

# Quality Report



Generated with Pix4Dmapper Pro - TRIAL version 2.0.104



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Additional information about the sections



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## Summary



|  |                     |
|--|---------------------|
| Project                                      | tyholt_ver2         |
| Processed                                    | 2016-02-29 21:18:57 |
| Average Ground Sampling Distance (GSD)       | 41.48 cm / 16.33 in |
| Time for Initial Processing (without report) | 45m:56s             |

## Quality Check



|                     |  |  |
|---------------------|--|--|
| Images              | median of 29355 keypoints per image  |  |
| Dataset             | 150 out of 150 images calibrated (100%), all images enabled                        |  |
| Camera Optimization | 1.59% relative difference between initial and optimized internal camera parameters |  |
| Matching            | median of 11440.8 matches per calibrated image                                     |  |
| Georeferencing      | yes, 26 GCPs (26 3D), mean RMS error = 0.013 m                                     |  |

## Calibration Details



|                             |                |
|-----------------------------|----------------|
| Number of Calibrated Images | 150 out of 150 |
| Number of Geolocated Images | 150 out of 150 |



## 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



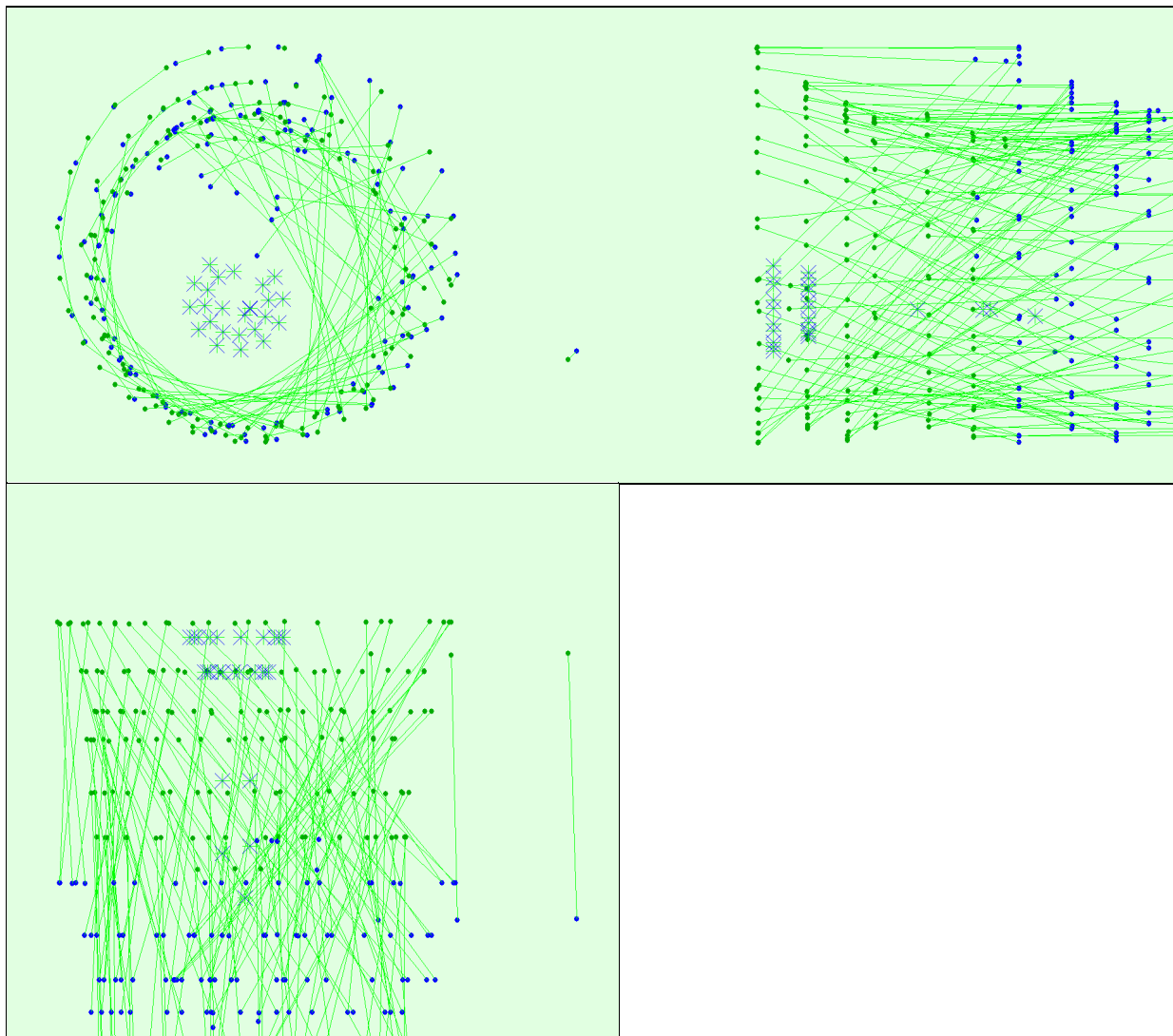


Figure 3: Offset between initial (blue dots) and computed (green dots) image positions as well as the offset between the GCPs initial positions (blue crosses) and their computed positions (green crosses) in the top-view (XY plane), front-view (XZ plane), and side-view (YZ plane).

## Bundle Block Adjustment Details



|  |          |
|--|----------|
| Number of 2D Keypoint Observations for Bundle Block Adjustment | 1707799  |
| Number of 3D Points for Bundle Block Adjustment                | 572587   |
| Mean Reprojection Error [pixels]                               | 0.200181 |

### ? Internal Camera Parameters

**FC300X\_20.7mm\_3.6\_3992x2992(2014031100) (RGB). Sensor Dimensions: 6.317 [mm] x 4.735 [mm]**



EXIF ID: FC300X\_20.7mm\_3.6\_3992x2992

|                  | Focal Length                   | Principal Point x              | Principal Point y              | R1     | R2    | R3     | T1    | T2    |
|------------------|--------------------------------|--------------------------------|--------------------------------|--------|-------|--------|-------|-------|
| Initial Values   | 2281.143 [pixel]<br>3.610 [mm] | 1996.000 [pixel]<br>3.159 [mm] | 1496.000 [pixel]<br>2.367 [mm] | 0.000  | 0.000 | 0.000  | 0.000 | 0.000 |
| Optimized Values | 2317.599 [pixel]<br>3.668 [mm] | 1998.419 [pixel]<br>3.163 [mm] | 1512.369 [pixel]<br>2.393 [mm] | -0.131 | 0.109 | -0.015 | 0.001 | 0.000 |



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, in average, more than 16 ATPs are extracted at this pixel location. Black indicates that, in average, 0 ATP has been extracted at this pixel location. Click on the image to see the average direction and magnitude of the reprojection error for each pixel. Note that the vectors are scaled for better visualization.

### 2D Keypoints Table



|        | Number of 2D Keypoints per Image | Number of Matched 2D Keypoints per Image |
|--------|----------------------------------|--|
| Median | 29355                            | 11441                                    |
| Mn     | 18863                            | 2008                                     |
| Max    | 41456                            | 21929                                    |
| Mean   | 30234                            | 11385                                    |

### 3D Points from 2D Keypoint Matches



|              | Number of 3D Points Observed |
|--------------|------------------------------|
| In 2 Images  | 374450                       |
| In 3 Images  | 92965                        |
| In 4 Images  | 38750                        |
| In 5 Images  | 21187                        |
| In 6 Images  | 12859                        |
| In 7 Images  | 8283                         |
| In 8 Images  | 5663                         |
| In 9 Images  | 4167                         |
| In 10 Images | 2940                         |
| In 11 Images | 2363                         |
| In 12 Images | 1698                         |
| In 13 Images | 1348                         |
| In 14 Images | 1110                         |
| In 15 Images | 883                          |
| In 16 Images | 703                          |
| In 17 Images | 571                          |
| In 18 Images | 478                          |
| In 19 Images | 418                          |
| In 20 Images | 329                          |
| In 21 Images | 282                          |
| In 22 Images | 243                          |
| In 23 Images | 183                          |
| In 24 Images | 147                          |
| In 25 Images | 128                          |
| In 26 Images | 111                          |
| In 27 Images | 66                           |
| In 28 Images | 57                           |
| In 29 Images | 57                           |
| In 30 Images | 36                           |
| In 31 Images | 31                           |
| In 32 Images | 17                           |
| In 33 Images | 18                           |
| In 34 Images | 13                           |
| In 35 Images | 14                           |
| In 36 Images | 5                            |
| In 37 Images | 4                            |
| In 38 Images | 4                            |
| In 39 Images | 1                            |
| In 40 Images | 1                            |
| In 41 Images | 2                            |
| In 44 Images | 1                            |

## ? 2D Keypoint Matches

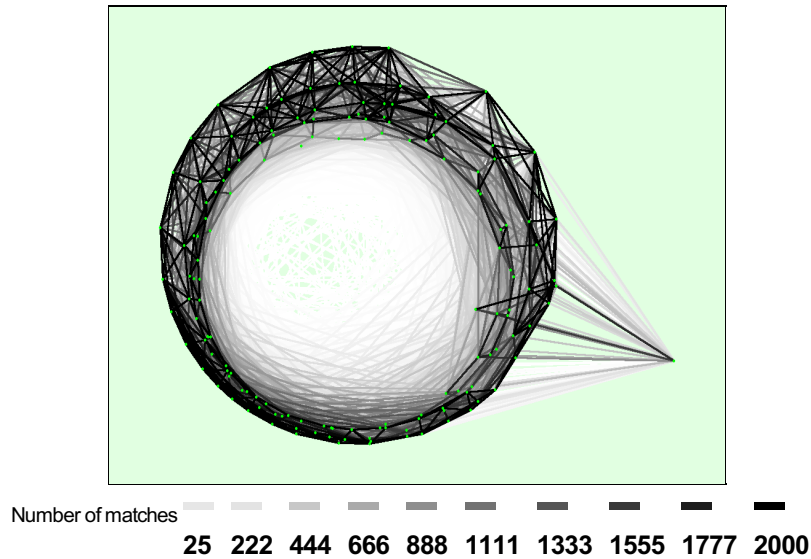


Figure 5: Top view of the image computed positions with a link between matching images. The darkness of the links indicates the number of matched 2D keypoints between the images. Bright links indicate weak links and require manual tie points or more images.

## Geolocation Details



### ? Ground Control Points



| GCP Name             | Accuracy XYZ [m] | Error X [m] | Error Y [m] | Error Z [m] | Projection Error [pixel] | Verified/Marked |
|----------------------|------------------|-------------|-------------|-------------|--------------------------|-----------------|
| GD1 (3D)             | 0.020/ 0.020     | 0.019       | 0.005       | -0.010      | 1.111                    | 11 / 11         |
| GD2 (3D)             | 0.020/ 0.020     | 0.008       | -0.001      | -0.003      | 0.978                    | 12 / 12         |
| GD3 (3D)             | 0.020/ 0.020     | 0.014       | 0.015       | -0.003      | 0.744                    | 11 / 11         |
| GD4 (3D)             | 0.020/ 0.020     | -0.009      | 0.001       | -0.007      | 0.909                    | 11 / 11         |
| GD10 (3D)            | 0.020/ 0.020     | -0.014      | 0.003       | -0.008      | 0.852                    | 11 / 11         |
| GD11 (3D)            | 0.020/ 0.020     | 0.005       | 0.033       | -0.011      | 1.022                    | 11 / 11         |
| GD12 (3D)            | 0.020/ 0.020     | 0.010       | 0.012       | -0.004      | 0.937                    | 11 / 11         |
| GG1 (3D)             | 0.020/ 0.020     | -0.001      | 0.009       | 0.007       | 1.534                    | 11 / 11         |
| GG2 (3D)             | 0.020/ 0.020     | -0.007      | -0.013      | -0.000      | 1.223                    | 11 / 11         |
| GG3 (3D)             | 0.020/ 0.020     | -0.001      | 0.001       | 0.004       | 1.263                    | 10 / 10         |
| GG4 (3D)             | 0.020/ 0.020     | -0.038      | -0.023      | -0.018      | 1.194                    | 8 / 8           |
| GG11 (3D)            | 0.020/ 0.020     | -0.032      | -0.028      | -0.005      | 0.934                    | 10 / 10         |
| GG12 (3D)            | 0.020/ 0.020     | -0.006      | 0.006       | -0.002      | 0.948                    | 12 / 12         |
| FP1 (3D)             | 0.020/ 0.020     | 0.015       | 0.004       | -0.005      | 1.005                    | 10 / 10         |
| FP2 (3D)             | 0.020/ 0.020     | -0.002      | -0.015      | 0.015       | 0.788                    | 10 / 10         |
| GD5 (3D)             | 0.020/ 0.020     | -0.012      | 0.011       | 0.012       | 1.054                    | 10 / 10         |
| GD6 (3D)             | 0.020/ 0.020     | -0.033      | 0.022       | -0.003      | 0.829                    | 6 / 6           |
| GG5 (3D)             | 0.020/ 0.020     | -0.006      | 0.002       | 0.023       | 0.714                    | 10 / 10         |
| GD9 (3D)             | 0.020/ 0.020     | 0.004       | -0.007      | -0.003      | 0.899                    | 11 / 11         |
| GD8 (3D)             | 0.020/ 0.020     | -0.009      | -0.000      | -0.004      | 1.183                    | 11 / 11         |
| GG8 (3D)             | 0.020/ 0.020     | 0.038       | -0.008      | -0.009      | 1.472                    | 9 / 9           |
| GG9 (3D)             | 0.020/ 0.020     | 0.031       | -0.001      | 0.001       | 1.727                    | 11 / 11         |
| GG10 (3D)            | 0.020/ 0.020     | 0.020       | -0.000      | 0.002       | 1.293                    | 10 / 10         |
| FP3 (3D)             | 0.020/ 0.020     | 0.006       | -0.036      | 0.013       | 1.517                    | 6 / 6           |
| FP4 (3D)             | 0.020/ 0.020     | -0.027      | -0.002      | -0.013      | 0.784                    | 2 / 2           |
| FP5 (3D)             | 0.020/ 0.020     | 0.003       | -0.001      | 0.008       | 1.233                    | 13 / 13         |
| <b>Mean [m]</b>      |                  | -0.000922   | -0.000484   | -0.000881   |                          |                 |
| <b>Sigma [m]</b>     |                  | 0.018346    | 0.014347    | 0.009198    |                          |                 |
| <b>RMS Error [m]</b> |                  | 0.018369    | 0.014355    | 0.009240    |                          |                 |



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



150 out of 150 geolocated and calibrated images have been labeled as inaccurate.

| Min Error [m] | Max Error [m] | Geolocation Error X[%] | Geolocation Error Y[%] | Geolocation Error Z[%] |
|---------------|---------------|------------------------|------------------------|------------------------|
| -             | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | 0.00          | 0.00                   | 0.00                   | 0.00                   |
| 0.00          | -             | 0.00                   | 0.00                   | 0.00                   |
| Mean [m]      |               | 0.000000               | 0.000000               | 0.000000               |
| Sigma [m]     |               | 0.000000               | 0.000000               | 0.000000               |
| RMS Error [m] |               | 0.000000               | 0.000000               | 0.000000               |

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]  | 2.258800 | 5.616998 | -65.708560 |

Bias between image initial and computed geolocation given in output coordinate system.

## ? Relative Geolocation Variance



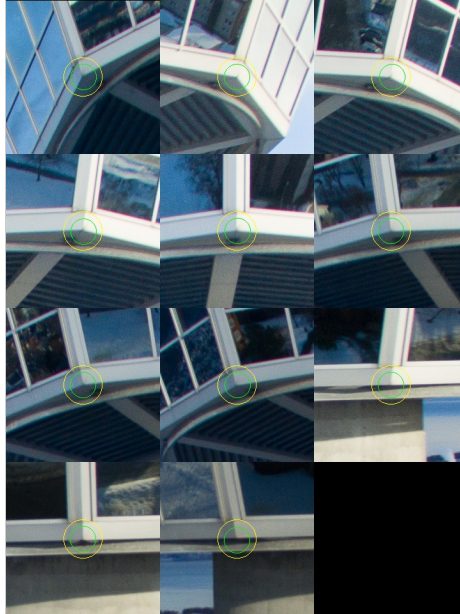
| Relative Geolocation Error        | Images X[%] | Images Y[%] | Images Z[%] |
|-----------------------------------|-------------|-------------|-------------|
| [-1.00, 1.00]                     | 0.00        | 0.00        | 0.00        |
| [-2.00, 2.00]                     | 0.00        | 0.00        | 0.00        |
| [-3.00, 3.00]                     | 0.00        | 0.00        | 0.00        |
| Mean of Geolocation Accuracy [m]  | 0.000000    | 0.000000    | 0.000000    |
| 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.

## ? Georeference Verification



GCP Name: GD1 (571473.846,7033439.995,180.091)



DJI\_0068.jpg  
DJI\_0089.jpg  
DJI\_0090.jpg  
DJI\_0091.jpg  
DJI\_0092.jpg  
DJI\_0093.jpg  
DJI\_0094.jpg  
DJI\_0095.jpg  
DJI\_0118.jpg  
DJI\_0119.jpg  
DJI\_0120.jpg

GCP GD1 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.


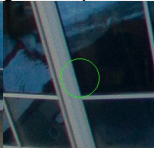
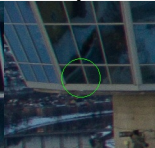














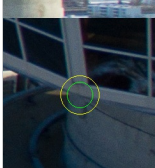

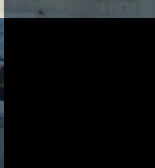


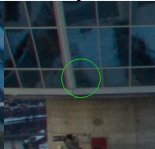
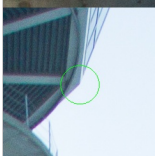

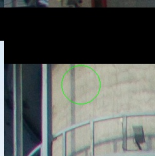
DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0034.jpg  
DJI\_0035.jpg  
DJI\_0036.jpg

GCP Name: GD2 (571470.762,7033442.598,180.091)



DJI\_0067.jpg  
DJI\_0088.jpg  
DJI\_0089.jpg  
DJI\_0090.jpg  
DJI\_0091.jpg  
DJI\_0092.jpg  
DJI\_0093.jpg  
DJI\_0094.jpg  
DJI\_0096.jpg  
DJI\_0116.jpg  
DJI\_0117.jpg  
DJI\_0118.jpg

|  |   |   |
|--|---|---|
| GCP GD2 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy. |   |   |
|   |  |  |
|   |  |  |
| DJI_0008.jpg<br>DJI_0009.jpg<br>DJI_0010.jpg<br>DJI_0034.jpg<br>DJI_0035.jpg<br>DJI_0036.jpg   |   |   |

|  |   |   |
|--|---|---|
| GCP Name: GD3 (571469.402,7033446.397,180.083)   |   |   |
|   |    |    |
|   |    |    |
|   |    |    |
|    |   |   |
| DJI_0087.jpg<br>DJI_0088.jpg<br>DJI_0089.jpg<br>DJI_0090.jpg<br>DJI_0091.jpg<br>DJI_0092.jpg<br>DJI_0114.jpg<br>DJI_0115.jpg<br>DJI_0116.jpg<br>DJI_0143.jpg<br>DJI_0144.jpg                           |   |   |
| GCP GD3 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy. |   |   |
|   |  |  |
|   |  |  |
| DJI_0008.jpg<br>DJI_0009.jpg<br>DJI_0010.jpg<br>DJI_0034.jpg<br>DJI_0035.jpg<br>DJI_0048.jpg   |   |   |

GCP Name: GD4 (571470.075,7033450.354,180.092)



DJI\_0062.jpg  
DJI\_0063.jpg  
DJI\_0064.jpg  
DJI\_0086.jpg  
DJI\_0087.jpg  
DJI\_0088.jpg  
DJI\_0089.jpg  
DJI\_0090.jpg  
DJI\_0091.jpg  
DJI\_0115.jpg  
DJI\_0116.jpg

GCP GD4 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.
















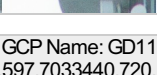

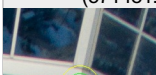

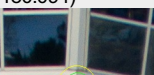
DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0034.jpg  
DJI\_0048.jpg  
DJI\_0049.jpg



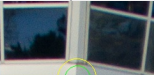





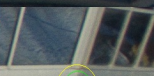








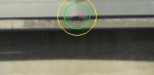


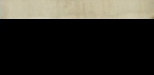


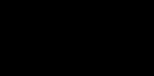
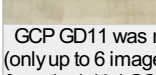
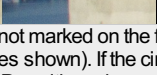
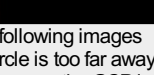
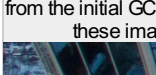
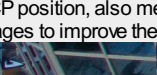
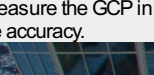
























GCP Name: GD10  
(571484.168,7033443.785,180.075)





DJI\_0069.jpg  
DJI\_0071.jpg  
DJI\_0096.jpg  
DJI\_0097.jpg  
DJI\_0098.jpg  
DJI\_0099.jpg  
DJI\_0123.jpg  
DJI\_0124.jpg  
DJI\_0125.jpg  
DJI\_0126.jpg  
DJI\_0152.jpg




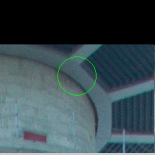








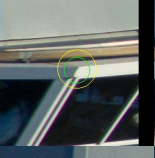



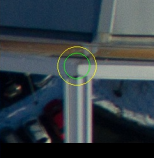



|  |   |   |              |
|--|---|---|--------------|
| <p>GCP GD10 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.</p> |   |   |              |
|   |  |  | DJI_0008.jpg |
|   |  |  | DJI_0009.jpg |
|   |  |  | DJI_0010.jpg |
|   |  |  | DJI_0034.jpg |
|   |  |  | DJI_0035.jpg |
|   |  |  | DJI_0036.jpg |


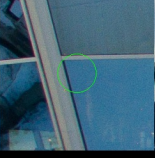



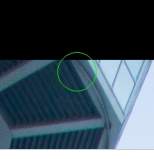
|  |   |   |              |
|--|---|---|--------------|
| <p>GCP Name: GD11<br/>(571481.597,7033440.720,180.094)</p>   |   |   |              |
|   |    |    |              |
|   |    |    | DJI_0094.jpg |
|   |    |    | DJI_0095.jpg |
|   |    |    | DJI_0096.jpg |
|   |    |    | DJI_0097.jpg |
|   |    |    | DJI_0098.jpg |
|    |   |   | DJI_0120.jpg |
|   |  |  | DJI_0121.jpg |
|   |  |  | DJI_0122.jpg |
|   |  |  | DJI_0123.jpg |
|   |  |  | DJI_0124.jpg |
|   |  |  | DJI_0125.jpg |
| <p>GCP GD11 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.</p> |   |   |              |
|   |  |  | DJI_0008.jpg |
|   |  |  | DJI_0009.jpg |
|   |  |  | DJI_0010.jpg |
|   |  |  | DJI_0034.jpg |
|   |  |  | DJI_0035.jpg |
|   |  |  | DJI_0036.jpg |

|   |  |  |
|---|--|--|
| GCP Name: GD12<br>(571477.807,7033439.315,180.108)  |  |  |
|    |  | DJI_0091.jpg<br>DJI_0092.jpg<br>DJI_0093.jpg<br>DJI_0094.jpg<br>DJI_0095.jpg<br>DJI_0096.jpg<br>DJI_0119.jpg<br>DJI_0120.jpg<br>DJI_0121.jpg<br>DJI_0123.jpg<br>DJI_0151.jpg |
| GCP GD12 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy. |  |  |
|   |  | DJI_0008.jpg<br>DJI_0009.jpg<br>DJI_0010.jpg<br>DJI_0034.jpg<br>DJI_0035.jpg<br>DJI_0036.jpg   |

|   |  |  |
|---|--|--|
| GCP Name: GG1 (571472.358,7033436.834,188.589)                                      |  |  |
|  |  | DJI_0117.jpg<br>DJI_0118.jpg<br>DJI_0119.jpg<br>DJI_0120.jpg<br>DJI_0121.jpg<br>DJI_0122.jpg<br>DJI_0144.jpg<br>DJI_0145.jpg<br>DJI_0146.jpg<br>DJI_0147.jpg<br>DJI_0148.jpg |

|   |   |   |
|---|---|---|
| <p>GCP GG1 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.</p> |   |   |
|    |  |  |
|    |  |  |
| <p>DJI_0008.jpg<br/>DJI_0009.jpg<br/>DJI_0010.jpg<br/>DJI_0034.jpg<br/>DJI_0053.jpg<br/>DJI_0054.jpg</p>  |   |   |

|   |  |  |
|---|--|--|
| <p>GCP Name: GG2 (571467.870,7033440.581,188.551)</p>   |  |  |
|    |   |   |
|    |   |   |
|    |   |   |
|   |  |  |
| <p>DJI_0117.jpg<br/>DJI_0118.jpg<br/>DJI_0119.jpg<br/>DJI_0120.jpg<br/>DJI_0141.jpg<br/>DJI_0142.jpg<br/>DJI_0143.jpg<br/>DJI_0144.jpg<br/>DJI_0145.jpg<br/>DJI_0146.jpg<br/>DJI_0148.jpg</p> |  |  |

|   |   |   |
|---|---|---|
| <p>GCP GG2 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.</p> |   |   |
|    |  |  |
|    |  |  |
| <p>DJI_0008.jpg<br/>DJI_0009.jpg<br/>DJI_0010.jpg<br/>DJI_0052.jpg<br/>DJI_0053.jpg<br/>DJI_0054.jpg</p>  |   |   |



GCP Name: GG3 (571465.868,7033446.112,188.552)



DJI\_0086.jpg  
DJI\_0114.jpg  
DJI\_0115.jpg  
DJI\_0116.jpg  
DJI\_0117.jpg  
DJI\_0118.jpg  
DJI\_0119.jpg  
DJI\_0142.jpg  
DJI\_0143.jpg  
DJI\_0147.jpg

GCP GG3 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.



DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0052.jpg  
DJI\_0055.jpg  
DJI\_0056.jpg

GCP Name: GG4 (571466.890,7033451.863,188.541)



DJI\_0085.jpg  
DJI\_0086.jpg  
DJI\_0114.jpg  
DJI\_0115.jpg  
DJI\_0116.jpg  
DJI\_0117.jpg  
DJI\_0118.jpg  
DJI\_0141.jpg

GCP GG4 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.









DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0055.jpg  
DJI\_0056.jpg  
DJI\_0057.jpg












|  |  |  |
|--|--|--|
| GCP Name: GG11<br>(571483.608,7033437.762,188.546)   |  |  |
|  |  | DJI_0097.jpg<br>DJI_0121.jpg<br>DJI_0122.jpg<br>DJI_0123.jpg<br>DJI_0124.jpg<br>DJI_0125.jpg<br>DJI_0149.jpg<br>DJI_0150.jpg<br>DJI_0151.jpg<br>DJI_0152.jpg |
| GCP GG11 was not marked on the following images<br>(only up to 6 images shown). If the circle is too far away<br>from the initial GCP position, also measure the GCP in<br>these images to improve the accuracy. |  |  |
|  |  | DJI_0008.jpg<br>DJI_0009.jpg<br>DJI_0010.jpg<br>DJI_0034.jpg<br>DJI_0035.jpg<br>DJI_0036.jpg   |

|  |  |  |
|--|--|--|
| GCP Name: GG12<br>(571478.125,7033435.799,188.584) |  |  |
|  |  | DJI_0097.jpg<br>DJI_0118.jpg<br>DJI_0119.jpg<br>DJI_0120.jpg<br>DJI_0121.jpg<br>DJI_0122.jpg<br>DJI_0123.jpg<br>DJI_0125.jpg<br>DJI_0145.jpg<br>DJI_0148.jpg<br>DJI_0149.jpg<br>DJI_0150.jpg |



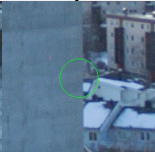



GCP GG12 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.

|   |   |   |  |
|---|---|---|--|
|  |  |  | DJI_0008.jpg   |
|  |  |  | DJI_0009.jpg<br>DJI_0010.jpg<br>DJI_0034.jpg<br>DJI_0035.jpg<br>DJI_0054.jpg |

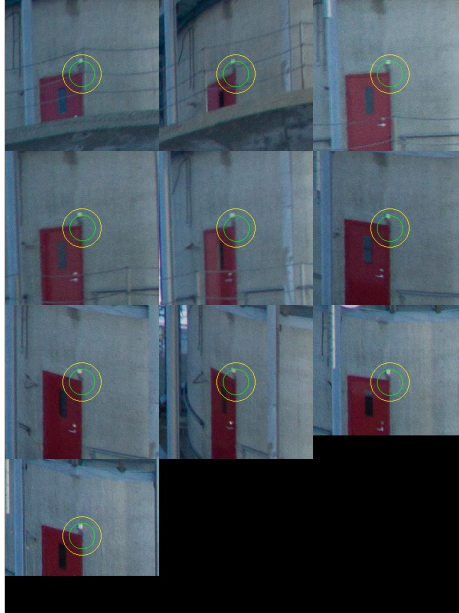
GCP Name: FP1 (571473.660,7033445.923,135.874)

|  |  |  |  |
|--|--|--|--|
|   |   |   | DJI_0016.jpg<br>DJI_0017.jpg<br>DJI_0018.jpg<br>DJI_0019.jpg<br>DJI_0020.jpg<br>DJI_0038.jpg<br>DJI_0039.jpg<br>DJI_0040.jpg<br>DJI_0041.jpg<br>DJI_0042.jpg |
|   |   |   |  |
|   |   |   |  |
|  |  |  |  |

GCP FP1 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.

|   |   |   |  |
|---|---|---|--|
|  |  |  | DJI_0010.jpg<br>DJI_0012.jpg<br>DJI_0013.jpg<br>DJI_0014.jpg<br>DJI_0015.jpg<br>DJI_0021.jpg |
|  |  |  |  |

GCP Name: FP2 (571473.695,7033445.795,153.606)



DJI\_0018.jpg  
DJI\_0020.jpg  
DJI\_0040.jpg  
DJI\_0041.jpg  
DJI\_0042.jpg  
DJI\_0064.jpg  
DJI\_0065.jpg  
DJI\_0066.jpg  
DJI\_0089.jpg  
DJI\_0090.jpg

GCP FP2 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.



DJI\_0008.jpg  
DJI\_0010.jpg  
DJI\_0012.jpg  
DJI\_0013.jpg  
DJI\_0014.jpg  
DJI\_0015.jpg


GCP Name: GD5 (571472.699,7033453.418,180.138)



DJI\_0060.jpg  
DJI\_0062.jpg  
DJI\_0084.jpg  
DJI\_0085.jpg  
DJI\_0086.jpg  
DJI\_0087.jpg  
DJI\_0088.jpg  
DJI\_0089.jpg  
DJI\_0090.jpg  
DJI\_0114.jpg



GCP GD5 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.




DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0048.jpg  
DJI\_0049.jpg  
DJI\_0050.jpg

GCP Name: GD6 (571476.448,7033454.791,180.128)



DJI\_0059.jpg  
DJI\_0061.jpg  
DJI\_0083.jpg  
DJI\_0086.jpg  
DJI\_0087.jpg  
DJI\_0088.jpg

GCP GD6 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.




DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0055.jpg  
DJI\_0056.jpg  
DJI\_0057.jpg

GCP Name: GG5 (571470.662,7033456.337,188.611)



DJI\_0082.jpg  
DJI\_0083.jpg  
DJI\_0084.jpg  
DJI\_0085.jpg  
DJI\_0086.jpg  
DJI\_0087.jpg  
DJI\_0112.jpg  
DJI\_0113.jpg  
DJI\_0114.jpg  
DJI\_0115.jpg

GCP GG5 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.



DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0055.jpg  
DJI\_0056.jpg  
DJI\_0066.jpg

GCP Name: GD9 (571484.905,7033447.744,180.073)



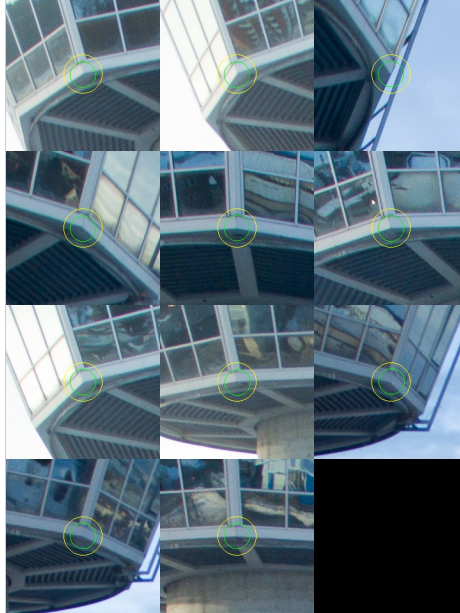
DJI\_0009.jpg  
DJI\_0069.jpg  
DJI\_0071.jpg  
DJI\_0097.jpg  
DJI\_0098.jpg  
DJI\_0099.jpg  
DJI\_0123.jpg  
DJI\_0124.jpg  
DJI\_0125.jpg  
DJI\_0126.jpg  
DJI\_0127.jpg

GCP GD9 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.



DJI\_0008.jpg  
DJI\_0010.jpg  
DJI\_0034.jpg  
DJI\_0035.jpg  
DJI\_0036.jpg  
DJI\_0037.jpg

GCP Name: GD8 (571483.513,7033451.534,180.060)



DJI\_0055.jpg  
DJI\_0056.jpg  
DJI\_0069.jpg  
DJI\_0071.jpg  
DJI\_0073.jpg  
DJI\_0074.jpg  
DJI\_0075.jpg  
DJI\_0079.jpg  
DJI\_0099.jpg  
DJI\_0100.jpg  
DJI\_0102.jpg

GCP GD8 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.



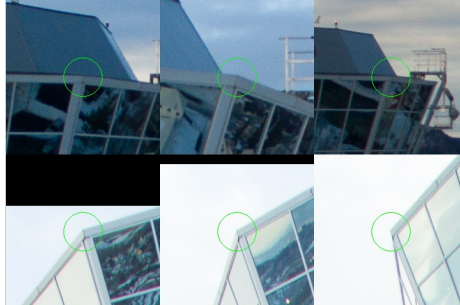
DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0036.jpg  
DJI\_0037.jpg  
DJI\_0057.jpg

GCP Name: GG8 (571486.438,7033453.505,188.511)







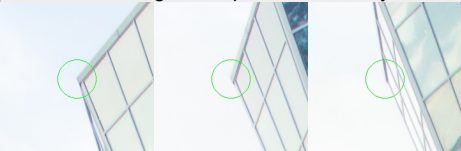
DJI\_0080.jpg  
DJI\_0099.jpg  
DJI\_0102.jpg  
DJI\_0104.jpg  
DJI\_0106.jpg  
DJI\_0127.jpg  
DJI\_0129.jpg  
DJI\_0156.jpg  
DJI\_0157.jpg

GCP GG8 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.




DJI\_0008.jpg  
DJI\_0009.jpg  
DJI\_0010.jpg  
DJI\_0055.jpg  
DJI\_0056.jpg  
DJI\_0057.jpg



|  |  |  |
|--|--|--|
| GCP Name: GG9 (571488.441,7033448.018,188.513)   |  |  |
|   |  |  |
|   |  | DJI_0008.jpg<br>DJI_0009.jpg<br>DJI_0010.jpg<br>DJI_0097.jpg<br>DJI_0098.jpg<br>DJI_0099.jpg<br>DJI_0102.jpg<br>DJI_0127.jpg<br>DJI_0156.jpg<br>DJI_0157.jpg<br>DJI_0158.jpg |
|   |  |  |
|   |  |  |
| GCP GG9 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy. |  |  |
|   |  | DJI_0055.jpg<br>DJI_0056.jpg<br>DJI_0057.jpg<br>DJI_0058.jpg<br>DJI_0059.jpg<br>DJI_0060.jpg   |
|    |  |  |

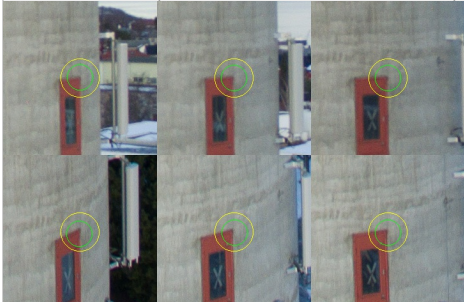
|   |  |  |
|---|--|--|
| GCP Name: GG10<br>(571487.391,7033442.273,188.515)                                  |  |  |
|  |  |  |
|  |  | DJI_0009.jpg<br>DJI_0098.jpg<br>DJI_0100.jpg<br>DJI_0122.jpg<br>DJI_0123.jpg<br>DJI_0124.jpg<br>DJI_0125.jpg<br>DJI_0127.jpg<br>DJI_0151.jpg<br>DJI_0152.jpg |
|  |  |  |
|  |  |  |

GCP GG10 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.




DJI\_0008.jpg  
DJI\_0010.jpg  
DJI\_0055.jpg  
DJI\_0056.jpg  
DJI\_0057.jpg  
DJI\_0058.jpg

GCP Name: FP3 (571480.431,7033445.764,137.649)



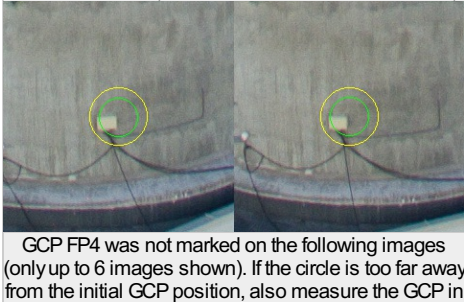
DJI\_0023.jpg  
DJI\_0024.jpg  
DJI\_0025.jpg  
DJI\_0045.jpg  
DJI\_0046.jpg  
DJI\_0047.jpg

GCP FP3 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.



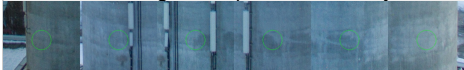
DJI\_0010.jpg  
DJI\_0012.jpg  
DJI\_0013.jpg  
DJI\_0014.jpg  
DJI\_0015.jpg  
DJI\_0016.jpg

GCP Name: FP4 (571479.211,7033444.150,125.022)



DJI\_0024.jpg  
DJI\_0025.jpg

GCP FP4 was not marked on the following images (only up to 6 images shown). If the circle is too far away from the initial GCP position, also measure the GCP in these images to improve the accuracy.



DJI\_0012.jpg  
DJI\_0013.jpg  
DJI\_0014.jpg  
DJI\_0015.jpg  
DJI\_0016.jpg  
DJI\_0017.jpg



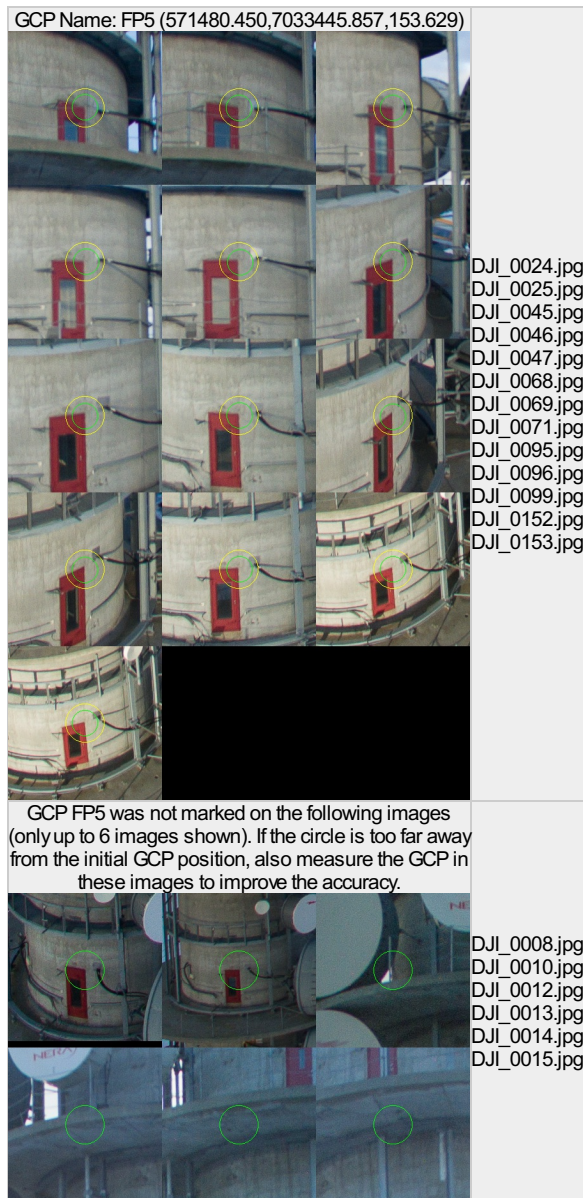


Figure 7: Images in which GCPs have been marked (yellow circle) and in which their computed 3D points have been projected (green circle). A green circle outside of the yellow circle indicates either an accuracy issue or a GCP issue.

## Processing Options



|  |  |
|--|--|
| Hardware                                     | CPU: Intel(R) Core(TM) i3 CPU M350 @2.27GHz<br>RAM: 8GB<br>GPU: Intel(R) HD Graphics (Driver: 8.771.1.0), ATI Mobility Radeon HD 5650 (Driver: 8.771.1.0), RDPDD Chained DD (Driver: unknown), RDP Encoder Mirror Driver (Driver: unknown), RDP Reflector Display Driver (Driver: unknown) |
| Operating System                             | Windows 7 Professional, 64-bit   |
| Camera Model Name                            | FC300X_20.7mm_3.6_3992x2992(2014031100) (RGB)  |
| Image Coordinate System                      | WGS84 (egm96)  |
| Ground Control Point (GCP) Coordinate System | WGS84 / UTMzone 32N  |
| Output Coordinate System                     | WGS84 / UTMzone 32N  |
| 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: yes   |

Point Cloud Densification details

Processing Options

|  |  |
|--|--|
| Image Scale                                | multiscale, 1/2 (Half image size, Default)                         |
| Point Density                              | Optimal  |
| Minimum Number of Matches                  | 4  |
| 3D Textured Mesh Generation                | yes, Maximum Number of Triangles: 1000000, Texture Size: 8192x8192 |
| Advanced: Matching Window Size             | 9x9 pixels   |
| Advanced: Image Groups                     | group1   |
| Advanced: Use Densification Area           | yes  |
| Advanced: Use Annotations                  | yes  |
| Advanced: Limit Camera Depth Automatically | yes  |
| Time for Point Cloud Densification         | 58m:26s  |
| Time for 3D Textured Mesh Generation       | 31m:06s  |

Results

|                                       |         |
|---------------------------------------|---------|
| Number of Generated Tiles             | 1       |
| Number of 3D Densified Points         | 1887780 |
| Average Density (per m <sup>3</sup> ) | 29.61   |