

# 20190810\_BearTrap\_RockPile01

Processing Report

01 November 2021



# Survey Data

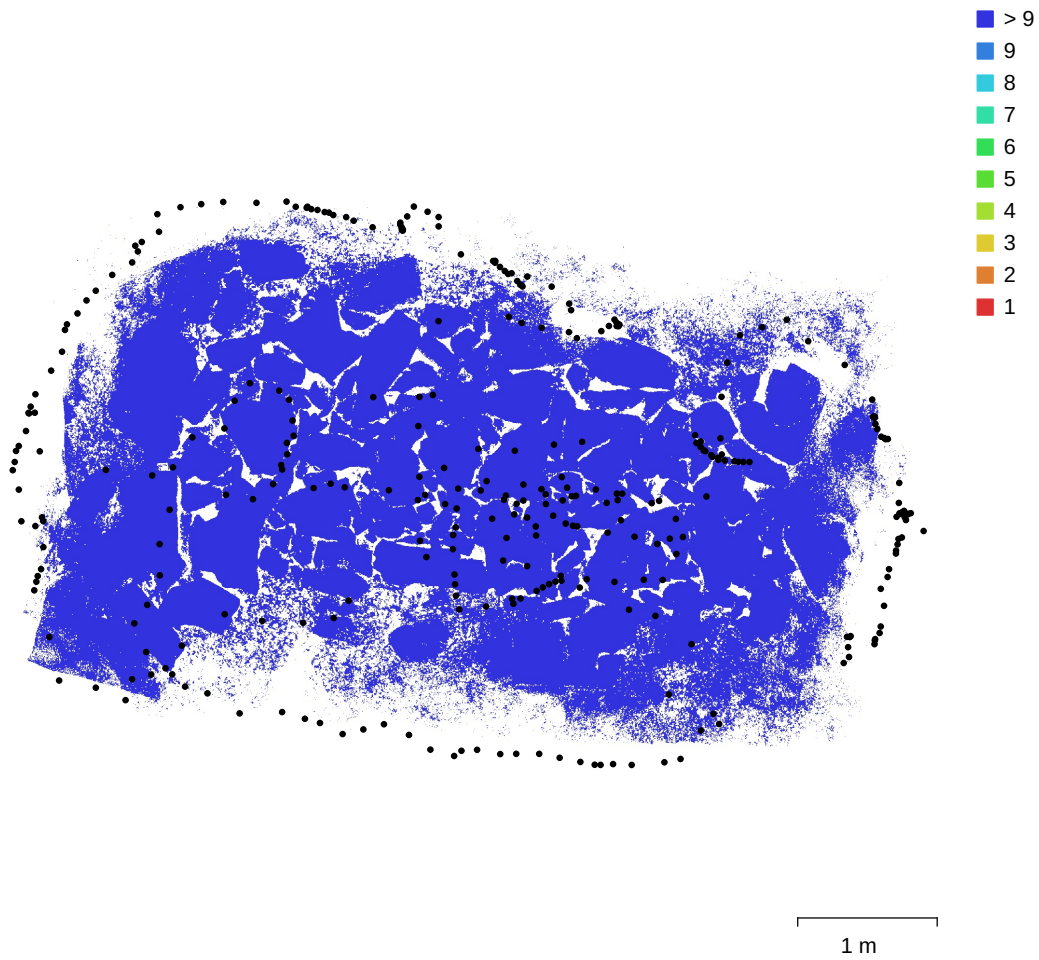


Fig. 1. Camera locations and image overlap.

|                    |                   |                     |           |
|--------------------|-------------------|---------------------|-----------|
| Number of images:  | 326               | Camera stations:    | 326       |
| Flying altitude:   | 1.45 m            | Tie points:         | 359,892   |
| Ground resolution: | 0.347 mm/pix      | Projections:        | 844,673   |
| Coverage area:     | 14 m <sup>2</sup> | Reprojection error: | 0.416 pix |

| Camera Model     | Resolution  | Focal Length | Pixel Size    | Precalibrated |
|------------------|-------------|--------------|---------------|---------------|
| ILCE-5100 (16mm) | 6000 x 4000 | 16 mm        | 4 x 4 $\mu$ m | No            |

Table 1. Cameras.

# Camera Calibration

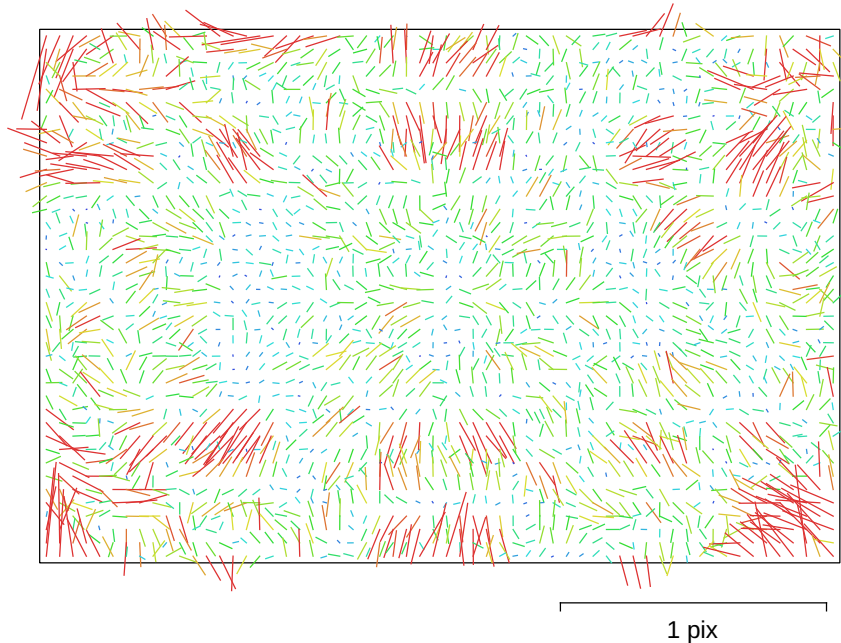


Fig. 2. Image residuals for ILCE-5100 (16mm).

## ILCE-5100 (16mm)

326 images

|       |                    |              |                 |
|-------|--------------------|--------------|-----------------|
| Type  | Resolution         | Focal Length | Pixel Size      |
| Frame | <b>6000 x 4000</b> | <b>16 mm</b> | <b>4 x 4 μm</b> |

|           | Value               | Error   | F    | Cx    | Cy    | B1    | B2    | K1    | K2    | K3    | K4    | P1    | P2    |
|-----------|---------------------|---------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <b>F</b>  | <b>4012.96</b>      | 0.5     | 1.00 | -0.01 | -0.13 | -0.33 | -0.01 | -0.98 | 0.96  | -0.92 | 0.87  | -0.01 | -0.09 |
| <b>Cx</b> | <b>-23.7731</b>     | 0.22    |      | 1.00  | 0.06  | -0.06 | -0.55 | 0.01  | -0.01 | 0.01  | -0.02 | 0.98  | 0.05  |
| <b>Cy</b> | <b>-82.5538</b>     | 0.16    |      |       | 1.00  | 0.33  | -0.07 | 0.08  | -0.08 | 0.08  | -0.08 | 0.06  | 0.93  |
| <b>B1</b> | <b>0.0564135</b>    | 0.038   |      |       |       | 1.00  | 0.02  | 0.33  | -0.33 | 0.30  | -0.27 | -0.05 | 0.39  |
| <b>B2</b> | <b>-0.437945</b>    | 0.028   |      |       |       |       | 1.00  | 0.00  | -0.00 | 0.00  | -0.00 | -0.60 | -0.09 |
| <b>K1</b> | <b>-0.037578</b>    | 0.001   |      |       |       |       |       | 1.00  | -0.99 | 0.97  | -0.93 | 0.01  | 0.06  |
| <b>K2</b> | <b>0.0359377</b>    | 0.003   |      |       |       |       |       |       | 1.00  | -0.99 | 0.97  | -0.01 | -0.06 |
| <b>K3</b> | <b>-0.0229201</b>   | 0.004   |      |       |       |       |       |       |       | 1.00  | -0.99 | 0.02  | 0.06  |
| <b>K4</b> | <b>0.0127333</b>    | 0.0019  |      |       |       |       |       |       |       |       | 1.00  | -0.02 | -0.07 |
| <b>P1</b> | <b>-0.000996784</b> | 2.9e-05 |      |       |       |       |       |       |       |       |       | 1.00  | 0.06  |
| <b>P2</b> | <b>-0.00661405</b>  | 2e-05   |      |       |       |       |       |       |       |       |       |       | 1.00  |

Table 2. Calibration coefficients and correlation matrix.

# Ground Control Points

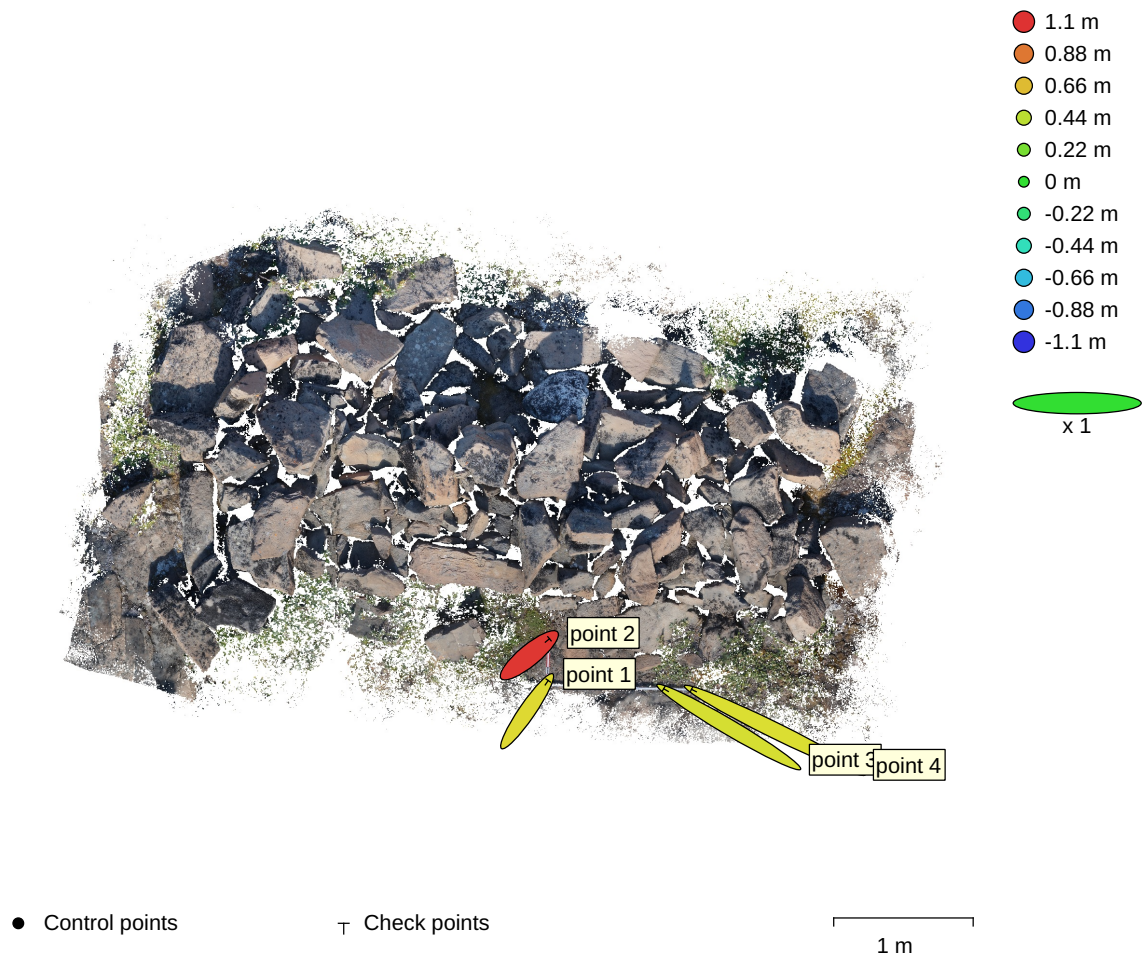


Fig. 3. GCP locations and error estimates.

Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.  
 Estimated GCP locations are marked with a dot or crossing.

| Count | X error (m) | Y error (m) | Z error (m) | XY error (m) | Total (m) |
|-------|-------------|-------------|-------------|--------------|-----------|
| 4     | 0.785951    | 0.473428    | 0.7176      | 0.917526     | 1.16482   |

Table 3. Check points RMSE.

| <b>Label</b> | <b>X error (m)</b> | <b>Y error (m)</b> | <b>Z error (m)</b> | <b>Total (m)</b> | <b>Image (pix)</b> |
|--------------|--------------------|--------------------|--------------------|------------------|--------------------|
| point 1      | 0.302256           | 0.439973           | 0.565811           | 0.777867         | 1.371 (49)         |
| point 2      | 0.288516           | 0.236777           | 1.0841             | 1.14655          | 1.368 (53)         |
| point 3      | -0.933136          | 0.548701           | 0.522004           | 1.20179          | 1.115 (67)         |
| point 4      | -1.19396           | 0.588069           | 0.540263           | 1.4364           | 1.067 (37)         |
| <b>Total</b> | <b>0.785951</b>    | <b>0.473428</b>    | <b>0.7176</b>      | <b>1.16482</b>   | <b>1.240</b>       |

Table 4. Check points.

# Scale Bars

| <b>Label</b>    | <b>Distance (m)</b> | <b>Error (m)</b>  |
|-----------------|---------------------|-------------------|
| point 1_point 2 | 0.299465            | -0.000534706      |
| point 3_point 4 | 0.200797            | 0.000797451       |
| <b>Total</b>    |                     | <b>0.00067891</b> |

Table 5. Control scale bars.

# Digital Elevation Model

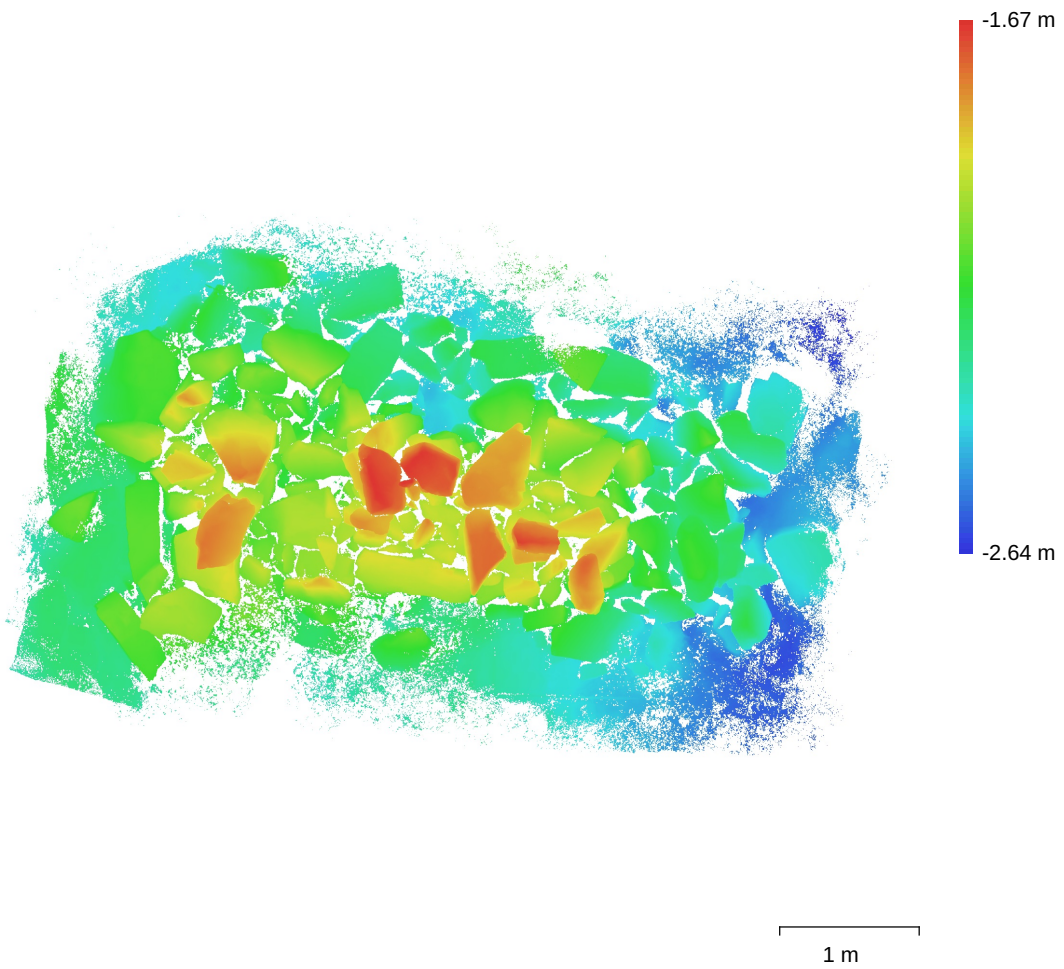


Fig. 4. Reconstructed digital elevation model.

Resolution: 0.695 mm/pix  
Point density: 2.07 points/mm<sup>2</sup>

# Processing Parameters

## General

|                   |                       |
|-------------------|-----------------------|
| Cameras           | 326                   |
| Aligned cameras   | 326                   |
| Markers           | 4                     |
| Scale bars        | 2                     |
| Coordinate system | Local Coordinates (m) |
| Rotation angles   | Yaw, Pitch, Roll      |

## Point Cloud

|                                |                        |
|--------------------------------|------------------------|
| Points                         | 359,892 of 2,752,665   |
| RMS reprojection error         | 0.143904 (0.41637 pix) |
| Max reprojection error         | 2.19058 (7.73811 pix)  |
| Mean key point size            | 2.8181 pix             |
| Point colors                   | 3 bands, uint8         |
| Key points                     | No                     |
| Average tie point multiplicity | 7.29489                |

## Alignment parameters

|                               |                       |
|-------------------------------|-----------------------|
| Accuracy                      | High                  |
| Generic preselection          | No                    |
| Reference preselection        | No                    |
| Key point limit               | 0                     |
| Tie point limit               | 60,000                |
| Exclude stationary tie points | No                    |
| Guided image matching         | No                    |
| Adaptive camera model fitting | No                    |
| Matching time                 | 20 hours 14 minutes   |
| Matching memory usage         | 5.76 GB               |
| Alignment time                | 30 minutes 40 seconds |
| Alignment memory usage        | 2.17 GB               |

## Optimization parameters

|                               |                                  |
|-------------------------------|----------------------------------|
| Parameters                    | f, b1, b2, cx, cy, k1-k4, p1, p2 |
| Fit additional corrections    | Yes                              |
| Adaptive camera model fitting | No                               |
| Optimization time             | 28 seconds                       |
| Software version              | 1.7.1.11797                      |
| File size                     | 322.56 MB                        |

## Depth Maps

|       |     |
|-------|-----|
| Count | 306 |
|-------|-----|

## Depth maps generation parameters

|                  |                    |
|------------------|--------------------|
| Quality          | High               |
| Filtering mode   | Aggressive         |
| Processing time  | 1 hours 15 minutes |
| Memory usage     | 9.61 GB            |
| Software version | 1.7.1.11797        |
| File size        | 1.99 GB            |

## Dense Point Cloud

|              |                |
|--------------|----------------|
| Points       | 49,937,303     |
| Point colors | 3 bands, uint8 |

## Depth maps generation parameters

|                 |                    |
|-----------------|--------------------|
| Quality         | High               |
| Filtering mode  | Aggressive         |
| Processing time | 1 hours 15 minutes |



|  |  |
|--|--|
| Memory usage                             | 9.61 GB                                  |
| <b>Dense cloud generation parameters</b> |  |
| Processing time                          | 1 hours 17 minutes                       |
| Memory usage                             | 21.55 GB                                 |
| Software version                         | 1.7.1.11797                              |
| File size                                | 1.82 GB                                  |
| <b>Model</b>                             |  |
| Faces                                    | 11,533,647                               |
| Vertices                                 | 5,768,243                                |
| Vertex colors                            | 3 bands, uint8                           |
| Texture                                  | 4,096 x 4,096, 4 bands, uint8            |
| <b>Depth maps generation parameters</b>  |  |
| Quality                                  | High                                     |
| Filtering mode                           | Aggressive                               |
| Processing time                          | 1 hours 15 minutes                       |
| Memory usage                             | 9.61 GB                                  |
| <b>Reconstruction parameters</b>         |  |
| Surface type                             | Arbitrary                                |
| Source data                              | Depth maps                               |
| Interpolation                            | Enabled                                  |
| Strict volumetric masks                  | No                                       |
| Processing time                          | 41 minutes 46 seconds                    |
| Memory usage                             | 9.26 GB                                  |
| <b>Texturing parameters</b>              |  |
| Mapping mode                             | Generic                                  |
| Blending mode                            | Mosaic                                   |
| Texture size                             | 4,096                                    |
| Enable hole filling                      | Yes                                      |
| Enable ghosting filter                   | Yes                                      |
| UV mapping time                          | 3 minutes 9 seconds                      |
| UV mapping memory usage                  | 4.55 GB                                  |
| Blending time                            | 23 minutes 34 seconds                    |
| Blending memory usage                    | 4.64 GB                                  |
| Software version                         | 1.7.1.11797                              |
| File size                                | 518.11 MB                                |
| <b>DEM</b>                               |  |
| Size                                     | 10,360 x 6,159                           |
| Coordinate system                        | Local Coordinates (m)                    |
| <b>Reconstruction parameters</b>         |  |
| Source data                              | Dense cloud                              |
| Interpolation                            | Disabled                                 |
| Processing time                          | 12 seconds                               |
| Memory usage                             | 172.57 MB                                |
| Software version                         | 1.7.1.11797                              |
| File size                                | 118.30 MB                                |
| <b>System</b>                            |  |
| Software name                            | Agisoft Metashape Professional           |
| Software version                         | 1.7.1 build 11797                        |
| OS                                       | Linux 64 bit                             |
| RAM                                      | 125.62 GB                                |
| CPU                                      | Intel(R) Core(TM) i7-9800X CPU @ 3.80GHz |
| GPU(s)                                   | Quadro P1000                             |