Quality Report

Generated with Pix4Dmapper version 4.4.12

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	Harelbeke-191210
Processed	2019-12-11 09:57:28
Camera Model Name(s)	FC6310_8.8_5472x3648 (RGB)
Average Ground Sampling Distance (GSD)	1.02 cm / 0.40 in
Area Covered	0.039 km^2 / 3.8967 ha / 0.02 sq. mi. / 9.6340 acres
Time for Initial Processing (without report)	12m:02s

Quality Check

Images	median of 63743 keypoints per image	✓
Dataset	160 out of 160 images calibrated (100%), all images enabled	✓
Camera Optimization	1.2% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 11720.9 matches per calibrated image	✓
Georeferencing	yes, 9 GCPs (9 3D), mean RMS error = 0.007 m	✓

Preview

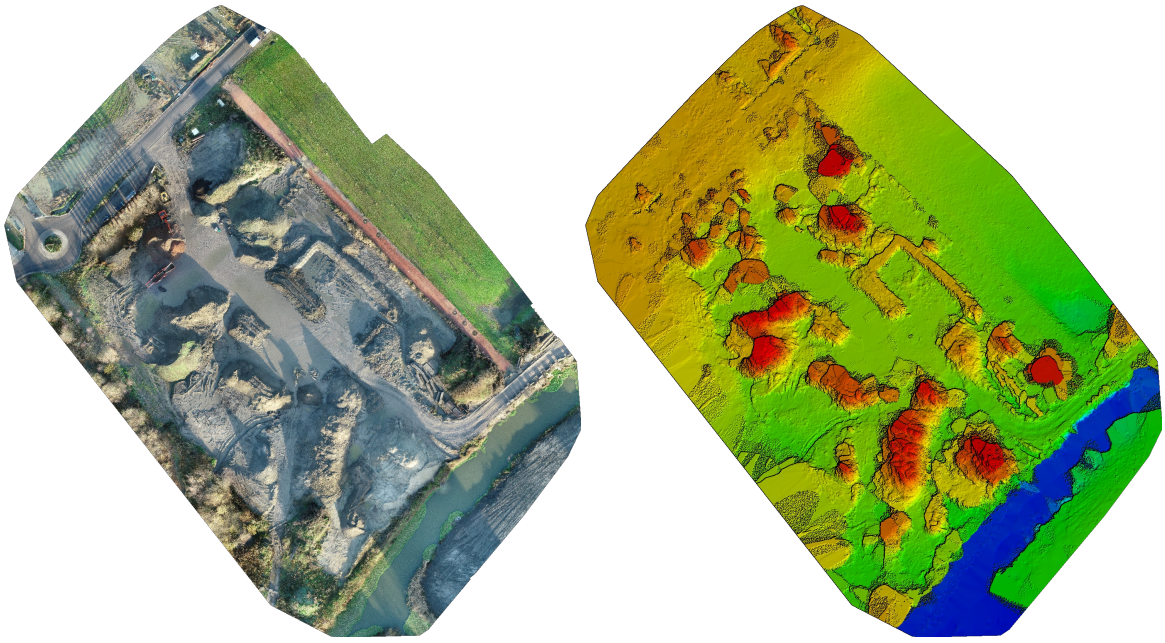


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	160 out of 160
Number of Geolocated Images	160 out of 160

Initial Image Positions

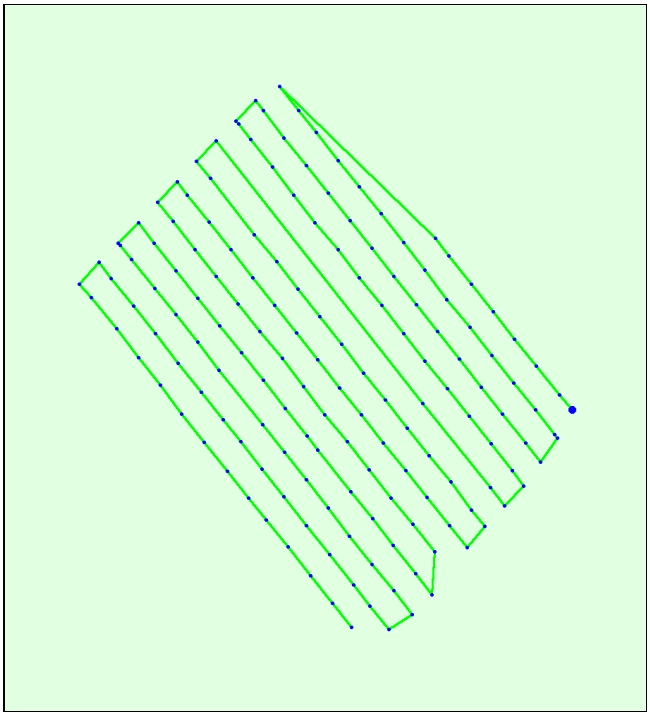
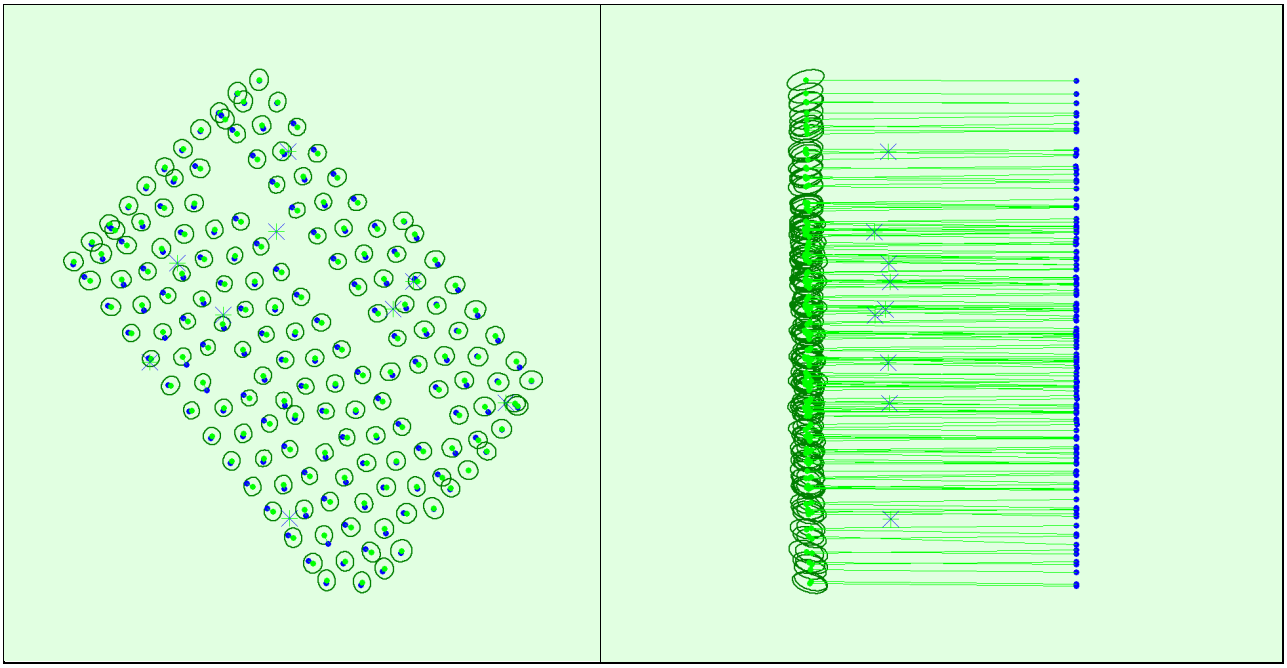
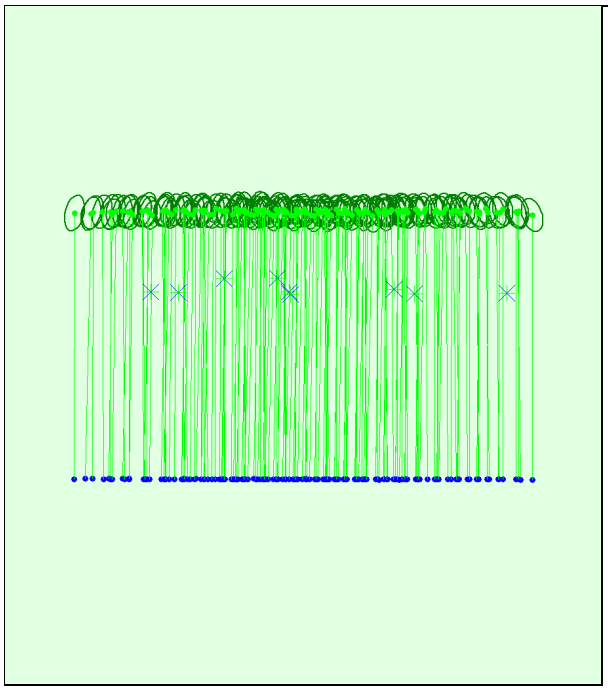


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions





Uncertainty ellipses 500x 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]
Mean	0.008	0.008	0.014	0.006	0.006	0.002
Sigma	0.001	0.001	0.001	0.001	0.001	0.001

Overlap

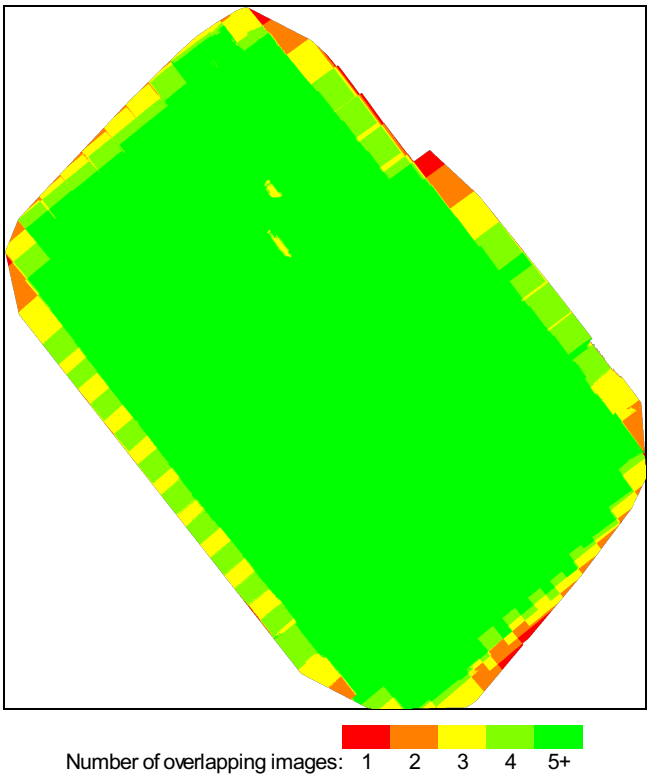


Figure 4: Number of overlapping images computed for each pixel of the orthomosaic.
Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap of over 5 images for every pixel. Good quality results will be generated as long as the number of keypoint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

Bundle Block Adjustment Details

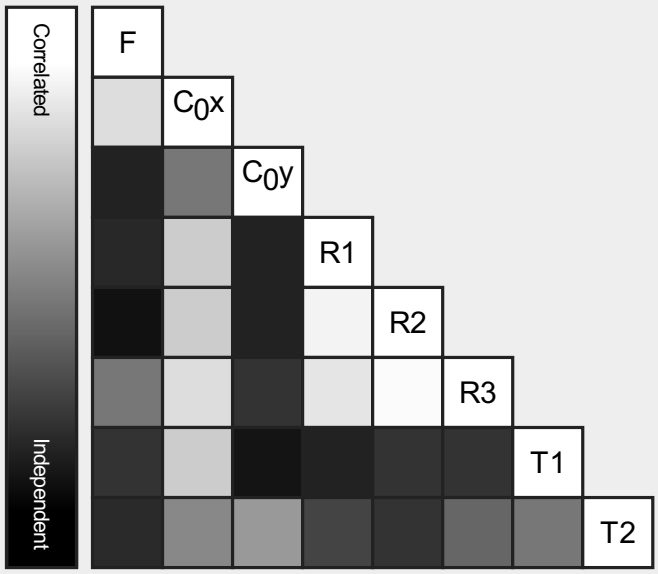
Number of 2D Keypoint Observations for Bundle Block Adjustment	1944834
Number of 3D Points for Bundle Block Adjustment	777863
Mean Reprojection Error [pixels]	0.180

Internal Camera Parameters

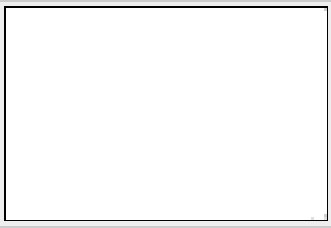
FC6310_8.8_5472x3648 (RGB). Sensor Dimensions: 12.833 [mm] x 8.556 [mm]

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	3624.448 [pixel] 8.500 [mm]	2687.388 [pixel] 6.303 [mm]	1844.769 [pixel] 4.326 [mm]	-0.004	-0.010	0.009	0.000	-0.004
Uncertainties (Sigma)	1.363 [pixel] 0.003 [mm]	0.742 [pixel] 0.002 [mm]	0.718 [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

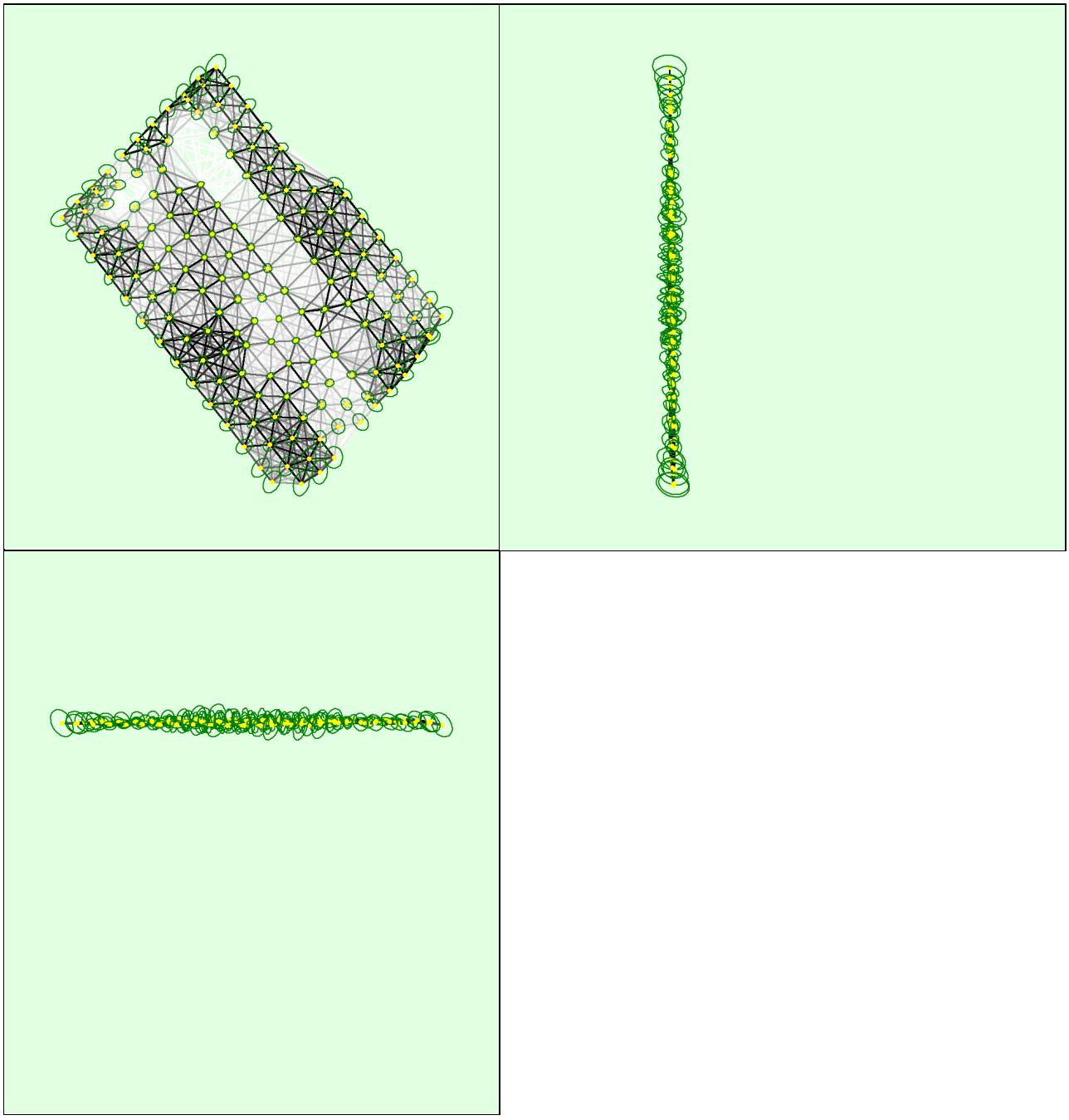
	Number of 2D Keypoints per Image	Number of Matched 2D Keypoints per Image
Median	63743	11721
Min	41181	3141
Max	82902	24266
Mean	63033	12155

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	565157

In 3 Images	126087
In 4 Images	44933
In 5 Images	19724
In 6 Images	9809
In 7 Images	5310
In 8 Images	3097
In 9 Images	1777
In 10 Images	1080
In 11 Images	526
In 12 Images	254
In 13 Images	64
In 14 Images	32
In 15 Images	8
In 16 Images	5

2D Keypoint Matches



Uncertainty ellipses 500x 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]
Mean	0.007	0.006	0.008	0.014	0.014	0.007
Sigma	0.002	0.002	0.004	0.007	0.006	0.002

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
gcp-01 (3D)	0.020/ 0.020	0.001	0.002	0.003	0.260	6 / 6
gcp-10_patje (3D)	0.020/ 0.020	0.013	0.002	0.002	0.318	10 / 10
gcp-03 (3D)	0.020/ 0.020	0.001	-0.002	-0.008	0.400	10 / 10
gcp-02 (3D)	0.020/ 0.020	-0.004	0.013	-0.006	0.430	10 / 10
gcp-04 (3D)	0.020/ 0.020	0.003	0.001	0.011	0.301	8 / 8
gcp-06 (3D)	0.020/ 0.020	-0.010	0.007	-0.002	0.483	8 / 8
gcp-08 (3D)	0.020/ 0.020	-0.003	-0.020	-0.003	0.471	7 / 7
gcp-07 (3D)	0.020/ 0.020	-0.010	0.008	-0.004	0.446	8 / 8
gcp-09 (3D)	0.020/ 0.020	0.007	-0.012	0.008	0.446	9 / 9
Mean [m]		-0.000051	-0.000158	0.000181		
Sigma [m]		0.007058	0.009429	0.005903		
RMS Error [m]		0.007058	0.009430	0.005906		

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	1.88	0.00
-3.00	0.00	43.75	48.75	50.62
0.00	3.00	56.25	49.38	49.38
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]		-0.715677	-0.235702	-122.511322
Sigma [m]		1.235047	1.445375	0.837803
RMS Error [m]		1.427423	1.464467	122.514187

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]	-0.715677	-0.235702	-122.511322

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	0.539
Phi	0.312
Kappa	1.433

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) i7-8700 CPU @ 3.20GHz RAM: 32GB GPU: NVIDIA Quadro P1000 (Driver: 24.21.14.1195), Citrix Indirect Display Adapter (Driver: 12.40.44.247)
Operating System	Windows 10 Enterprise, 64-bit

Coordinate Systems

Image Coordinate System	WGS 84 (EGM96 Geoid)
Ground Control Point (GCP) Coordinate System	Belge 1972 / Belgian Lambert 72 (EGM96 Geoid)
Output Coordinate System	Belge 1972 / Belgian Lambert 72 (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 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	20m:39s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	08m:53s

Results

Number of Generated Tiles	1
Number of 3D Densified Points	23376345
Average Density (per m^3)	2538.66

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	3 x GSD (1.02 [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
Grid DSM	Generated: yes, Spacing [cm]: 2
Time for DSM Generation	04m:51s
Time for Orthomosaic Generation	09m:05s
Time for DTM Generation	00s
Time for Contour Lines Generation	00s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s