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_041221
Processed	2021-04-21 16:10:48
Camera Model Name(s)	L1D-20c_10.3_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	3.33 cm / 1.31 in

Quality Check

Images	median of 59697 keypoints per image	✓
Dataset	85 out of 85 images calibrated (100%), all images enabled	✓
Camera Optimization	4.82% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 21943 matches per calibrated image	✓
Georeferencing	yes, 6 GCPs (6 3D), mean RMS error = 0.029 m	✓

Calibration Details

Number of Calibrated Images	85 out of 85
Number of Geolocated Images	85 out of 85

Initial Image Positions

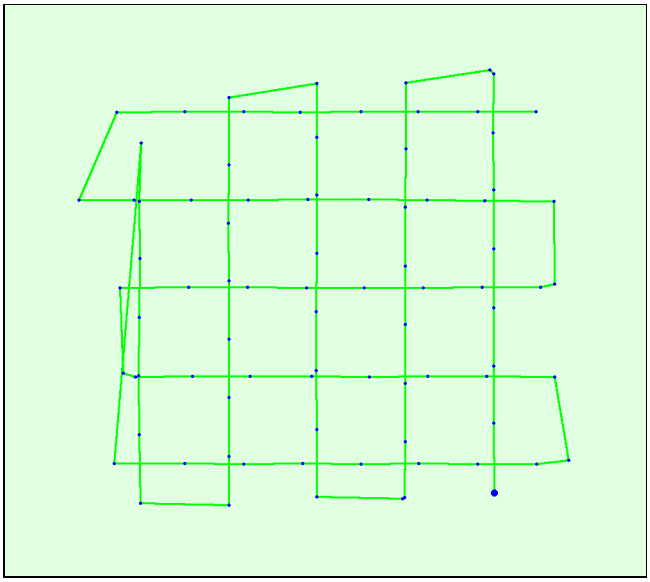
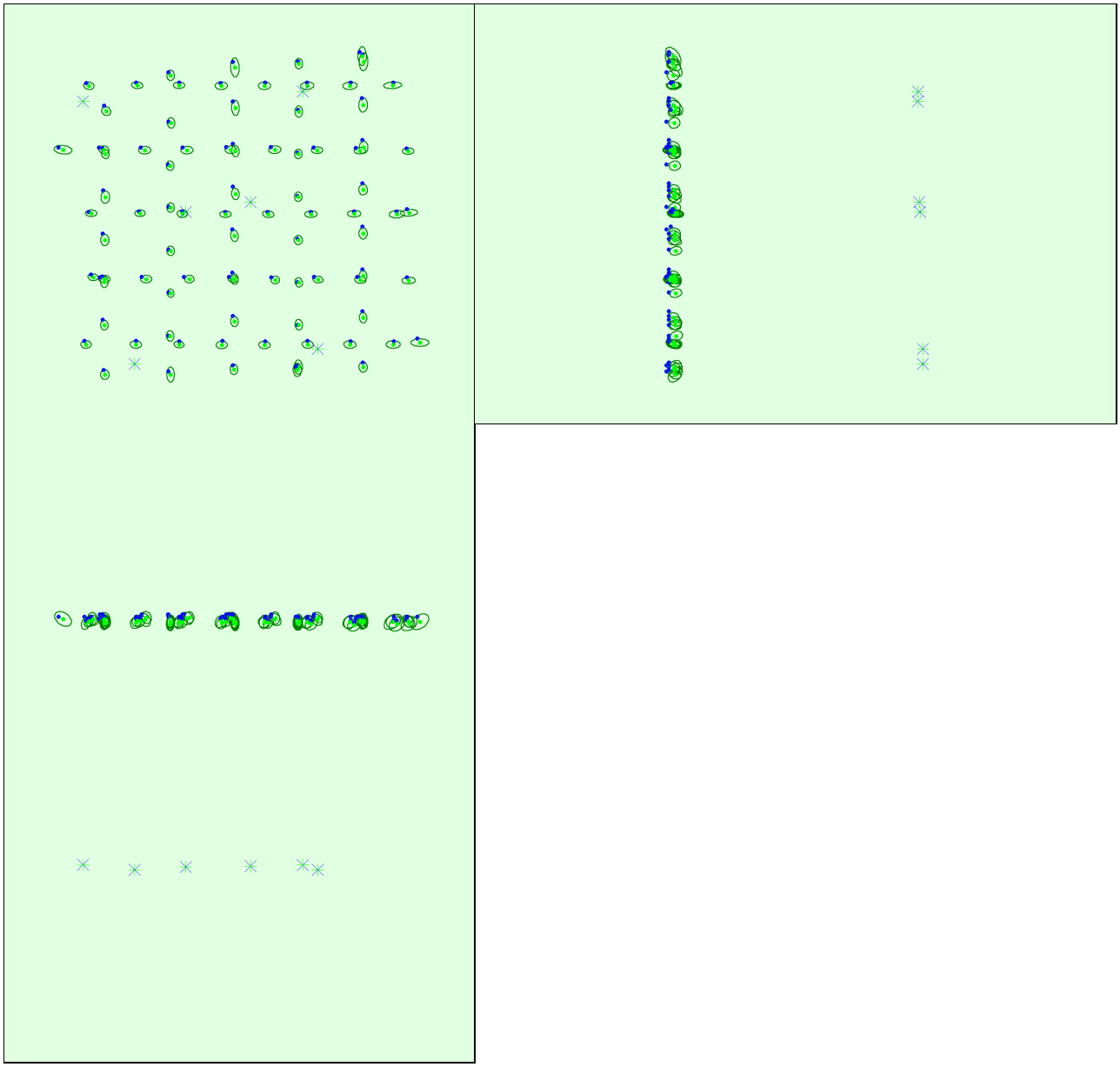


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

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). 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	0.025	0.023	0.031	0.011	0.011	0.007	0.003	0.003	0.014
Sigma	0.006	0.007	0.003	0.004	0.004	0.002	0.001	0.001	0.004

Bundle Block Adjustment Details

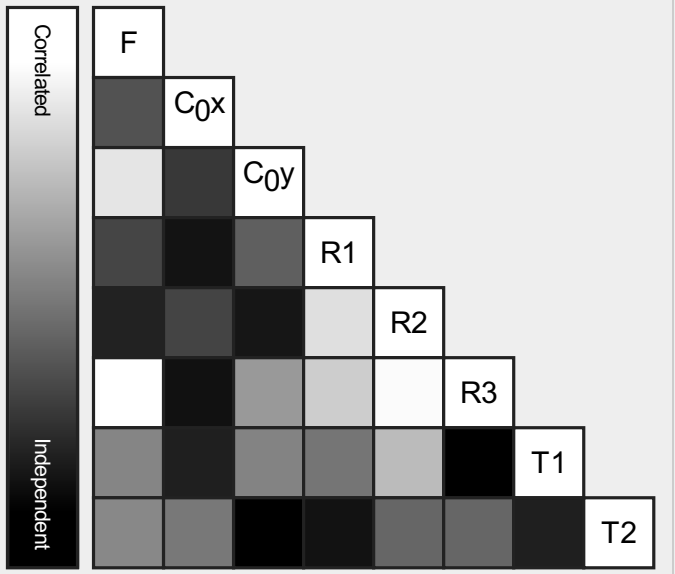
Number of 2D Keypoint Observations for Bundle Block Adjustment	1750367
Number of 3D Points for Bundle Block Adjustment	579230
Mean Reprojection Error [pixels]	0.156

Internal Camera Parameters

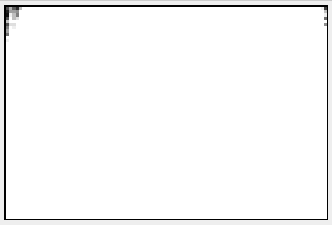
L1D-20c_10.3_5472x3648 (RGB). Sensor Dimensions: 12.825 [mm] x 8.550 [mm]

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	4255.033 [pixel] 9.973 [mm]	2727.098 [pixel] 6.392 [mm]	1816.071 [pixel] 4.256 [mm]	-0.008	0.020	-0.028	-0.003	-0.001
Uncertainties (Sigma)	0.732 [pixel] 0.002 [mm]	0.130 [pixel] 0.000 [mm]	0.709 [pixel] 0.002 [mm]	0.000	0.000	0.000	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

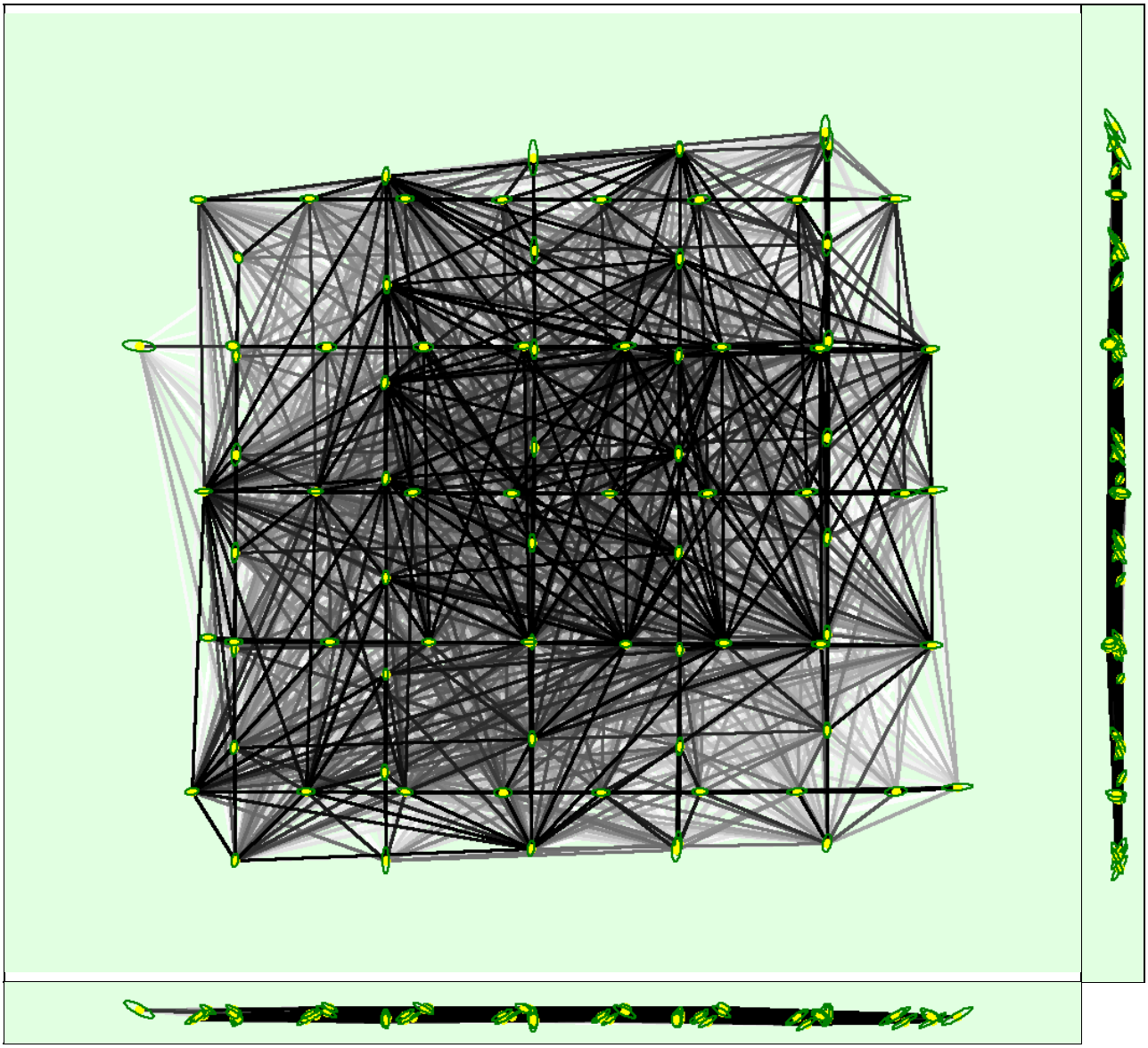
	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	59697	21943
Min	51774	4194
Max	67300	28740
Mean	59659	20593

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	332187
In 3 Images	120898
In 4 Images	54175
In 5 Images	27656
In 6 Images	15395
In 7 Images	9140
In 8 Images	5803
In 9 Images	3733
In 10 Images	2720

In 11 Images	1885
In 12 Images	1376
In 13 Images	1037
In 14 Images	778
In 15 Images	597
In 16 Images	465
In 17 Images	396
In 18 Images	259
In 19 Images	216
In 20 Images	147
In 21 Images	121
In 22 Images	95
In 23 Images	62
In 24 Images	34
In 25 Images	32
In 26 Images	11
In 27 Images	5
In 28 Images	2
In 29 Images	5

2D Keypoint Matches



Uncertainty ellipses 100x magnified

Number of matches

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. 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	0.014	0.013	0.013	0.008	0.008	0.005	0.003	0.003	0.013
Sigma	0.007	0.007	0.003	0.004	0.005	0.003	0.001	0.001	0.003

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	-0.006	0.009	0.071	0.437	2 / 2
2 (3D)	0.020/ 0.020	-0.002	0.001	-0.059	0.298	2 / 2
3 (3D)	0.020/ 0.020	-0.009	0.006	0.104	0.636	2 / 2
4 (3D)	0.020/ 0.020	0.011	-0.005	0.048	1.583	2 / 2
5 (3D)	0.020/ 0.020	-0.010	-0.014	0.067	0.341	2 / 2
6 (3D)	0.020/ 0.020	0.001	0.002	-0.098	0.502	2 / 2
Mean [m]		-0.002617	-0.000254	0.022310		
Sigma [m]		0.006963	0.007733	0.073971		
RMS Error [m]		0.007438	0.007737	0.077262		

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	50.59	62.35	49.41
0.00	3.00	49.41	37.65	50.59
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]		-0.953377	1.764366	2.468972
Sigma [m]		0.743759	0.934395	0.941667
RMS Error [m]		1.209175	1.996517	2.642453

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]	-0.953377	1.764366	2.468972

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	2.312
Phi	2.297
Kappa	4.187

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

Rolling Shutter Statistics

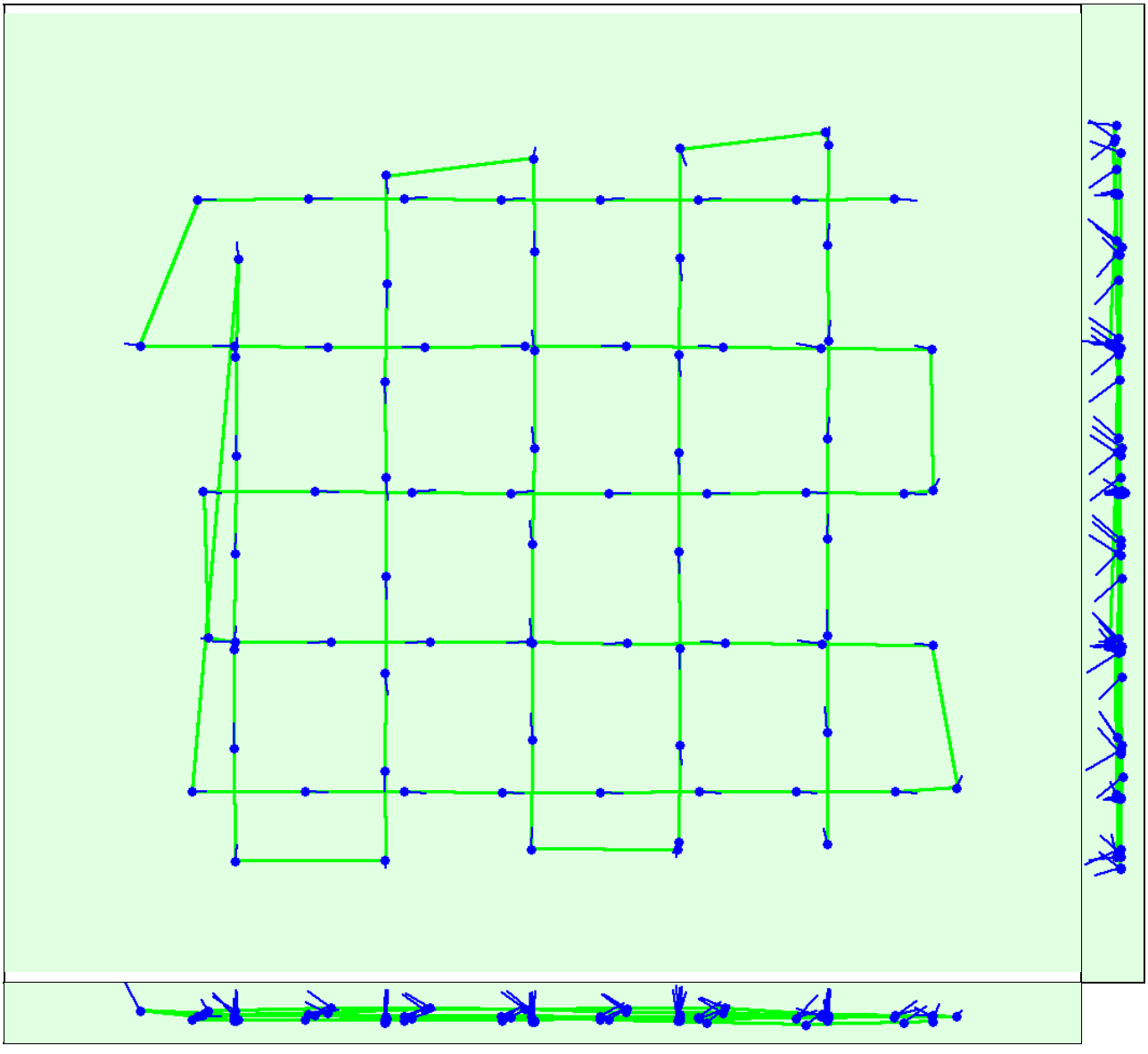


Figure 6: Camera movement estimated by the rolling shutter camera model. The green line follows the computed image positions. The blue dots represent the camera position at the start of the exposure. The blue lines represent the camera motion during the rolling shutter readout, re-scaled by a project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

Median Camera Speed	5.238 [m/s]
Median Camera Displacement During Sensor Readout)	0.5677 [m]
Median Rolling Shutter Readout Time	113.2457 [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	NAD83(2011) / UTM zone 16N (EGM96 Geoid)
Output Coordinate System	NAD83(2011) / UTM zone 16N (EGM96 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, yes

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	37m:11s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	04m:29s

Results

Number of Generated Tiles	1
Number of 3D Densified Points	9083958

Average Density (per m^3)	104

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (3.33 [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	12m:34s
Time for Orthomosaic Generation	18m:23s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s