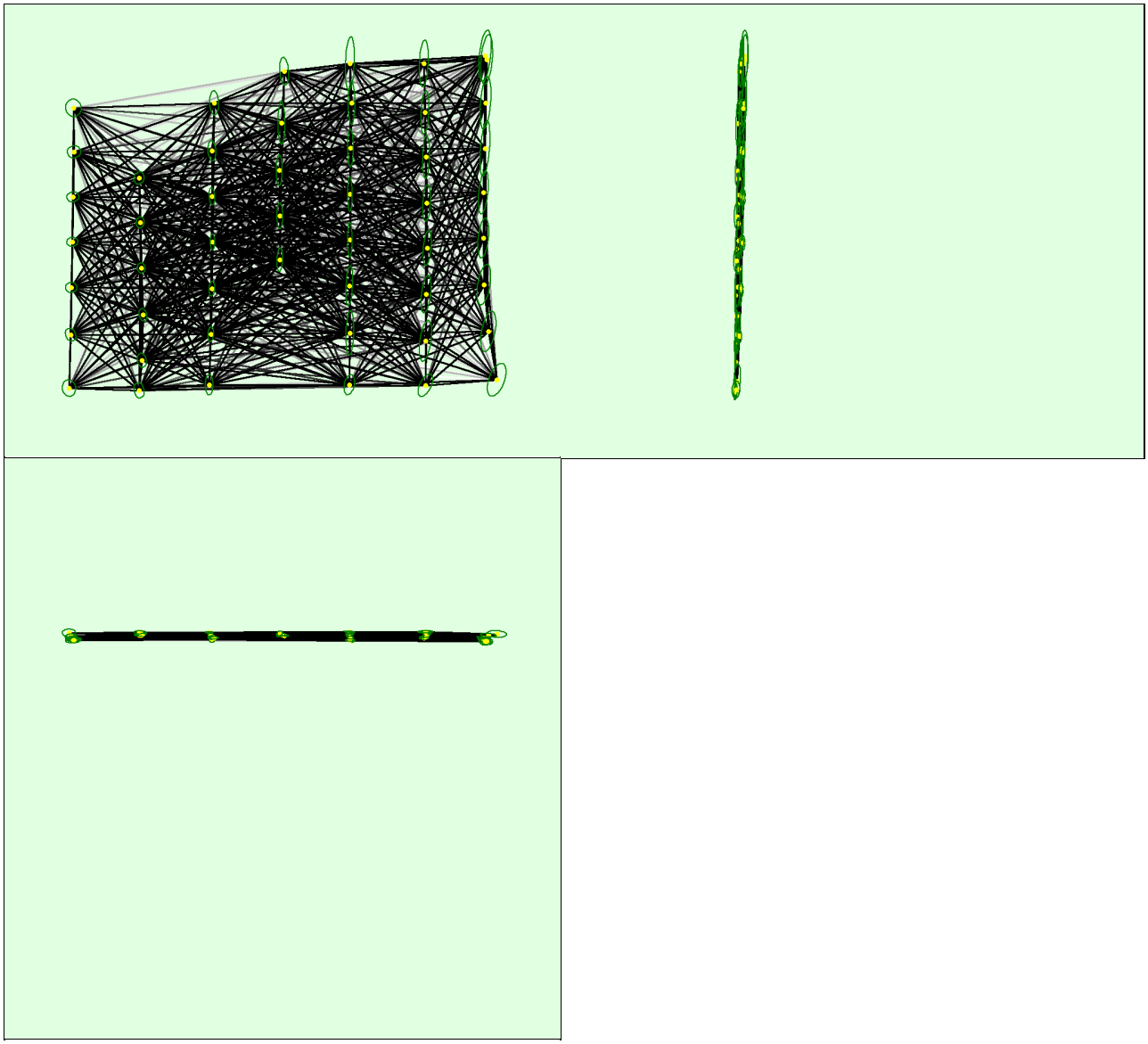


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty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

Relative camera position and orientation uncertainties

	X [m]	Y [m]	Z [m]	Omega [degree]	Phi [degree]	Kappa [degree]	Camera Displacement X [m]	Camera Displacement Y [m]	Camera Displacement Z [m]
Mean	0.039	0.123	0.015	0.083	0.048	0.029	0.019	0.025	0.066
Sigma	0.014	0.060	0.008	0.011	0.009	0.001	0.004	0.002	0.008

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
1 (3D)	0.020/ 0.020	-0.020	0.010	-0.093	0.247	2 / 2
2 (3D)	0.020/ 0.020	-0.014	0.011	0.032	0.415	2 / 2
3 (3D)	0.020/ 0.020	0.004	0.005	0.023	0.752	2 / 2
4 (3D)	0.020/ 0.020	0.013	-0.024	-0.143	1.052	2 / 2
5 (3D)	0.020/ 0.020	0.006	-0.004	0.026	0.649	2 / 2
6 (3D)	0.020/ 0.020	-0.007	-0.004	0.164	0.074	2 / 2
7 (3D)	0.020/ 0.020	0.014	-0.021	-0.219	1.320	2 / 2
Mean [m]		-0.000419	-0.003850	-0.029899		
Sigma [m]		0.012204	0.013067	0.119370		
RMS Error [m]		0.012211	0.013622	0.123058		

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 [%]
-	-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	40.00	40.00	54.00
0.00	3.00	60.00	60.00	46.00
3.00	6.00	0.00	0.00	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]		-1.590253	-5.685233	-93.918290
Sigma [m]		1.301321	1.073954	1.398320
RMS Error [m]		2.054833	5.785780	93.928699

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]	-1.590253	-5.685233	-93.918290

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	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.

Geolocation Orientational Variance	RMS [degree]
Omega	2.820
Phi	2.086
Kappa	10.773

Geolocation RMS error of the orientation angles given by the difference between the initial and computed image orientation angles.

Rolling Shutter Statistics

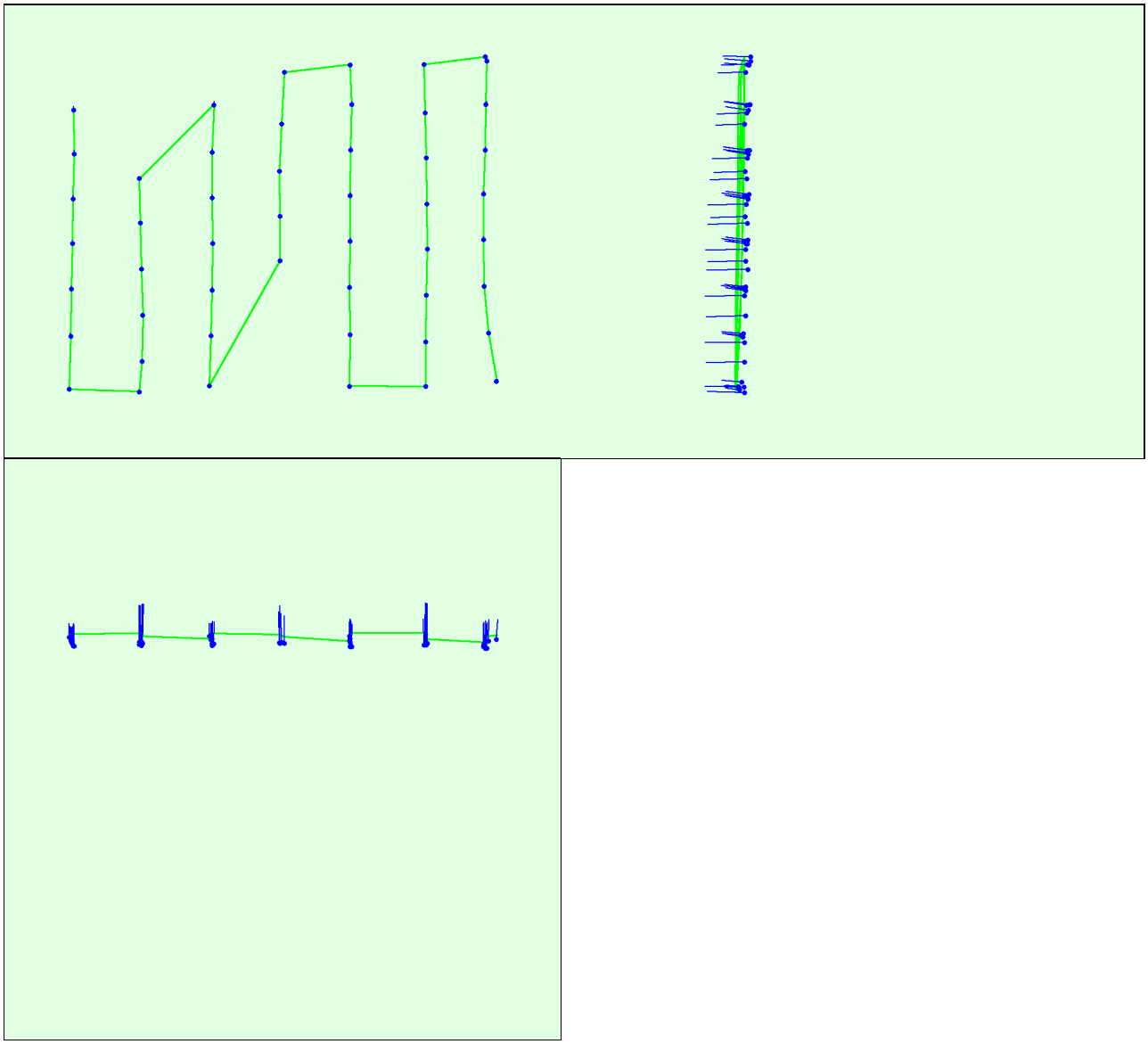


Figure 6: Camera movement estimated by the rolling shutter camera model. The green line follows the computed image positions. The blue dots represent the camera position at the start of the exposure. The blue lines represent the camera motion during the rolling shutter readout, re-scaled by a project dependant scaling factor for better visibility.

Median Camera Speed	4.7347 [m/s]
Median Camera Displacement During Sensor Readout)	4.4988 [m]
Median Rolling Shutter Readout Time	973.423 [ms]

Initial Processing Details

System Information

Hardware	CPU: Intel(R) Core(TM) i7-6700T CPU @ 2.80GHz RAM: 32GB GPU: Intel(R) HD Graphics 530 (Driver: 26.20.100.8142)
Operating System	Windows 10 Education, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84 (EGM96 Geoid)
Ground Control Point (GCP) Coordinate System	WGS 84 / UTM zone 16N (EGM96 Geoid)
Output Coordinate System	WGS 84 / UTM zone 16N (EGM96 Geoid)

Processing Options

Detected Template	3D Maps
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 External Parameters Optimization: All Rematch: Auto, yes

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	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	19m:32s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	03m:25s

Results

Number of Generated Tiles	1
Number of 3D Densified Points	6396632
Average Density (per m^3)	183.9

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (2.55 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Sharp
Raster DSM	Generated: yes Method: Inverse Distance Weighting Merge Tiles: yes

Orthomosaic	Generated: yes Merge Tiles: yes GeoTIFF Without Transparency: no Google Maps Tiles and KML: no
Time for DSM Generation	08m:12s
Time for Orthomosaic Generation	08m:49s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s