

# Quality Report



Generated with PIX4Dmapper version 4.9.0

- !** **Important:** Click on the different icons for:
  - ?** Help to analyze the results in the Quality Report
  - i** Additional information about the sections

**💡** Click [here](#) for additional tips to analyze the Quality Report

## Summary



Project	23-0641 Aalborg Havn
Processed	2024-02-17 01:42:52
Camera Model Name(s)	L1D-20c_10.3_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	1.71 cm / 0.67 in
Area Covered	0.451 km <sup>2</sup> / 45.0611 ha / 0.17 sq. mi. / 111.4062 acres
Time for Initial Processing (without report)	09h:52m:32s

## Quality Check



<b>?</b> <b>Images</b>	median of 79965 keypoints per image	✓
<b>?</b> <b>Dataset</b>	999 out of 999 images calibrated (100%), all images enabled	✓
<b>?</b> <b>Camera Optimization</b>	1.33% relative difference between initial and optimized internal camera parameters	✓
<b>?</b> <b>Matching</b>	median of 42618.3 matches per calibrated image	✓
<b>?</b> <b>Georeferencing</b>	yes, no 3D GCP	⚠

## **?** Preview

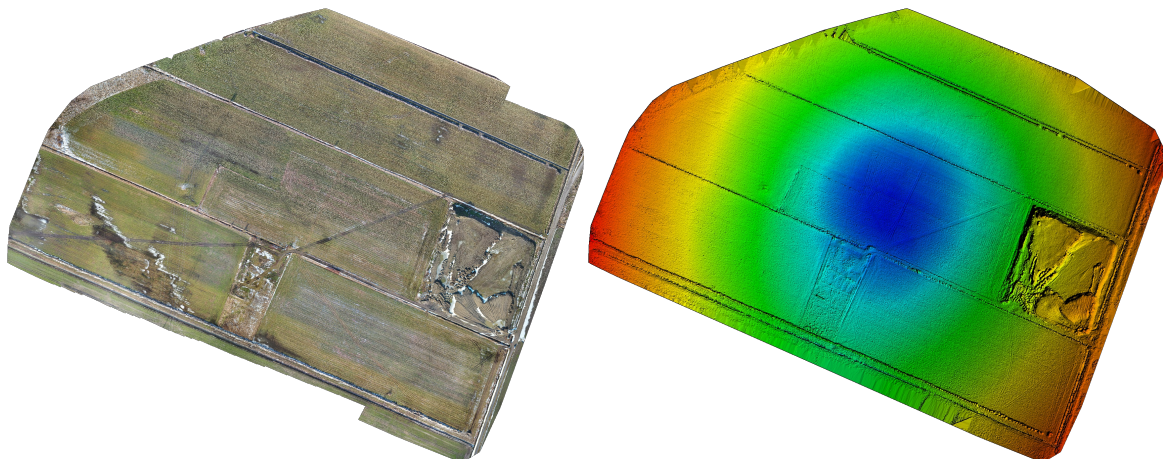


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

## Calibration Details



Number of Calibrated Images	999 out of 999
Number of Geolocated Images	999 out of 999

? Initial Image Positions

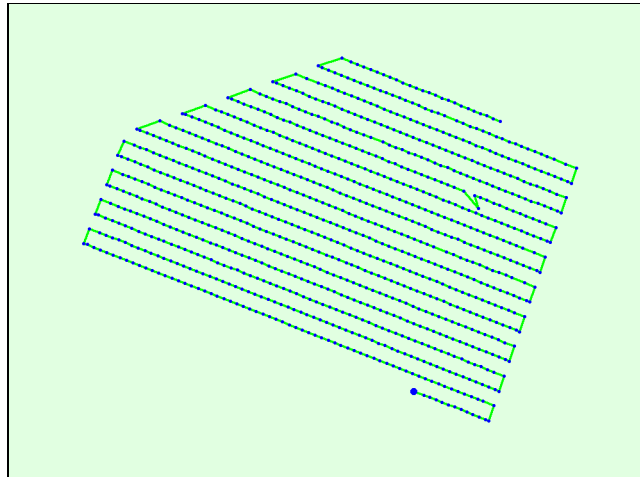
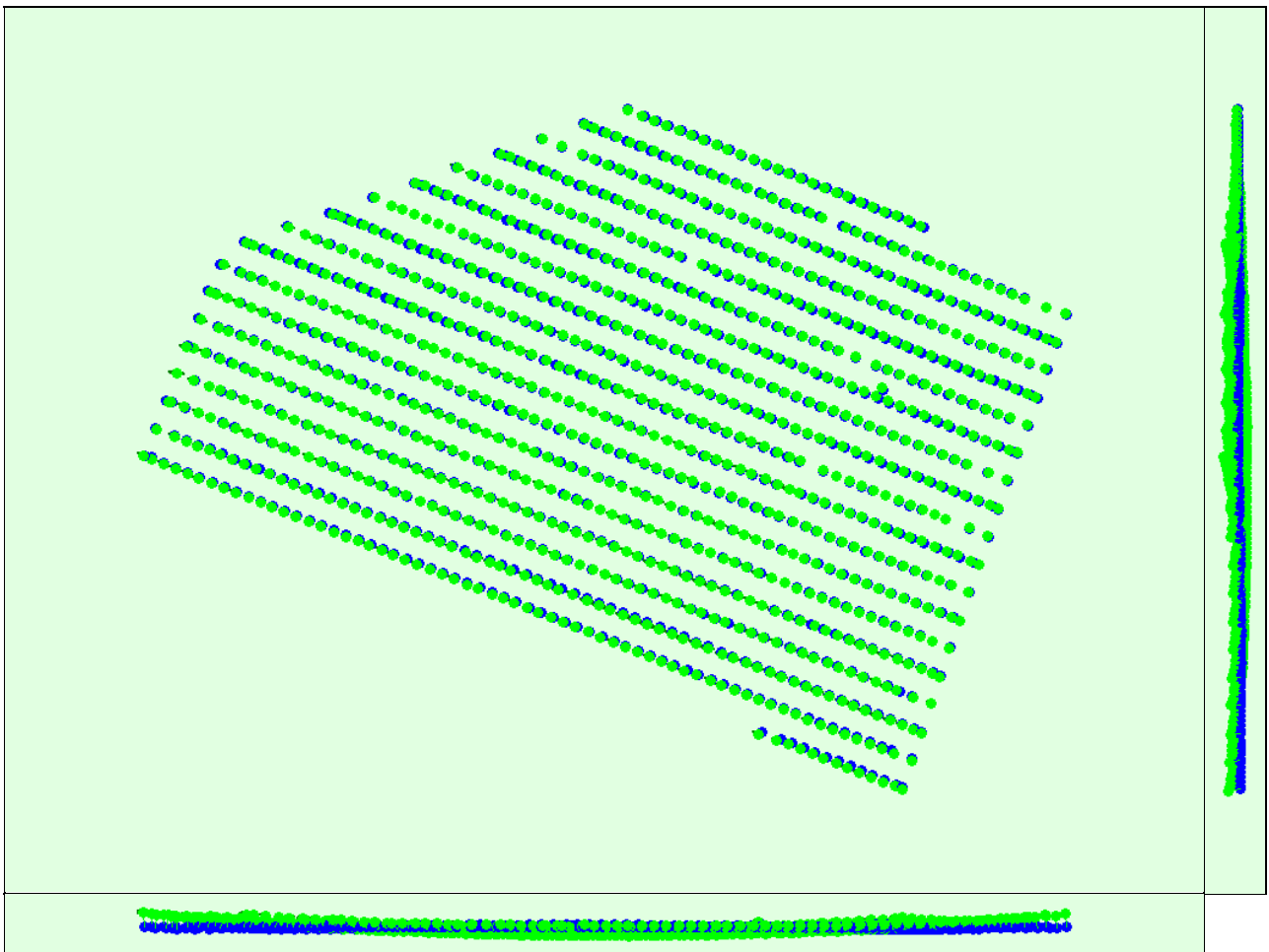


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

? Computed Image/GCPs/Manual Tie Points Positions



Uncertainty ellipses 10x 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]
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Mean	0.354	0.155	0.132	0.107	0.266	0.020	0.012	0.010	0.154
Sigma	0.139	0.048	0.026	0.042	0.112	0.008	0.005	0.003	0.064

## Overlap

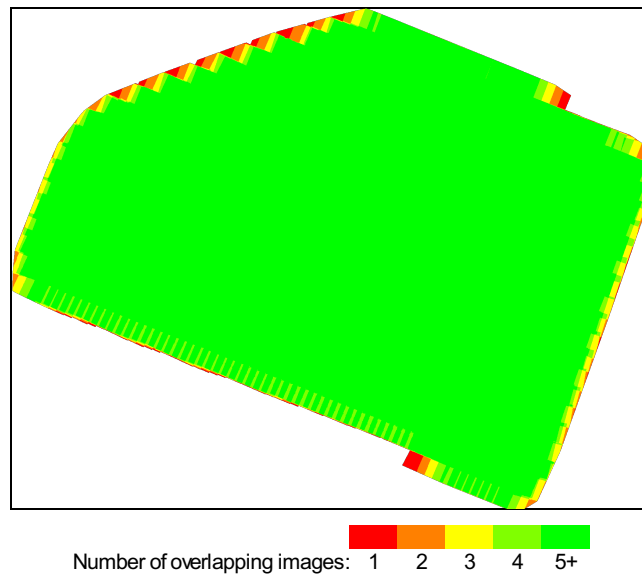


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic. Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

## Bundle Block Adjustment Details

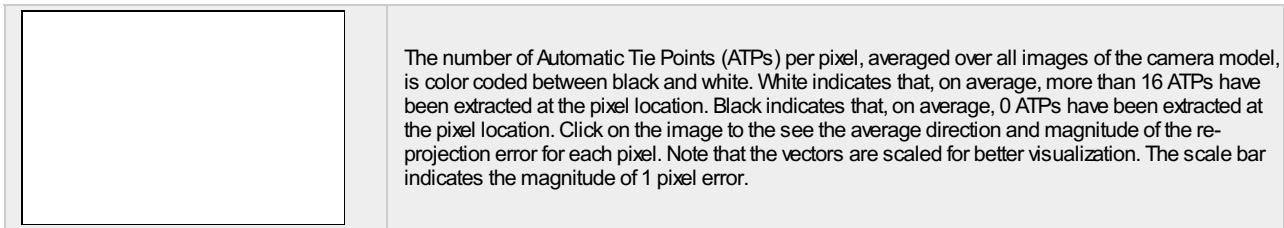
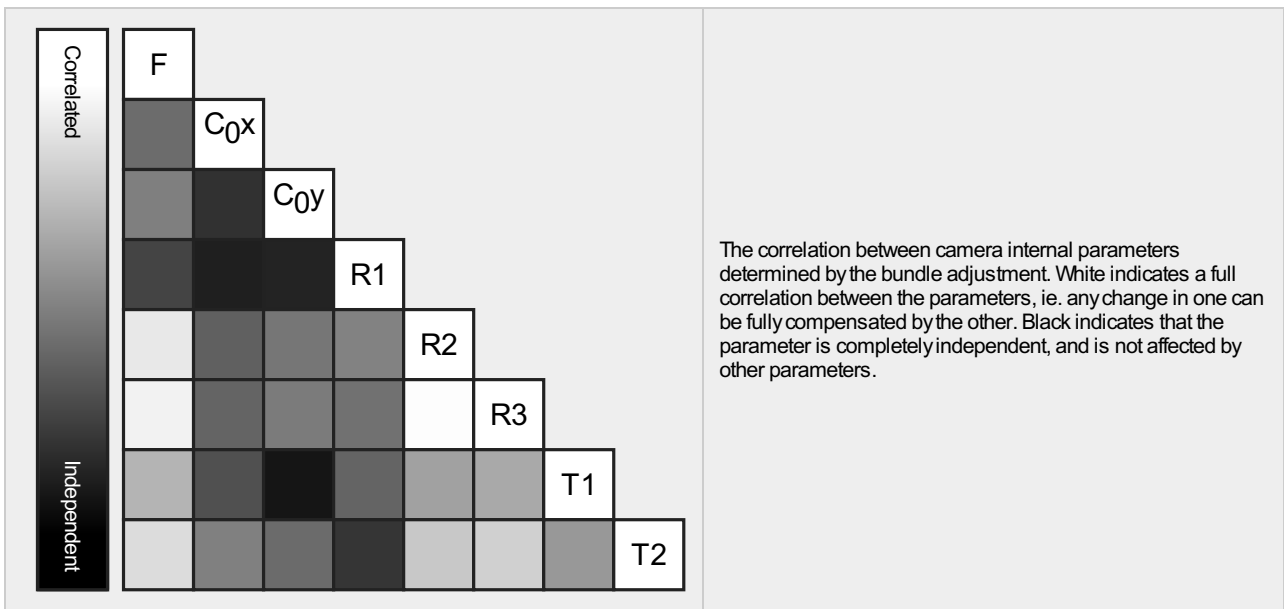
Number of 2D Keypoint Observations for Bundle Block Adjustment	43370557
Number of 3D Points for Bundle Block Adjustment	11801311
Mean Reprojection Error [pixels]	0.117

## 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	4411.090 [pixel] 10.338 [mm]	2755.225 [pixel] 6.458 [mm]	1825.622 [pixel] 4.279 [mm]	-0.007	0.034	-0.037	-0.001	0.002
Uncertainties (Sigma)	17.093 [pixel] 0.040 [mm]	0.404 [pixel] 0.001 [mm]	1.327 [pixel] 0.003 [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	79965	42618
Mn	32302	7946
Max	99970	64703
Mean	81768	43414

### ? 3D Points from 2D Keypoint Matches



	Number of 3D Points Observed
In 2 Images	5595839
In 3 Images	2281742
In 4 Images	1298474
In 5 Images	817971
In 6 Images	412958
In 7 Images	315506
In 8 Images	256097
In 9 Images	228560
In 10 Images	154932
In 11 Images	103655
In 12 Images	94390
In 13 Images	91462
In 14 Images	77615
In 15 Images	37818
In 16 Images	11944
In 17 Images	9166
In 18 Images	6770
In 19 Images	4408
In 20 Images	1917
In 21 Images	87

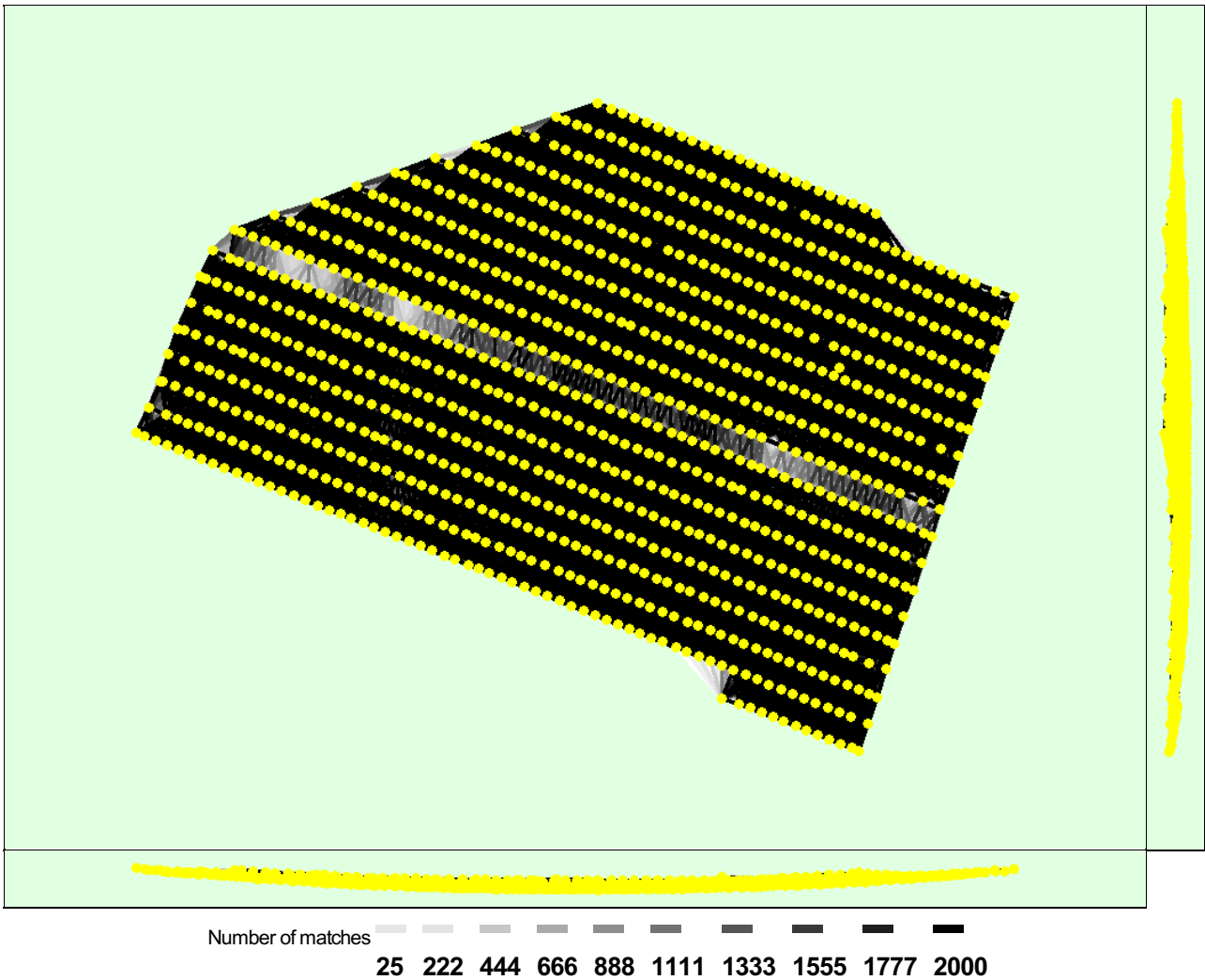


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

## Geolocation Details

### Absolute Geolocation Variance

Mn 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	0.80
-12.00	-9.00	0.00	0.00	3.90
-9.00	-6.00	0.00	0.00	7.71
-6.00	-3.00	5.71	0.00	12.71
-3.00	0.00	41.34	48.35	18.82
0.00	3.00	50.35	51.65	24.62
3.00	6.00	2.60	0.00	26.83
6.00	9.00	0.00	0.00	4.60
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
<b>Mean [m]</b>		-0.000018	0.000001	0.000041
<b>Sigma [m]</b>		1.756759	0.982252	4.608431
<b>RMS Error [m]</b>		1.756759	0.982252	4.608431

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

Relative Geolocation Error	Images X [%]	Images Y [%]	Images Z [%]
[-1.00, 1.00]	99.90	100.00	97.10
[-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>	5.000000	5.000000	10.000000
<b>Sigma of Geolocation Accuracy [m]</b>	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	2.277
Phi	3.283
Kappa	3.747

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

### Rolling Shutter Statistics

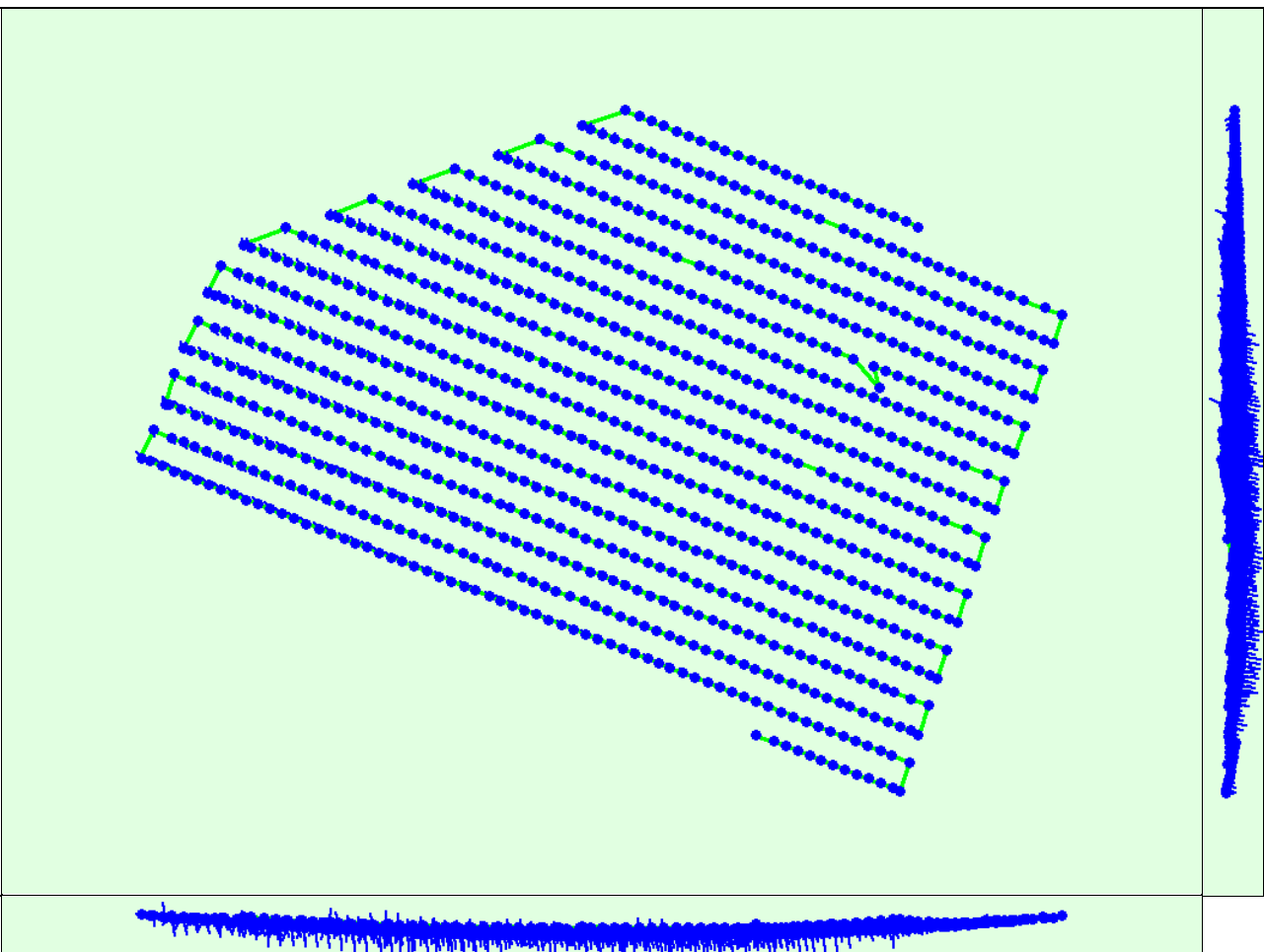


Figure 6: Camera movement estimated by the rolling shutter camera model. The green line follows the computed image positions. The blue dots represent the camera position at the start of the exposure. The blue lines represent the camera motion during the rolling shutter readout, re-scaled by a project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

Median Camera Speed	6.2276 [m/s]
Median Camera Displacement During Sensor Readout)	1.1475 [m]
Median Rolling Shutter Readout Time	191.5919 [ms]

# Initial Processing Details



## System Information



Hardware	CPU: Intel(R) Core(TM) i5-10210U CPU @ 1.60GHz RAM: 24GB GPU: Intel(R) UHD Graphics (Driver: 31.0.101.2114)
Operating System	Windows 10 Pro, 64-bit

## Coordinate Systems



Image Coordinate System	WGS 84 (EGM96 Geoid)
Output Coordinate System	WGS 84 / UTMzone 32N

## 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 External Parameters Optimization: All Rematch: Auto, no

# 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: High Resolution 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	07h:48m:07s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	03h:22m:18s

## Results



Number of Processed Clusters	37
Number of Generated Tiles	6
Number of 3D Densified Points	120491140
Average Density (per m <sup>3</sup> )	697.53

# DSM, Orthomosaic and Index Details



## Processing Options



DSM and Orthomosaic Resolution	1 x GSD (1.71 [cm/pixel])
DSM Filters	Noise Filtering: yes Surface Smoothing: yes, Type: Medium
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
Grid DSM	Generated: yes, Spacing [cm]: 100
Raster DTM	Generated: yes Merge Tiles: yes
DTM Resolution	5 x GSD (1.71 [cm/pixel])
Contour Lines Generation	Generated: yes Contour Base [m]: 0 Elevation Interval [m]: 0.25 Resolution [cm]: 100 Minimum Line Size [vertices]: 20
Time for DSM Generation	40m:18s
Time for Orthomosaic Generation	05h:16m:08s
Time for DTM Generation	01h:09m:50s
Time for Contour Lines Generation	22s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s