

Quality Report



Generated with Pix4Dmapper version 4.3.31



Summary

Project	Penalva_Área Urbana
Processed	2019-11-05 00:23:53
Camera Model Name(s)	DSC-RX1RM2_35.0_7952x5304 (RGB)
Average Ground Sampling Distance (GSD)	4.13 cm / 1.62 in
Area Covered	0.800 km ² / 80.0344 ha / 0.31 sq. mi. / 197.8717 acres

Quality Check

Images	median of 31679 keypoints per image	✓
Dataset	522 out of 522 images calibrated (100%), all images enabled	✓
Camera Optimization	0.99% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 16784.2 matches per calibrated image	✓
Georeferencing	yes, 11 GCPs (11 3D), mean RMS error = 0.024 m	✓

Preview

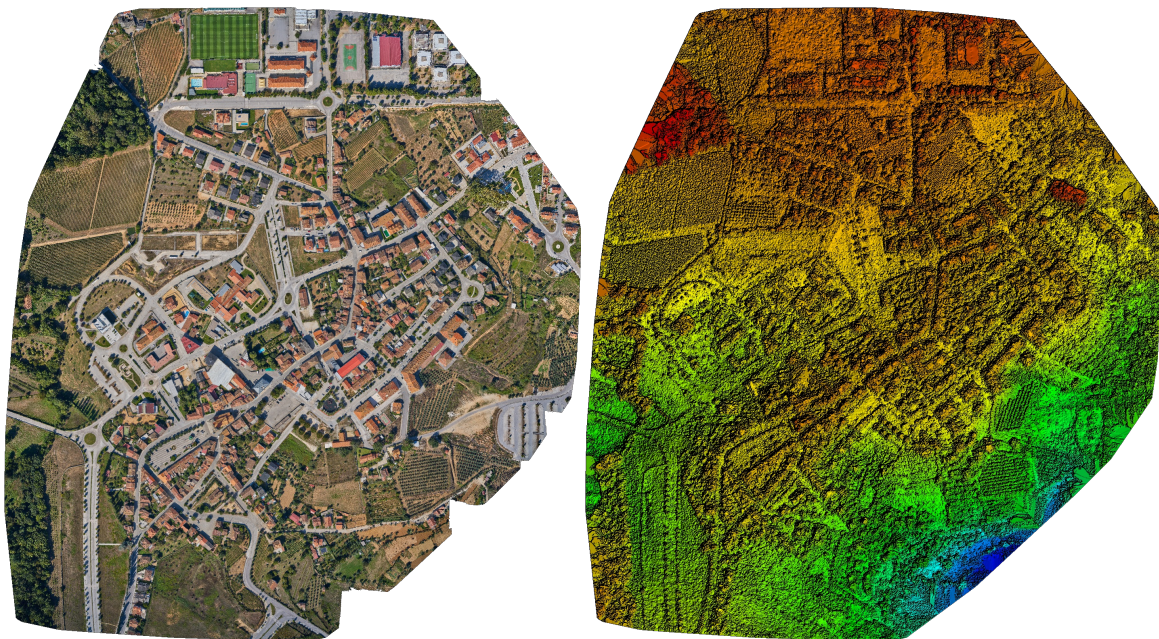


Figure 1: Orthomosaic and the corresponding sparse Digital Surface Model (DSM) before densification.

Calibration Details

Number of Calibrated Images	522 out of 522
Number of Geolocated Images	522 out of 522

Initial Image Positions

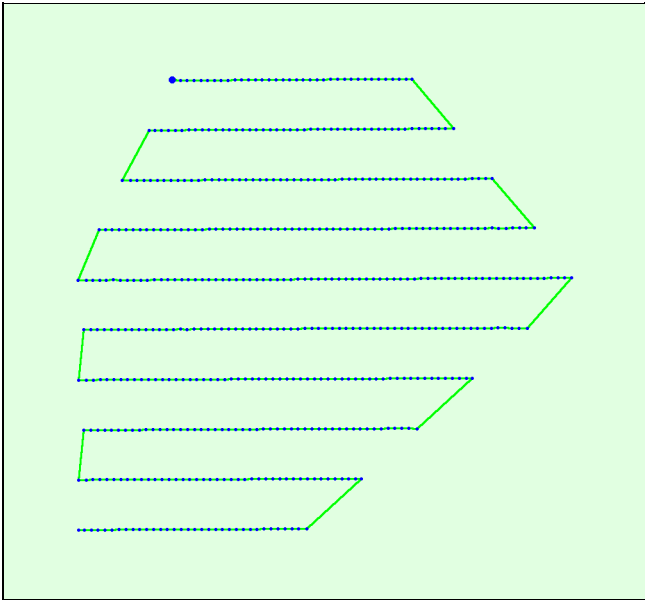
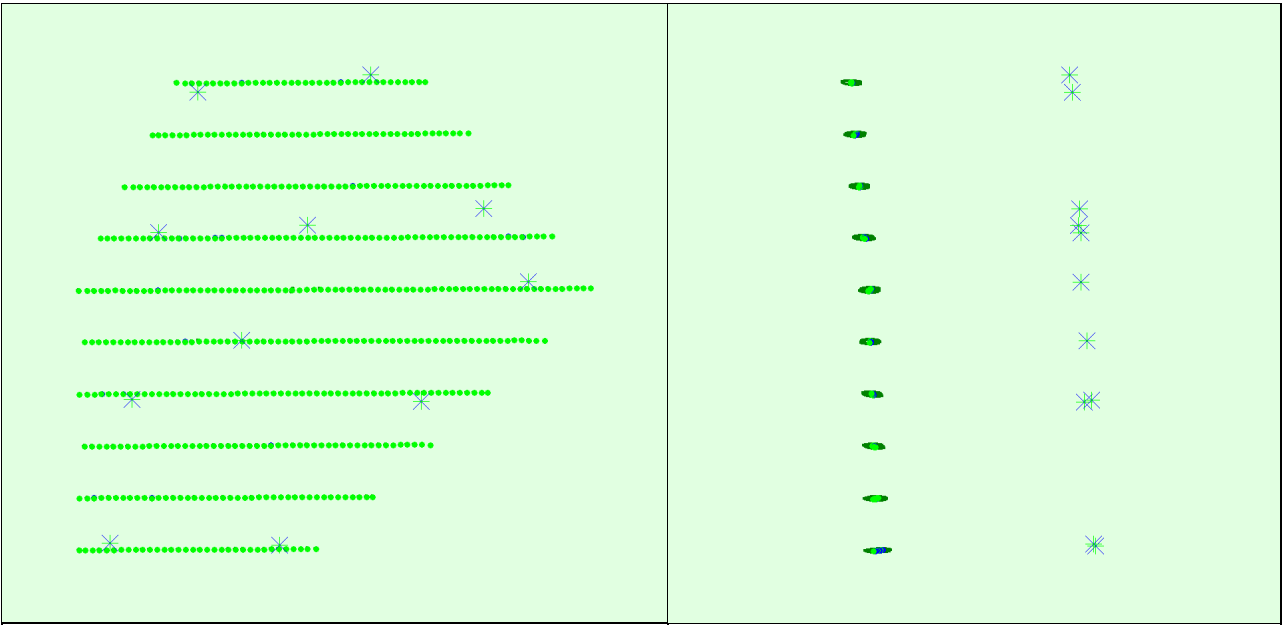
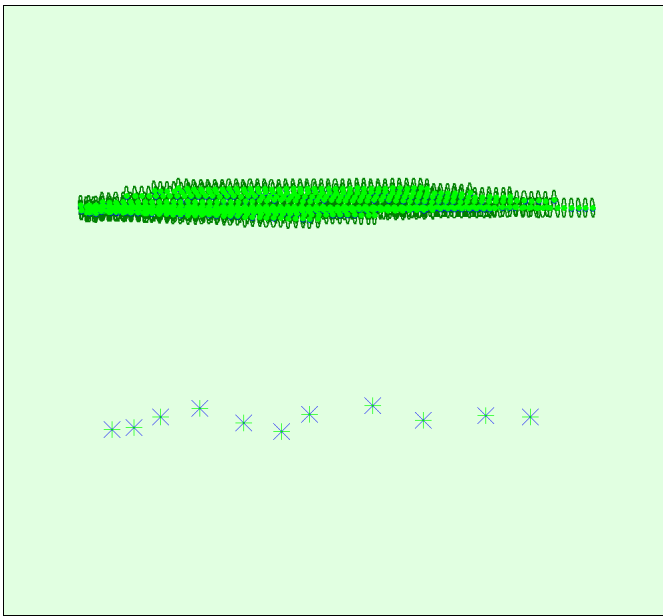


Figure 2: Top view of the initial image position. The green line follows the position of the images in time starting from the large blue dot.

Computed Image/GCPs/Manual Tie Points Positions





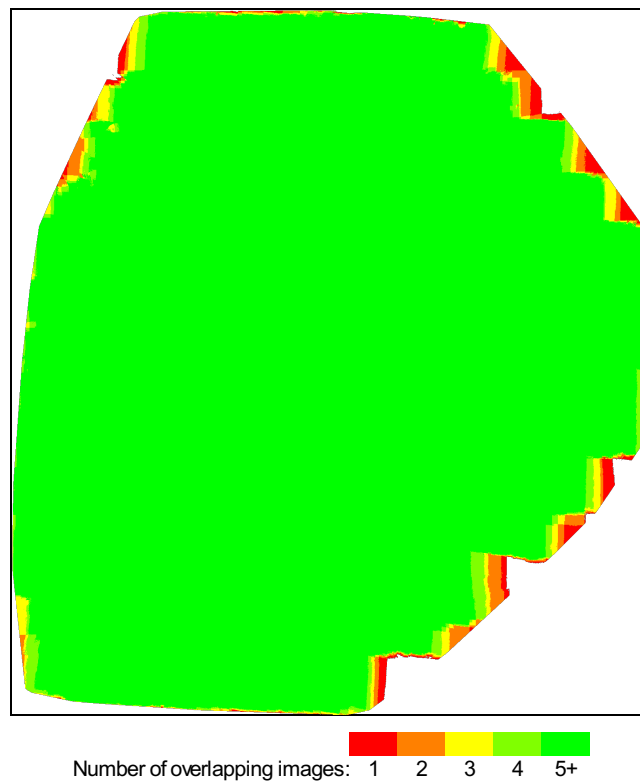
Uncertainty ellipses 500x magnified

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	0.006	0.006	0.027	0.001	0.001	0.001
Sigma	0.000	0.000	0.000	0.000	0.000	0.000

Overlap



Number of overlapping images: 1 2 3 4 5+

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

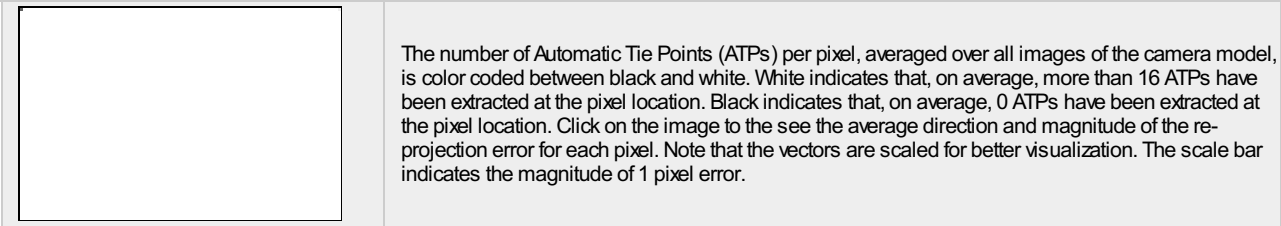
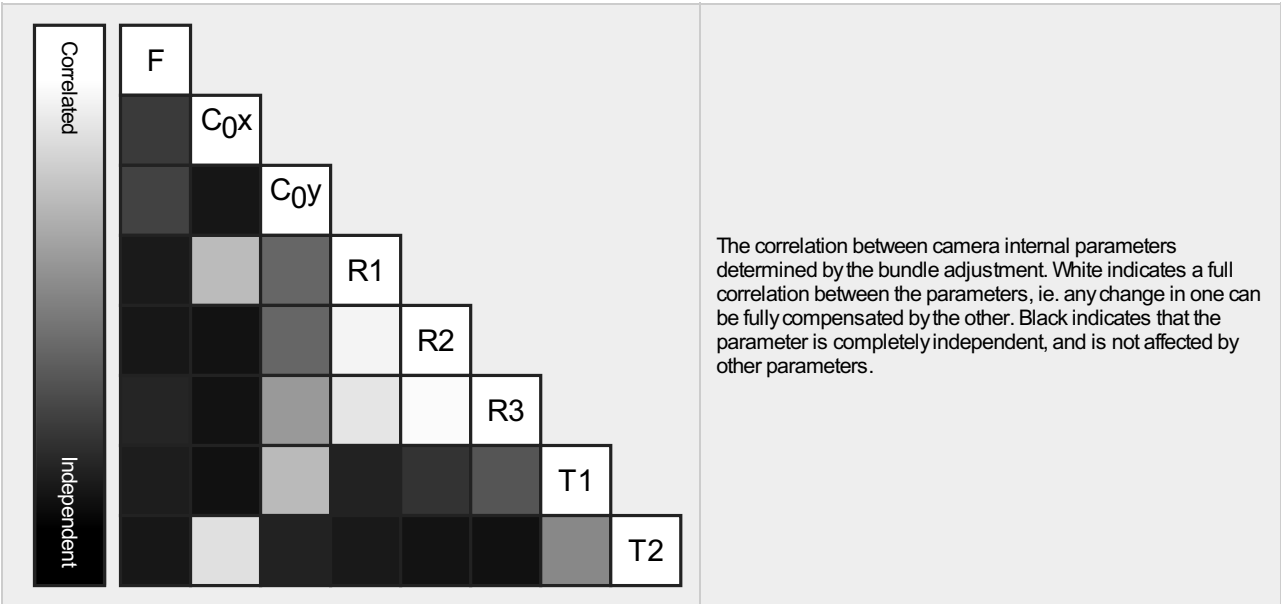
Number of 2D Keypoint Observations for Bundle Block Adjustment	9023332
Number of 3D Points for Bundle Block Adjustment	1666252
Mean Reprojection Error [pixels]	0.155

Internal Camera Parameters

 **DSC-RX1RM2_35.0_7952x5304 (RGB). Sensor Dimensions: 35.000 [mm] x 23.345 [mm]**

EXIF ID: DSC-RX1RM2_35mmf2_35.0_7952x5304

	Focal Length	Principal Point x	Principal Point y	R1	R2	R3	T1	T2
Initial Values	7451.230 [pixel] 32.796 [mm]	3949.280 [pixel] 17.382 [mm]	2642.930 [pixel] 11.633 [mm]	-0.011	0.043	-0.069	0.001	-0.000
Optimized Values	7525.618 [pixel] 33.123 [mm]	3935.064 [pixel] 17.320 [mm]	2630.030 [pixel] 11.576 [mm]	-0.042	-0.243	0.376	0.001	-0.000
Uncertainties (Sigma)	0.644 [pixel] 0.003 [mm]	0.121 [pixel] 0.001 [mm]	0.083 [pixel] 0.000 [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	31679	16784
Mn	26295	9854
Max	53739	27200
Mean	31998	17286

3D Points from 2D Keypoint Matches

	Number of 3D Points Observed
In 2 Images	621970

In 3 Images	311229
In 4 Images	185641
In 5 Images	120081
In 6 Images	83129
In 7 Images	60886
In 8 Images	46148
In 9 Images	35561
In 10 Images	28027
In 11 Images	22228
In 12 Images	18540
In 13 Images	15183
In 14 Images	13048
In 15 Images	11041
In 16 Images	9396
In 17 Images	8464
In 18 Images	7438
In 19 Images	6943
In 20 Images	6389
In 21 Images	5419
In 22 Images	4105
In 23 Images	3270
In 24 Images	2847
In 25 Images	2637
In 26 Images	2419
In 27 Images	2287
In 28 Images	2093
In 29 Images	1980
In 30 Images	1851
In 31 Images	1691
In 32 Images	1551
In 33 Images	1462
In 34 Images	1417
In 35 Images	1318
In 36 Images	1280
In 37 Images	1105
In 38 Images	1012
In 39 Images	972
In 40 Images	947
In 41 Images	885
In 42 Images	715
In 43 Images	649
In 44 Images	621
In 45 Images	520
In 46 Images	487
In 47 Images	457
In 48 Images	431
In 49 Images	429
In 50 Images	397
In 51 Images	407
In 52 Images	392
In 53 Images	379
In 54 Images	357
In 55 Images	320
In 56 Images	308
In 57 Images	303
In 58 Images	267
In 59 Images	282
In 60 Images	309
In 61 Images	282

In 62 Images	310
In 63 Images	264
In 64 Images	222
In 65 Images	197
In 66 Images	177
In 67 Images	138
In 68 Images	140
In 69 Images	171
In 70 Images	150
In 71 Images	151
In 72 Images	136
In 73 Images	102
In 74 Images	126
In 75 Images	122
In 76 Images	133
In 77 Images	110
In 78 Images	133
In 79 Images	92
In 80 Images	115
In 81 Images	105
In 82 Images	118
In 83 Images	85
In 84 Images	94
In 85 Images	100
In 86 Images	89
In 87 Images	68
In 88 Images	54
In 89 Images	24
In 90 Images	28
In 91 Images	23
In 92 Images	23
In 93 Images	20
In 94 Images	20
In 95 Images	16
In 96 Images	14
In 97 Images	15
In 98 Images	17
In 99 Images	11
In 100 Images	17
In 101 Images	15
In 102 Images	9
In 103 Images	21
In 104 Images	19
In 105 Images	12
In 106 Images	16
In 107 Images	18
In 108 Images	7
In 109 Images	2
In 110 Images	1

2D Keypoint Matches

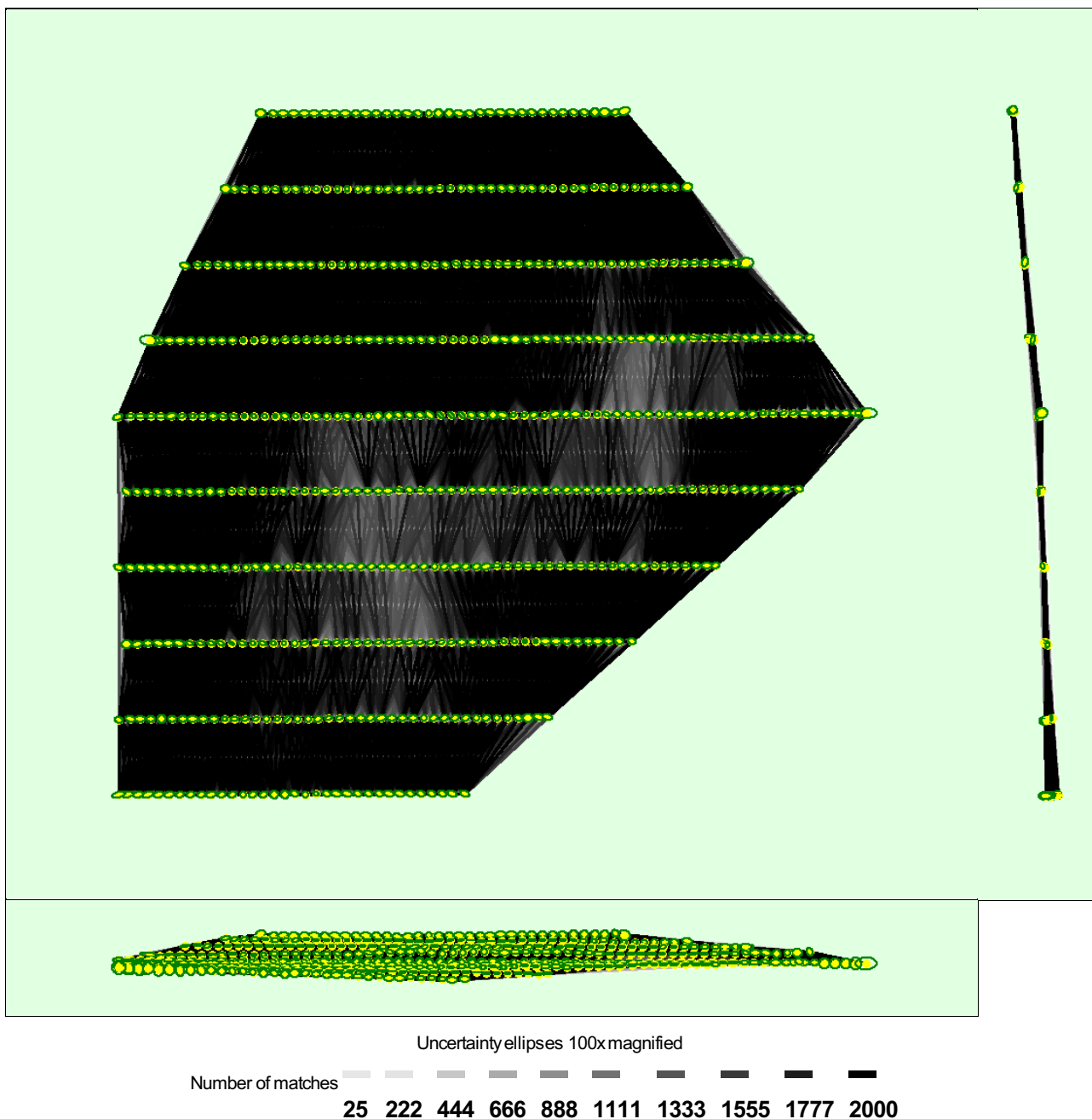


Figure 5: Computed image positions with links between matched images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images. Dark green ellipses indicate the relative camera position uncertainty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

Relative camera position and orientation uncertainties

	X[m]	Y[m]	Z[m]	Omega [degree]	Phi [degree]	Kappa [degree]
Mean	0.039	0.028	0.020	0.011	0.011	0.002
Sigma	0.007	0.004	0.011	0.005	0.004	0.001

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
PC1 (3D)	0.020/ 0.020	0.008	-0.007	-0.067	0.593	50 / 50
PC2 (3D)	0.020/ 0.020	-0.049	-0.005	0.010	0.599	63 / 63

PC3 (3D)	0.020/ 0.020	0.027	-0.011	-0.004	0.624	65 / 65
PC4 (3D)	0.020/ 0.020	0.032	-0.013	0.039	0.569	64 / 64
PC5 (3D)	0.020/ 0.020	0.022	0.013	0.006	0.755	63 / 64
PC6 (3D)	0.020/ 0.020	0.044	0.017	0.021	0.558	61 / 61
PC7 (3D)	0.020/ 0.020	-0.023	0.020	-0.003	0.450	45 / 45
PC8 (3D)	0.020/ 0.020	-0.028	0.030	-0.020	0.656	89 / 89
PC9 (3D)	0.020/ 0.020	-0.017	-0.004	-0.023	0.719	76 / 76
PC10 (3D)	0.020/ 0.020	-0.036	-0.031	0.006	0.574	91 / 91
PC11 (3D)	0.020/ 0.020	0.016	-0.002	-0.038	0.732	107 / 107
Mean [m]		-0.000287	0.000717	-0.006711		
Sigma [m]		0.029853	0.016703	0.027987		
RMS Error [m]		0.029854	0.016718	0.028780		

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 v.s. manually marked.

Absolute Geolocation Variance

Mn Error [m]	Max Error [m]	Geolocation Error X[%]	Geolocation Error Y[%]	Geolocation Error Z[%]
-	-0.03	0.19	0.38	15.90
-0.03	-0.02	0.00	0.77	4.21
-0.02	-0.02	0.00	0.77	7.09
-0.02	-0.01	2.11	2.49	7.28
-0.01	-0.01	4.41	8.81	5.75
-0.01	0.00	45.02	39.08	9.58
0.00	0.01	43.30	32.95	8.62
0.01	0.01	2.87	9.96	7.28
0.01	0.02	0.96	3.45	8.05
0.02	0.02	0.38	0.96	4.98
0.02	0.03	0.38	0.19	4.60
0.03	-	0.38	0.19	16.67
Mean [m]		0.002891	0.014444	-0.377375
Sigma [m]		0.005301	0.007268	0.034365
RMS Error [m]		0.006038	0.016169	0.378936

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]	0.002891	0.014444	-0.377375

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]	98.66	97.51	50.77
[-2.00, 2.00]	100.00	100.00	81.42
[-3.00, 3.00]	100.00	100.00	92.53
Mean of Geolocation Accuracy [m]	0.020000	0.020000	0.020000
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	0.731
Phi	0.666
Kappa	0.261

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) Xeon(R) CPU E5-2680 v4 @ 2.40GHz RAM: 256GB GPU: NVIDIA GeForce GTX 1080 Ti (Driver: 24.21.13.9924)
Operating System	Windows 10 Pro, 64-bit

Coordinate Systems

Image Coordinate System	ETRS89 (+55.67m)
Ground Control Point (GCP) Coordinate System	ETRS89 / Portugal TM06 (+55.67m)
Output Coordinate System	ETRS89 / Portugal TM06 (+55.67m)

Processing Options

Detected Template	 Optimize for md1000DG*
Keypoints Image Scale	Full, Image Scale: 0.5
Advanced: Matching Image Pairs	Aerial Grid or Corridor
Advanced: Matching Strategy	Use Geometrically Verified Matching: yes
Advanced: Keypoint Extraction	Targeted Number of Keypoints: Automatic
Advanced: Calibration	Calibration Method: Geolocation Based Internal Parameters Optimization: All External Parameters Optimization: All Lever-Arm Parameters Optimization: Optimize Rematch: Auto, no

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	no
LOD	Generated: no
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	01h:36m:39s
Time for Point Cloud Classification	04m:51s
Time for 3D Textured Mesh Generation	NA

Results

Number of Generated Tiles	4
Number of 3D Densified Points	73034046
Average Density (per m ³)	89.32

DSM, Orthomosaic and Index Details

Processing Options

DSM and Orthomosaic Resolution	1 x GSD (4.13 [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: yes
Raster DTM	Generated: yes Merge Tiles: yes
DTM Resolution	5 [cm/pixel]
Contour Lines Generation	Generated: yes Contour Base [m]: 0 Elevation Interval [m]: 2 Resolution [cm]: 500 Minimum Line Size [vertices]: 20
Time for DSM Generation	12m:18s
Time for Orthomosaic Generation	01h:52m:56s
Time for DTM Generation	01h:02m:32s
Time for Contour Lines Generation	15s
Time for Reflectance Map Generation	00s
Time for Index Map Generation	00s