

# Agisoft Metashape

Processing Report

24 August 2023



# Survey Data

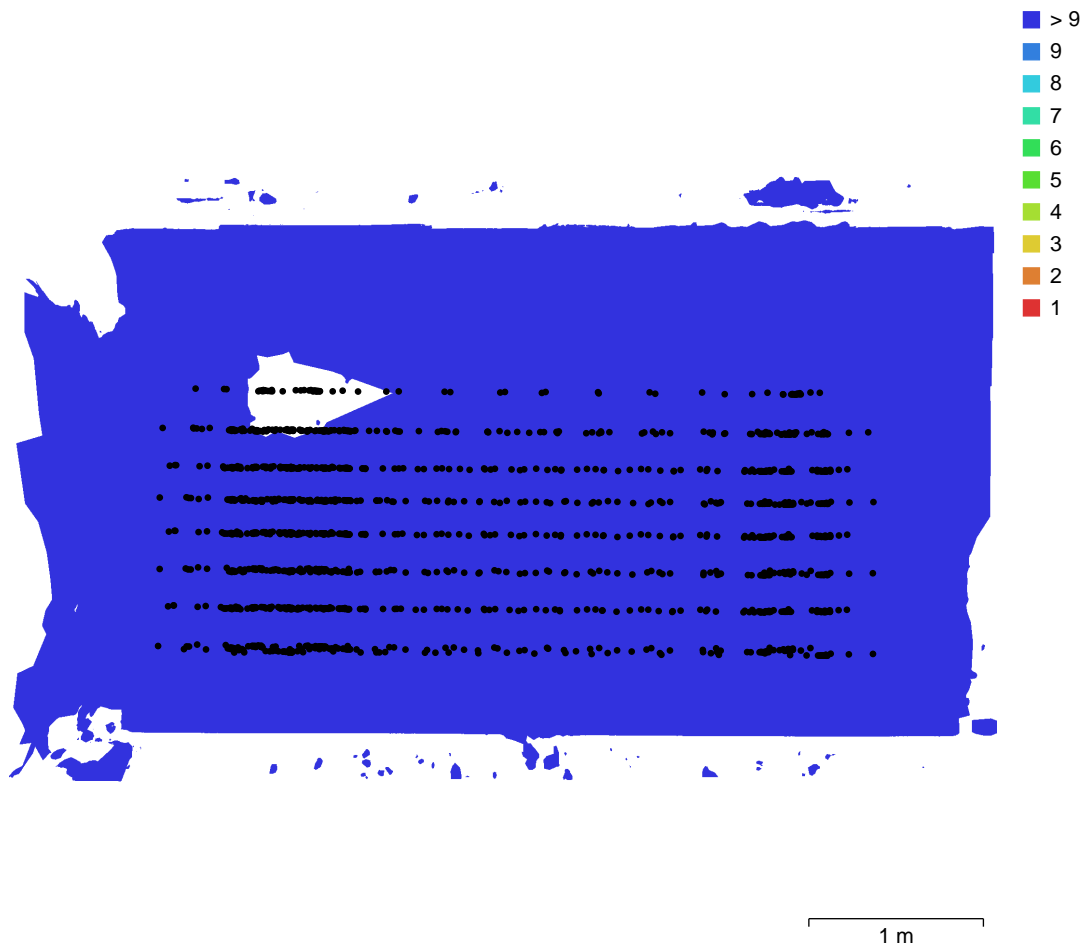


Fig. 1. Camera locations and image overlap.

Number of images:	1,474	Camera stations:	1,474
Flying altitude:	95.8 cm	Tie points:	1,324,566
Ground resolution:	0.458 mm/pix	Projections:	3,702,611
Coverage area:	15.6 m <sup>2</sup>	Reprojection error:	1.02 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Camera 0	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 1	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 2	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 3	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 4	5784 x 8660	12 mm	4.17 x 4.17 um	No

<b>Camera Model</b>	<b>Resolution</b>	<b>Focal Length</b>	<b>Pixel Size</b>	<b>Precalibrated</b>
Camera 5	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 6	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 7	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 8	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 9	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 10	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 11	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 12	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 13	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 14	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 15	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 16	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 17	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 18	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 19	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 20	5784 x 8660	12 mm	4.17 x 4.17 um	No
Camera 21	5784 x 8660	12 mm	4.17 x 4.17 um	No

Table 1. Cameras.

# Camera Calibration

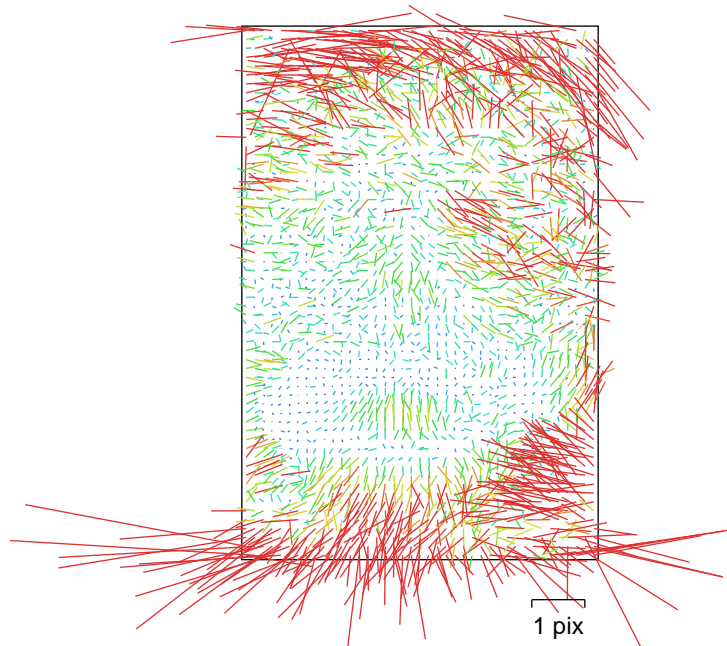


Fig. 2. Image residuals for Camera 0.

## Camera 0

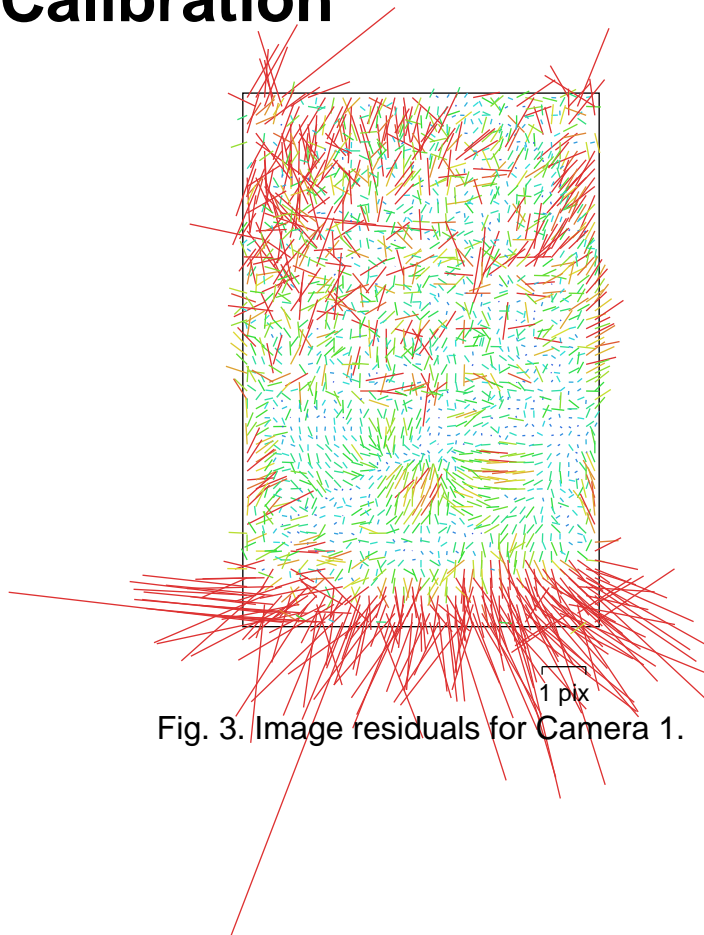
67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2982.43</b>	0.039	1.00	-0.02	-0.04	-0.86	0.79	-0.69	-0.09	0.16
<b>Cx</b>	<b>-15.4499</b>	0.043		1.00	-0.15	0.04	-0.02	0.02	0.82	-0.14
<b>Cy</b>	<b>-16.2959</b>	0.056			1.00	-0.01	-0.03	0.04	-0.15	0.82
<b>K1</b>	<b>-0.0294785</b>	3.6e-05				1.00	-0.96	0.89	0.11	-0.10
<b>K2</b>	<b>0.00518941</b>	3.2e-05					1.00	-0.98	-0.06	0.05
<b>K3</b>	<b>0.000183712</b>	8.4e-06						1.00	0.05	-0.03
<b>P1</b>	<b>0.000352166</b>	4.4e-06							1.00	-0.14
<b>P2</b>	<b>-0.000461182</b>	6e-06								1.00

Table 2. Calibration coefficients and correlation matrix.

# Camera Calibration



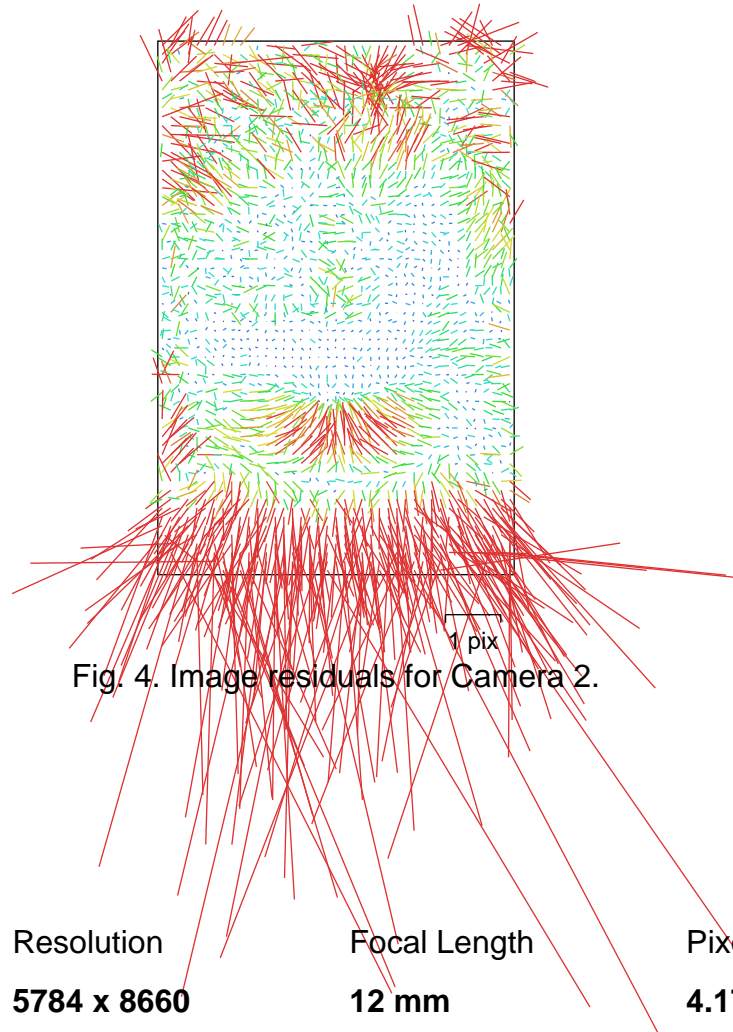
**Camera 1**  
67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2985.45</b>	0.053	1.00	0.01	0.05	-0.87	0.81	-0.72	0.02	0.33
<b>Cx</b>	<b>7.58043</b>	0.049		1.00	-0.07	-0.01	0.03	-0.04	0.84	-0.04
<b>Cy</b>	<b>26.3142</b>	0.067			1.00	-0.18	0.09	-0.08	-0.05	0.79
<b>K1</b>	<b>-0.0271986</b>	4.8e-05				1.00	-0.96	0.90	-0.02	-0.30
<b>K2</b>	<b>0.00317149</b>	4.1e-05					1.00	-0.98	0.02	0.22
<b>K3</b>	<b>0.000826579</b>	1e-05						1.00	-0.02	-0.18
<b>P1</b>	<b>-0.000655442</b>	5.5e-06							1.00	-0.01
<b>P2</b>	<b>-0.000490849</b>	6.8e-06								1.00

Table 3. Calibration coefficients and correlation matrix.

# Camera Calibration



**Camera 2**  
67 images

Type

Frame

Resolution

**5784 x 8660**

Focal Length

**12 mm**

Pixel Size

**4.17 x 4.17 um**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2985.59</b>	0.033	1.00	-0.01	-0.10	-0.74	0.71	-0.64	0.02	0.12
<b>Cx</b>	<b>-16.4572</b>	0.038		1.00	0.05	-0.00	0.01	-0.01	0.84	0.05
<b>Cy</b>	<b>51.4592</b>	0.05			1.00	-0.12	0.06	-0.07	0.03	0.83
<b>K1</b>	<b>-0.0285987</b>	3.2e-05				1.00	-0.96	0.89	-0.02	-0.12
<b>K2</b>	<b>0.00286277</b>	3.1e-05					1.00	-0.98	0.01	0.09
<b>K3</b>	<b>0.00108561</b>	8.3e-06						1.00	-0.01	-0.08
<b>P1</b>	<b>-0.000906609</b>	3.8e-06							1.00	0.04
<b>P2</b>	<b>-0.000279149</b>	4.9e-06								1.00

Table 4. Calibration coefficients and correlation matrix.

# Camera Calibration

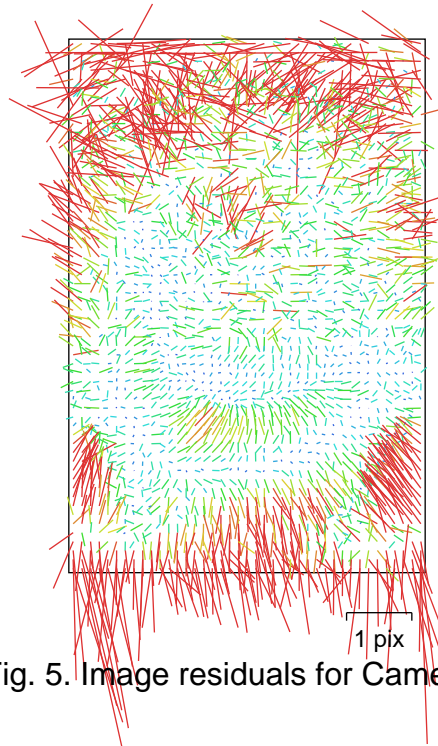


Fig. 5. Image residuals for Camera 3.

## Camera 3

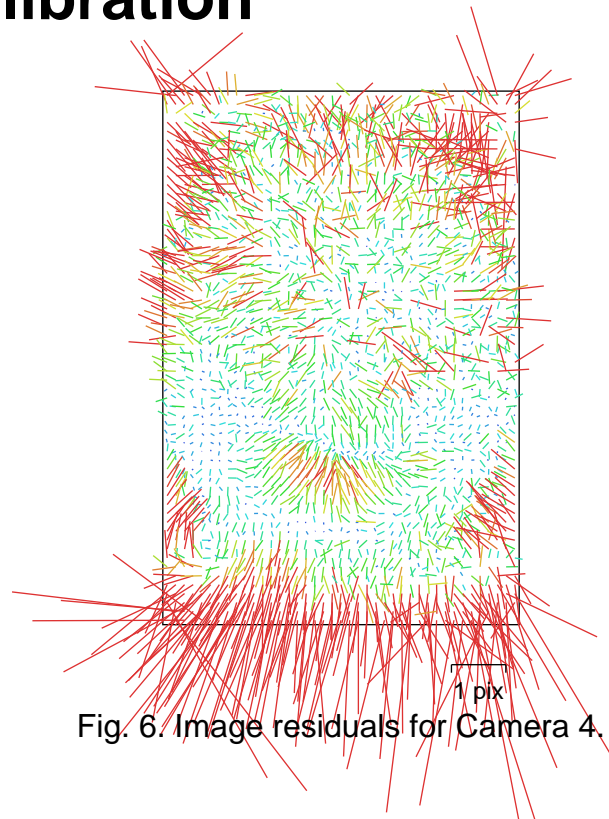
67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>3000.17</b>	0.029	1.00	-0.02	-0.11	-0.76	0.72	-0.65	-0.01	0.12
<b>Cx</b>	<b>-11.1767</b>	0.034		1.00	-0.03	0.01	-0.00	-0.00	0.87	-0.03
<b>Cy</b>	<b>-20.7533</b>	0.047			1.00	-0.02	-0.03	0.04	-0.02	0.86
<b>K1</b>	<b>-0.030224</b>	2.4e-05				1.00	-0.96	0.90	-0.03	-0.08
<b>K2</b>	<b>0.00646623</b>	2.1e-05					1.00	-0.98	0.02	0.03
<b>K3</b>	<b>-5.86791e-05</b>	5.3e-06						1.00	-0.02	-0.01
<b>P1</b>	<b>0.000362253</b>	3.4e-06							1.00	-0.02
<b>P2</b>	<b>-0.000376861</b>	4.6e-06								1.00

Table 5. Calibration coefficients and correlation matrix.

# Camera Calibration



**Camera 4**  
67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2996.9</b>	0.033	1.00	0.00	-0.06	-0.79	0.75	-0.65	-0.04	0.22
<b>Cx</b>	<b>-6.65455</b>	0.036		1.00	-0.03	-0.01	0.01	-0.01	0.86	-0.01
<b>Cy</b>	<b>-3.60745</b>	0.053			1.00	-0.15	0.07	-0.07	-0.02	0.84
<b>K1</b>	<b>-0.0277556</b>	2.9e-05				1.00	-0.96	0.89	0.03	-0.24
<b>K2</b>	<b>0.00458337</b>	2.5e-05					1.00	-0.98	-0.01	0.15
<b>K3</b>	<b>0.000485569</b>	6.5e-06						1.00	0.01	-0.11
<b>P1</b>	<b>0.000720612</b>	3.8e-06							1.00	-0.03
<b>P2</b>	<b>-0.000338566</b>	4.9e-06								1.00

Table 6. Calibration coefficients and correlation matrix.



# Camera Calibration

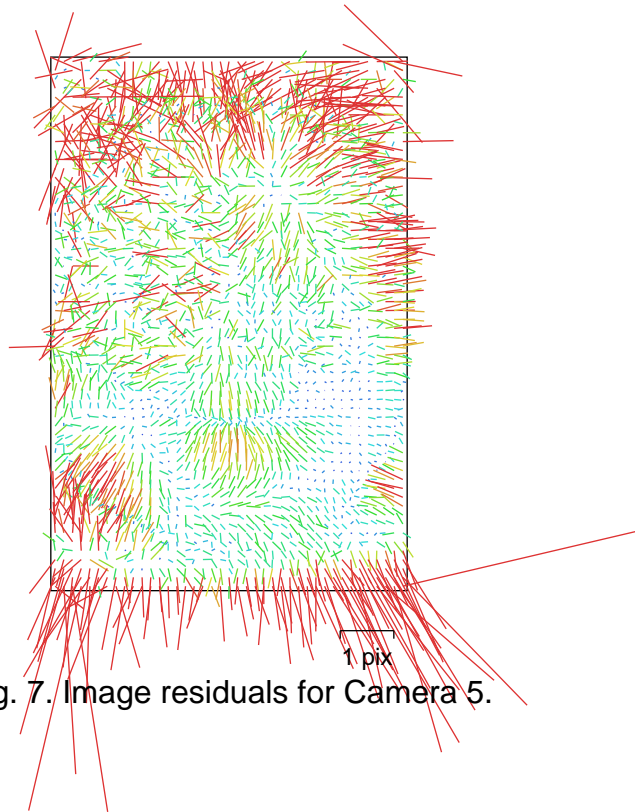


Fig. 7. Image residuals for Camera 5.

## Camera 5

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2984.18</b>	0.028	1.00	0.02	-0.01	-0.83	0.77	-0.69	0.09	0.23
<b>Cx</b>	<b>27.793</b>	0.032		1.00	0.08	-0.08	0.04	-0.03	0.84	0.05
<b>Cy</b>	<b>50.9631</b>	0.044			1.00	-0.10	0.05	-0.04	0.08	0.85
<b>K1</b>	<b>-0.0303566</b>	2.4e-05				1.00	-0.96	0.90	-0.13	-0.20
<b>K2</b>	<b>0.00616875</b>	2e-05					1.00	-0.98	0.07	0.13
<b>K3</b>	<b>8.40237e-05</b>	5.1e-06						1.00	-0.06	-0.10
<b>P1</b>	<b>-0.000857949</b>	3.2e-06							1.00	0.08
<b>P2</b>	<b>0.000152726</b>	4.3e-06								1.00

Table 7. Calibration coefficients and correlation matrix.

# Camera Calibration

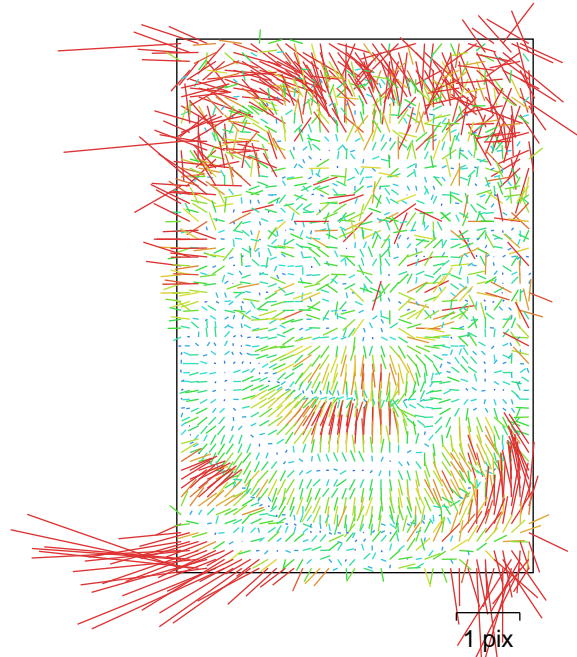


Fig. 8. Image residuals for Camera 6.

## Camera 6

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2982.57</b>	0.024	1.00	0.02	-0.17	-0.74	0.71	-0.62	-0.03	0.11
<b>Cx</b>	<b>-24.0861</b>	0.03		1.00	-0.12	0.04	-0.00	0.01	0.86	-0.09
<b>Cy</b>	<b>-15.0606</b>	0.042			1.00	-0.11	0.01	0.00	-0.11	0.85
<b>K1</b>	<b>-0.0308897</b>	1.9e-05				1.00	-0.95	0.89	0.04	-0.20
<b>K2</b>	<b>0.00610245</b>	1.6e-05					1.00	-0.98	0.00	0.08
<b>K3</b>	<b>0.000132783</b>	4.1e-06						1.00	-0.00	-0.04
<b>P1</b>	<b>0.000287853</b>	2.9e-06							1.00	-0.11
<b>P2</b>	<b>0.000276302</b>	3.7e-06								1.00

Table 8. Calibration coefficients and correlation matrix.

# Camera Calibration

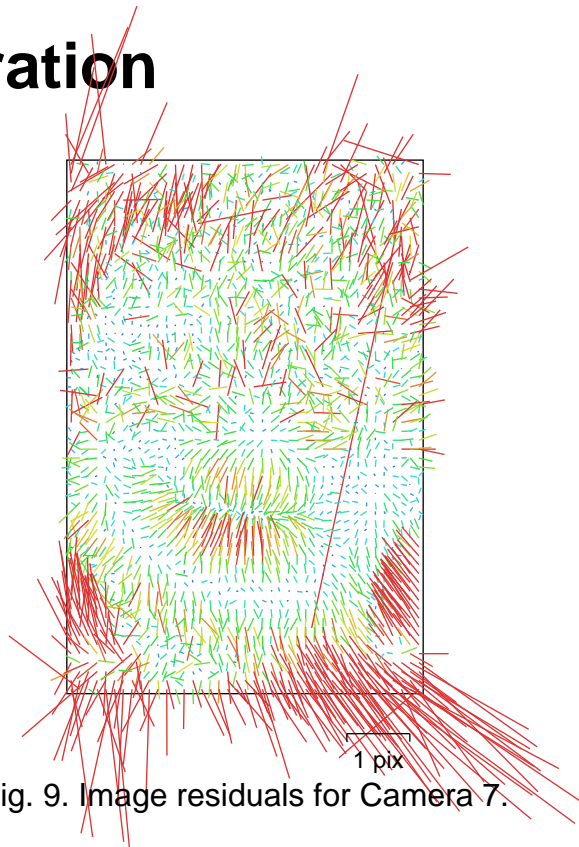


Fig. 9. Image residuals for Camera 7.

## Camera 7

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2990.79</b>	0.032	1.00	0.04	-0.29	-0.64	0.62	-0.53	0.04	0.08
<b>Cx</b>	<b>19.8086</b>	0.039		1.00	0.03	-0.01	0.01	-0.02	0.88	0.05
<b>Cy</b>	<b>21.9035</b>	0.054			1.00	-0.16	0.06	-0.05	0.03	0.79
<b>K1</b>	<b>-0.0297135</b>	2.6e-05				1.00	-0.95	0.89	-0.01	-0.24
<b>K2</b>	<b>0.00576689</b>	2.3e-05					1.00	-0.98	-0.00	0.13
<b>K3</b>	<b>0.000214044</b>	6.1e-06						1.00	-0.01	-0.09
<b>P1</b>	<b>-0.00029078</b>	3.9e-06							1.00	0.05
<b>P2</b>	<b>0.000230832</b>	4.3e-06								1.00

Table 9. Calibration coefficients and correlation matrix.

# Camera Calibration

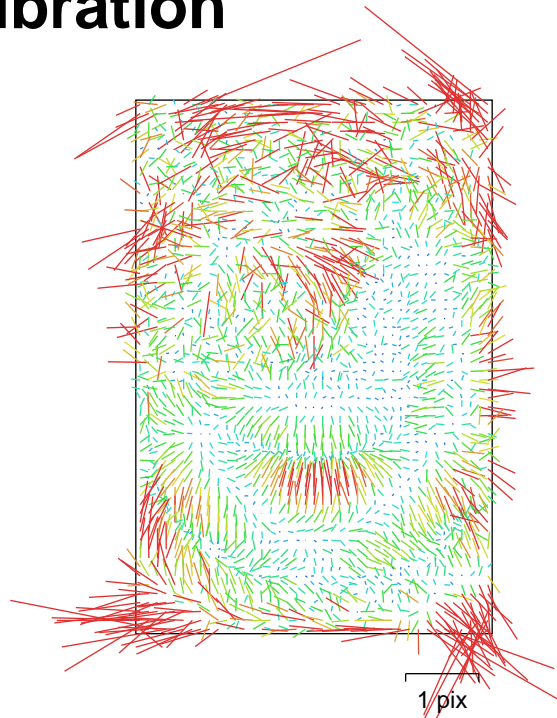


Fig. 10. Image residuals for Camera 8.

## Camera 8

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2982.17</b>	0.023	1.00	-0.03	-0.11	-0.65	0.62	-0.55	0.01	0.09
<b>Cx</b>	<b>18.276</b>	0.028		1.00	-0.04	-0.02	0.00	0.00	0.83	-0.06
<b>Cy</b>	<b>21.0815</b>	0.037			1.00	-0.09	0.03	-0.01	-0.05	0.86
<b>K1</b>	<b>-0.0286874</b>	2.1e-05				1.00	-0.95	0.88	0.01	-0.14
<b>K2</b>	<b>0.00392966</b>	2e-05					1.00	-0.98	-0.01	0.05
<b>K3</b>	<b>0.000772442</b>	5.6e-06						1.00	0.00	-0.01
<b>P1</b>	<b>-0.00072458</b>	2.5e-06							1.00	-0.05
<b>P2</b>	<b>-0.000307177</b>	3.5e-06								1.00

Table 10. Calibration coefficients and correlation matrix.

# Camera Calibration

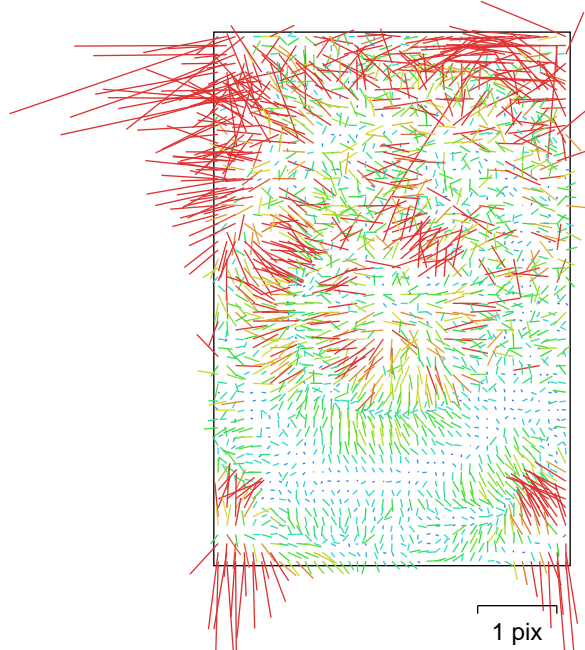


Fig. 11. Image residuals for Camera 9.

## Camera 9

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2979.51</b>	0.027	1.00	-0.01	-0.08	-0.78	0.76	-0.69	-0.01	0.12
<b>Cx</b>	<b>-20.4857</b>	0.027		1.00	-0.00	0.03	-0.02	0.02	0.85	0.01
<b>Cy</b>	<b>-11.3173</b>	0.039			1.00	-0.03	0.01	0.00	0.03	0.84
<b>K1</b>	<b>-0.0352987</b>	1.8e-05				1.00	-0.96	0.91	0.00	-0.14
<b>K2</b>	<b>0.010007</b>	1.3e-05					1.00	-0.98	-0.01	0.07
<b>K3</b>	<b>-0.000784633</b>	2.8e-06						1.00	0.01	-0.04
<b>P1</b>	<b>0.00024283</b>	2.4e-06							1.00	0.04
<b>P2</b>	<b>-5.75863e-05</b>	3.6e-06								1.00

Table 11. Calibration coefficients and correlation matrix.

# Camera Calibration

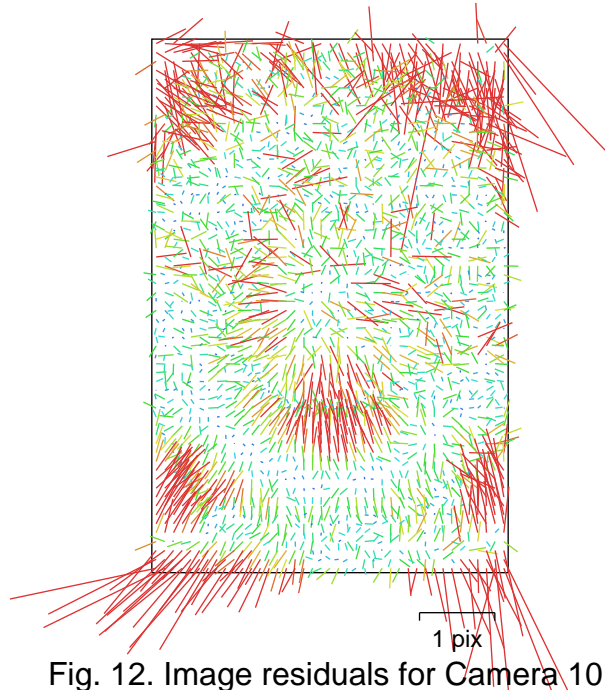


Fig. 12. Image residuals for Camera 10.

## Camera 10

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2990.57</b>	0.031	1.00	-0.02	-0.08	-0.81	0.78	-0.70	-0.06	0.10
<b>Cx</b>	<b>-9.93118</b>	0.036		1.00	-0.07	0.01	0.01	-0.02	0.89	-0.07
<b>Cy</b>	<b>-15.5926</b>	0.049			1.00	-0.09	-0.00	0.03	-0.08	0.88
<b>K1</b>	<b>-0.0312205</b>	2.4e-05				1.00	-0.96	0.90	0.05	-0.15
<b>K2</b>	<b>0.00791204</b>	1.9e-05					1.00	-0.98	-0.02	0.04
<b>K3</b>	<b>-0.000328743</b>	4.4e-06						1.00	0.00	-0.00
<b>P1</b>	<b>3.58671e-05</b>	3.7e-06							1.00	-0.09
<b>P2</b>	<b>-0.000485511</b>	4.8e-06								1.00

Table 12. Calibration coefficients and correlation matrix.

# Camera Calibration

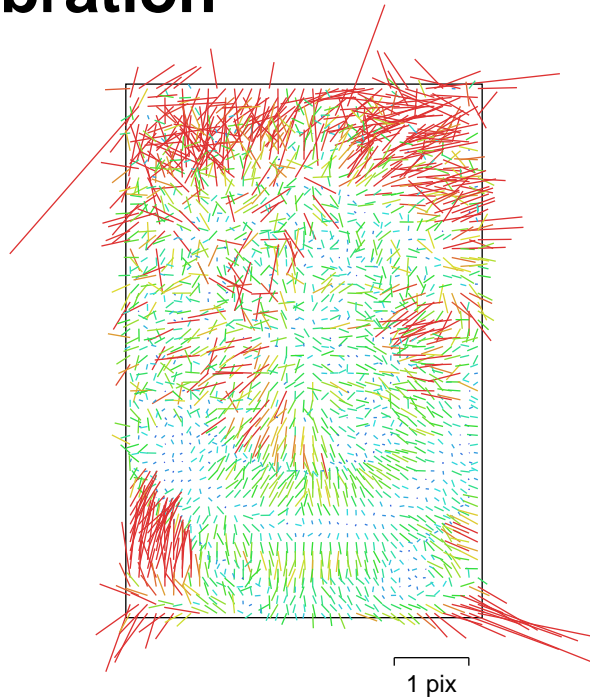


Fig. 13. Image residuals for Camera 11.

## Camera 11

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2990.81</b>	0.026	1.00	-0.01	-0.03	-0.85	0.80	-0.72	0.06	0.13
<b>Cx</b>	<b>21.1301</b>	0.028		1.00	0.06	-0.07	0.03	-0.03	0.84	0.07
<b>Cy</b>	<b>22.9852</b>	0.038			1.00	-0.04	0.01	0.00	0.07	0.83
<b>K1</b>	<b>-0.033631</b>	1.9e-05				1.00	-0.96	0.91	-0.11	-0.12
<b>K2</b>	<b>0.00887677</b>	1.4e-05					1.00	-0.98	0.05	0.04
<b>K3</b>	<b>-0.000507589</b>	3.3e-06						1.00	-0.04	-0.01
<b>P1</b>	<b>-0.000487354</b>	2.6e-06							1.00	0.11
<b>P2</b>	<b>-0.000339741</b>	3.4e-06								1.00

Table 13. Calibration coefficients and correlation matrix.

# Camera Calibration

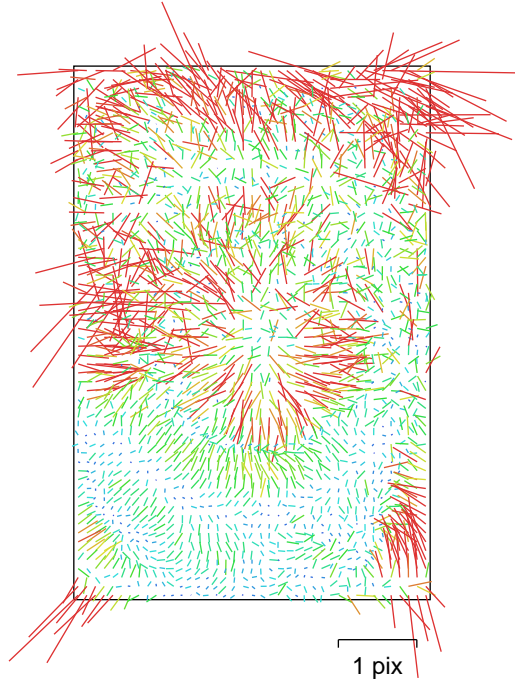


Fig. 14. Image residuals for Camera 12.

## Camera 12

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2984.25</b>	0.025	1.00	-0.00	-0.08	-0.80	0.79	-0.72	-0.01	0.08
<b>Cx</b>	<b>-16.4519</b>	0.031		1.00	-0.12	0.08	-0.03	0.01	0.88	-0.16
<b>Cy</b>	<b>-12.3808</b>	0.041			1.00	-0.10	0.04	-0.01	-0.14	0.84
<b>K1</b>	<b>-0.0350254</b>	1.7e-05				1.00	-0.95	0.90	0.07	-0.20
<b>K2</b>	<b>0.0103729</b>	1.1e-05					1.00	-0.98	-0.01	0.08
<b>K3</b>	<b>-0.000877765</b>	2.4e-06						1.00	-0.01	-0.03
<b>P1</b>	<b>0.000258602</b>	2.8e-06							1.00	-0.19
<b>P2</b>	<b>-0.000208361</b>	3.8e-06								1.00

Table 14. Calibration coefficients and correlation matrix.



# Camera Calibration

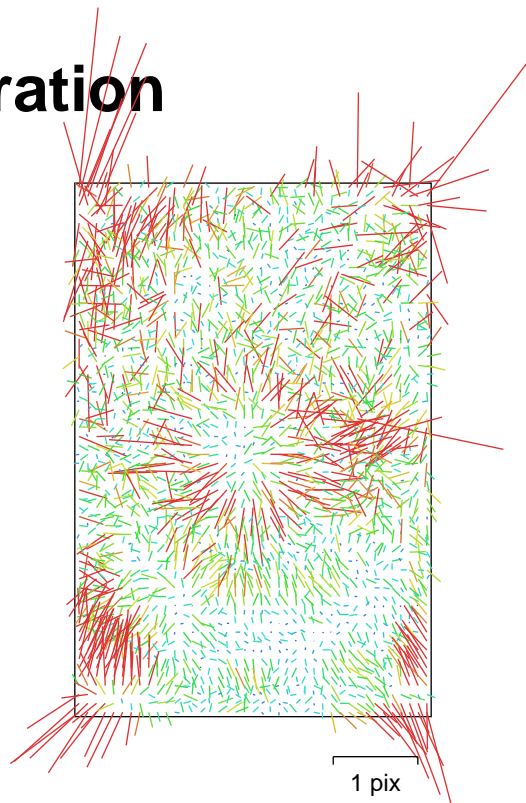


Fig. 15. Image residuals for Camera 13.

## Camera 13

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2976.77</b>	0.034	1.00	-0.01	-0.00	-0.84	0.81	-0.74	-0.01	0.11
<b>Cx</b>	<b>10.639</b>	0.04		1.00	0.05	-0.01	-0.02	0.01	0.89	0.06
<b>Cy</b>	<b>20.1919</b>	0.048			1.00	-0.12	0.05	-0.03	0.04	0.87
<b>K1</b>	<b>-0.033871</b>	2.6e-05				1.00	-0.96	0.91	-0.01	-0.17
<b>K2</b>	<b>0.00932291</b>	1.8e-05					1.00	-0.98	-0.02	0.06
<b>K3</b>	<b>-0.000626177</b>	4.1e-06						1.00	0.02	-0.03
<b>P1</b>	<b>-0.000113241</b>	4.2e-06							1.00	0.05
<b>P2</b>	<b>0.000103172</b>	5e-06								1.00

Table 15. Calibration coefficients and correlation matrix.

# Camera Calibration

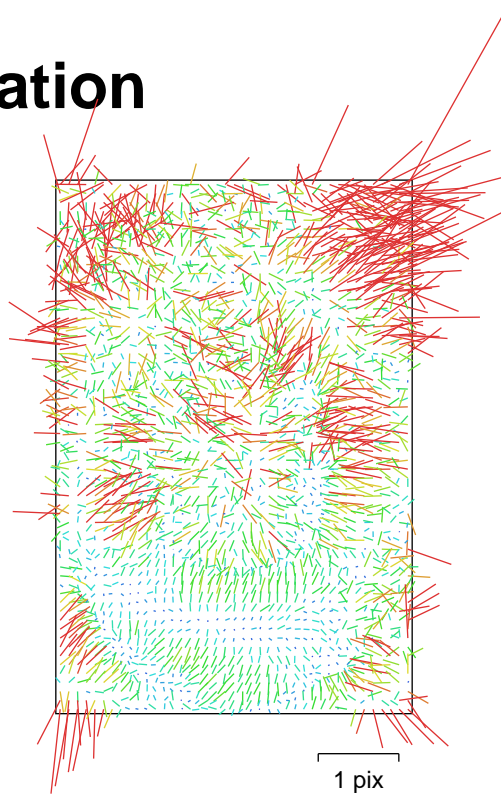


Fig. 16. Image residuals for Camera 14.

## Camera 14

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2991.17</b>	0.027	1.00	-0.01	0.02	-0.81	0.77	-0.69	0.01	0.17
<b>Cx</b>	<b>11.2284</b>	0.024		1.00	-0.06	-0.03	0.02	-0.02	0.81	-0.05
<b>Cy</b>	<b>43.0085</b>	0.036			1.00	-0.03	0.03	-0.02	-0.06	0.82
<b>K1</b>	<b>-0.0351654</b>	1.8e-05				1.00	-0.96	0.91	-0.03	-0.11
<b>K2</b>	<b>0.0102348</b>	1.3e-05					1.00	-0.98	0.03	0.05
<b>K3</b>	<b>-0.000775449</b>	3e-06						1.00	-0.03	-0.01
<b>P1</b>	<b>-0.000238308</b>	2.1e-06							1.00	-0.07
<b>P2</b>	<b>0.000235931</b>	3.3e-06								1.00

Table 16. Calibration coefficients and correlation matrix.

# Camera Calibration

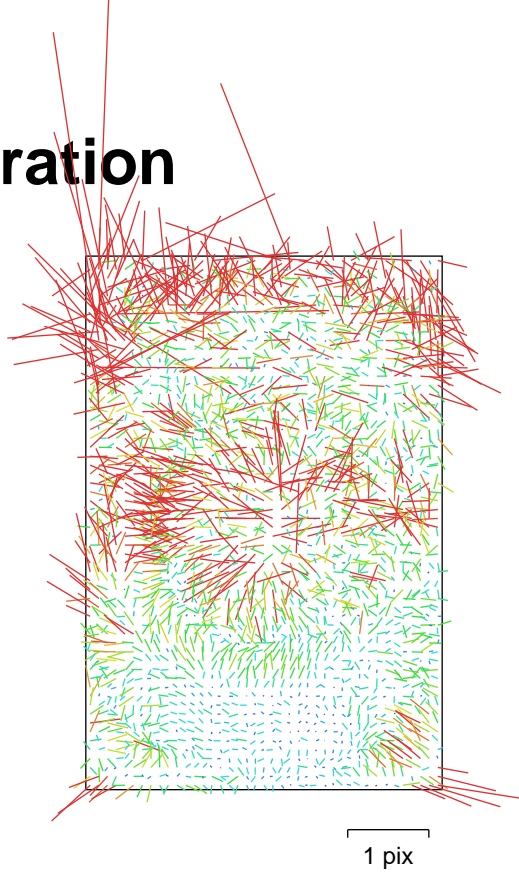


Fig. 17. Image residuals for Camera 15.

## Camera 15

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2989.94</b>	0.031	1.00	-0.01	-0.04	-0.78	0.76	-0.68	-0.01	0.10
<b>Cx</b>	<b>-6.22377</b>	0.031		1.00	-0.04	0.06	-0.04	0.03	0.87	-0.03
<b>Cy</b>	<b>-23.6326</b>	0.042			1.00	-0.03	0.02	0.01	-0.02	0.82
<b>K1</b>	<b>-0.0356354</b>	1.9e-05				1.00	-0.96	0.90	0.04	-0.13
<b>K2</b>	<b>0.0107441</b>	1.3e-05					1.00	-0.98	-0.03	0.03
<b>K3</b>	<b>-0.000916874</b>	2.9e-06						1.00	0.02	0.02
<b>P1</b>	<b>0.00062263</b>	2.7e-06							1.00	-0.01
<b>P2</b>	<b>-0.000223654</b>	3.9e-06								1.00

Table 17. Calibration coefficients and correlation matrix.

# Camera Calibration

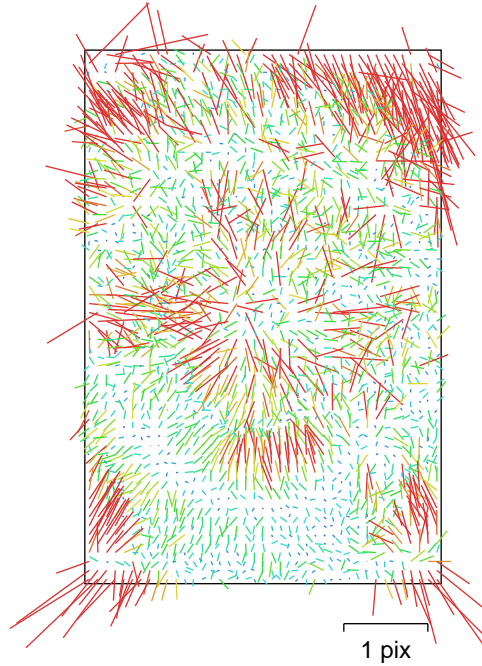


Fig. 18. Image residuals for Camera 16.

## Camera 16

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2978.27</b>	0.031	1.00	-0.03	-0.03	-0.82	0.79	-0.72	-0.05	0.09
<b>Cx</b>	<b>-6.80539</b>	0.04		1.00	-0.07	0.03	-0.00	-0.01	0.91	-0.11
<b>Cy</b>	<b>-13.7237</b>	0.046			1.00	-0.08	0.03	-0.01	-0.07	0.84
<b>K1</b>	<b>-0.0340929</b>	2.2e-05				1.00	-0.95	0.90	0.06	-0.16
<b>K2</b>	<b>0.00925649</b>	1.5e-05					1.00	-0.98	-0.02	0.04
<b>K3</b>	<b>-0.000641013</b>	3.3e-06						1.00	0.01	-0.01
<b>P1</b>	<b>0.000321053</b>	3.9e-06							1.00	-0.12
<b>P2</b>	<b>-0.000253926</b>	4.6e-06								1.00

Table 18. Calibration coefficients and correlation matrix.

# Camera Calibration

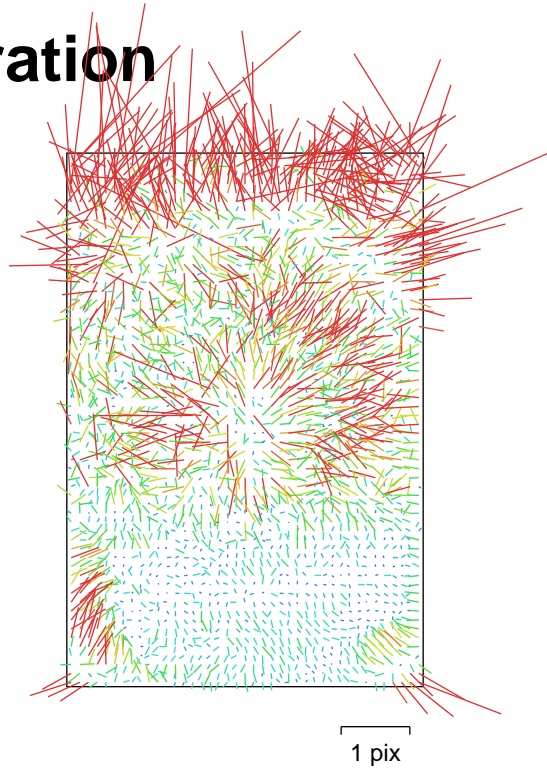


Fig. 19. Image residuals for Camera 17.

## Camera 17

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2988.94</b>	0.03	1.00	-0.00	0.03	-0.86	0.82	-0.75	0.05	0.10
<b>Cx</b>	<b>16.4585</b>	0.031		1.00	0.05	-0.09	0.04	-0.02	0.85	0.12
<b>Cy</b>	<b>36.4797</b>	0.038			1.00	-0.02	0.03	-0.01	0.07	0.77
<b>K1</b>	<b>-0.0361194</b>	2e-05				1.00	-0.96	0.91	-0.11	-0.06
<b>K2</b>	<b>0.0109837</b>	1.4e-05					1.00	-0.99	0.05	-0.01
<b>K3</b>	<b>-0.000929216</b>	2.9e-06						1.00	-0.03	0.05
<b>P1</b>	<b>-0.000118837</b>	2.9e-06							1.00	0.15
<b>P2</b>	<b>0.000159815</b>	3.5e-06								1.00

Table 19. Calibration coefficients and correlation matrix.

# Camera Calibration

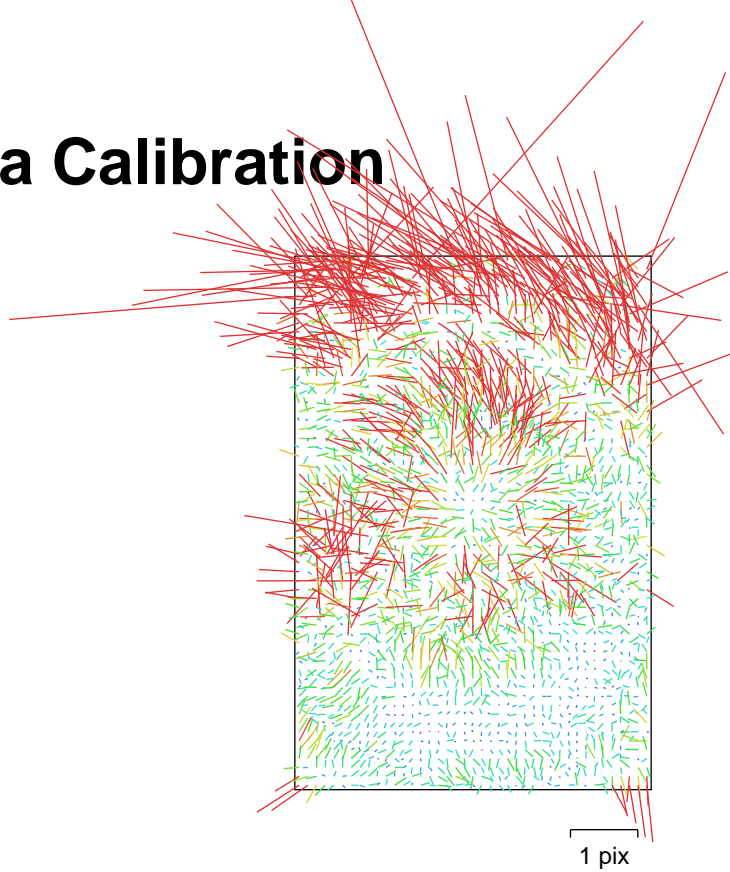


Fig. 20. Image residuals for Camera 18.

## Camera 18

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2988.65</b>	0.039	1.00	-0.02	0.06	-0.82	0.80	-0.74	0.01	-0.01
<b>Cx</b>	<b>-18.8817</b>	0.043		1.00	-0.05	0.05	-0.03	0.02	0.88	-0.06
<b>Cy</b>	<b>-27.4347</b>	0.042			1.00	0.03	0.04	-0.03	-0.08	0.66
<b>K1</b>	<b>-0.0365097</b>	2.5e-05				1.00	-0.95	0.91	0.02	0.01
<b>K2</b>	<b>0.0116019</b>	1.6e-05					1.00	-0.99	0.00	-0.09
<b>K3</b>	<b>-0.00107955</b>	3.1e-06						1.00	-0.01	0.11
<b>P1</b>	<b>8.0837e-05</b>	3.8e-06							1.00	-0.11
<b>P2</b>	<b>-0.000242528</b>	3.8e-06								1.00

Table 20. Calibration coefficients and correlation matrix.

# Camera Calibration

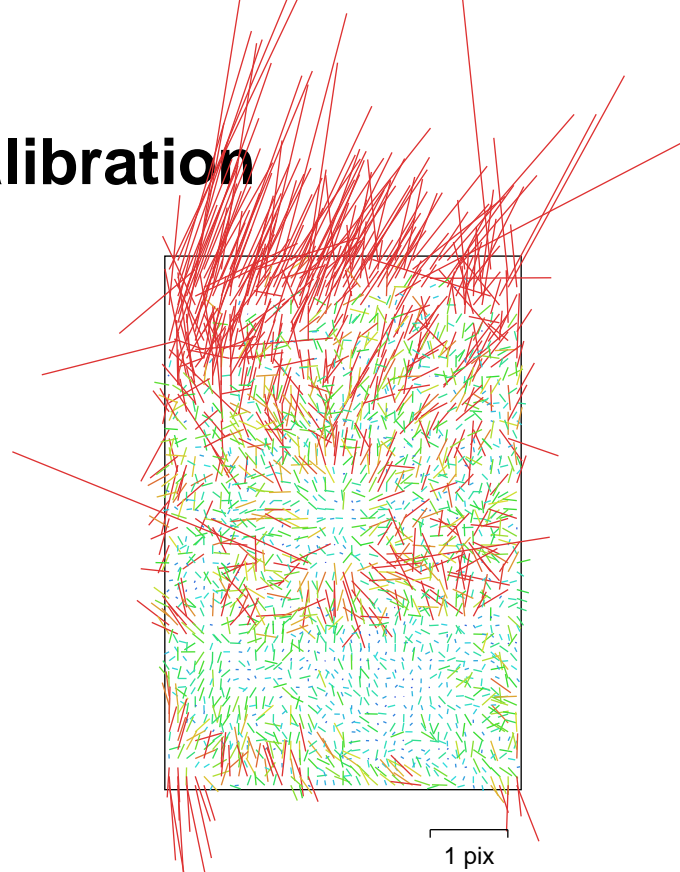


Fig. 21. Image residuals for Camera 19.

## Camera 19

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2984.28</b>	0.051	1.00	-0.02	0.01	-0.85	0.81	-0.73	-0.04	-0.07
<b>Cx</b>	<b>19.8403</b>	0.056		1.00	0.02	0.00	-0.03	0.04	0.88	0.06
<b>Cy</b>	<b>25.4701</b>	0.051			1.00	0.07	-0.02	0.01	0.04	0.71
<b>K1</b>	<b>-0.0349965</b>	3.6e-05				1.00	-0.96	0.90	0.02	0.08
<b>K2</b>	<b>0.0106596</b>	2.5e-05					1.00	-0.98	-0.05	-0.13
<b>K3</b>	<b>-0.000863658</b>	5.5e-06						1.00	0.05	0.14
<b>P1</b>	<b>-0.000290765</b>	5.6e-06							1.00	0.10
<b>P2</b>	<b>6.89532e-05</b>	5.4e-06								1.00

Table 21. Calibration coefficients and correlation matrix.



# Camera Calibration

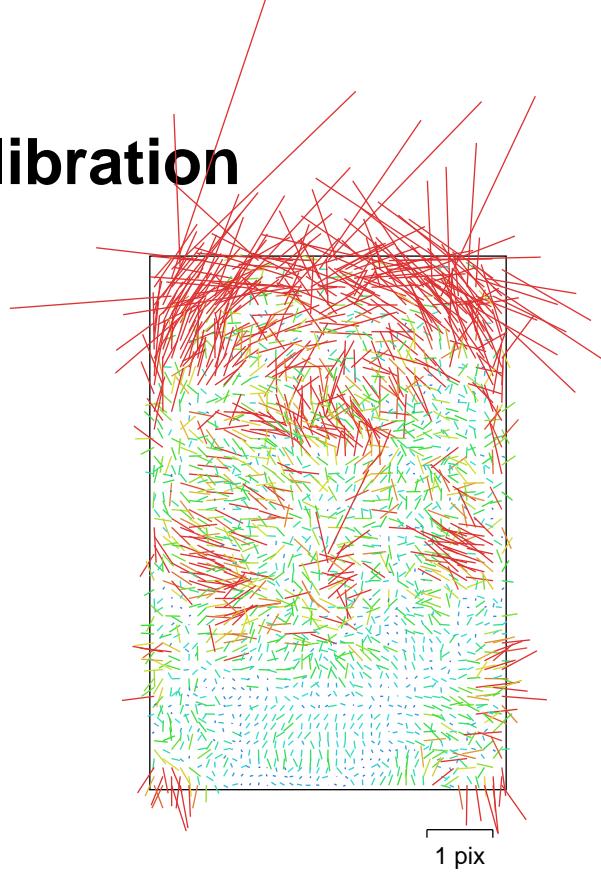


Fig. 22. Image residuals for Camera 20.

## Camera 20

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2986.23</b>	0.04	1.00	-0.00	0.07	-0.83	0.78	-0.71	0.00	0.02
<b>Cx</b>	<b>18.7721</b>	0.03		1.00	-0.05	-0.03	0.02	-0.03	0.76	-0.04
<b>Cy</b>	<b>24.5458</b>	0.044			1.00	0.06	0.02	-0.01	-0.04	0.67
<b>K1</b>	<b>-0.0363494</b>	2.7e-05				1.00	-0.96	0.91	-0.02	0.07
<b>K2</b>	<b>0.0110409</b>	1.9e-05					1.00	-0.99	0.02	-0.12
<b>K3</b>	<b>-0.00090199</b>	4.2e-06						1.00	-0.02	0.14
<b>P1</b>	<b>0.000169743</b>	2.8e-06							1.00	-0.07
<b>P2</b>	<b>0.000565333</b>	4e-06								1.00

Table 22. Calibration coefficients and correlation matrix.



# Camera Calibration

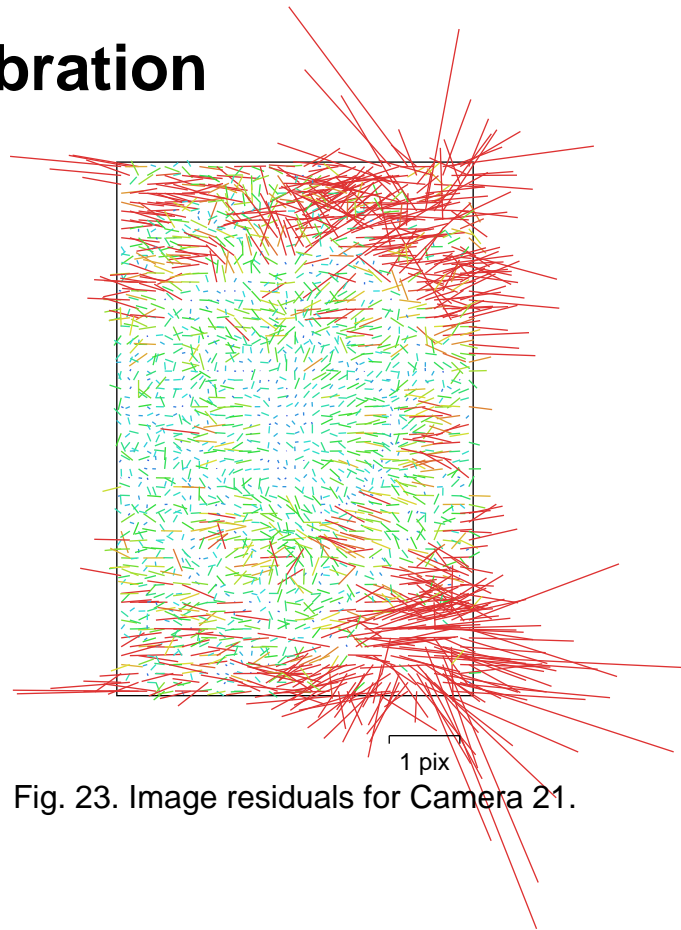


Fig. 23. Image residuals for Camera 21.

## Camera 21

67 images

Type	Resolution	Focal Length	Pixel Size
Frame	<b>5784 x 8660</b>	<b>12 mm</b>	<b>4.17 x 4.17 um</b>

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>2951.76</b>	0.78	1.00	-0.97	0.04	-0.44	0.36	-0.16	0.30	-0.12
<b>Cx</b>	<b>6.52078</b>	0.35		1.00	-0.03	0.37	-0.31	0.12	-0.26	0.12
<b>Cy</b>	<b>-28.6731</b>	0.083			1.00	-0.02	0.01	-0.01	0.03	0.57
<b>K1</b>	<b>-0.0333205</b>	4.7e-05				1.00	-0.95	0.85	-0.23	0.04
<b>K2</b>	<b>0.00893945</b>	3.4e-05					1.00	-0.96	0.21	-0.03
<b>K3</b>	<b>-0.000503604</b>	7e-06						1.00	-0.12	-0.00
<b>P1</b>	<b>8.65806e-05</b>	5.2e-06							1.00	-0.05
<b>P2</b>	<b>-0.000102765</b>	9.5e-06								1.00

Table 23. Calibration coefficients and correlation matrix.

# Scale Bars

<b>Label</b>	<b>Distance (m)</b>	<b>Error (m)</b>
003. 7-8	0.250211	0.000150552
006. 15-16	0.250048	1.77928e-05
009. 23-24	0.250311	0.000190737
002a. 4-5	0.250012	1.20245e-05
002b. 5-6	0.249873	-2.732e-05
005a. 12-13	0.249568	-0.00041244
005b. 13-14	0.250002	0.000112203
008a. 20-21	0.250057	2.68352e-05
008b. 21-22	0.249831	-4.93916e-05
<b>Total</b>		<b>0.000165365</b>

Table 24. Control scale bars.

# Digital Elevation Model

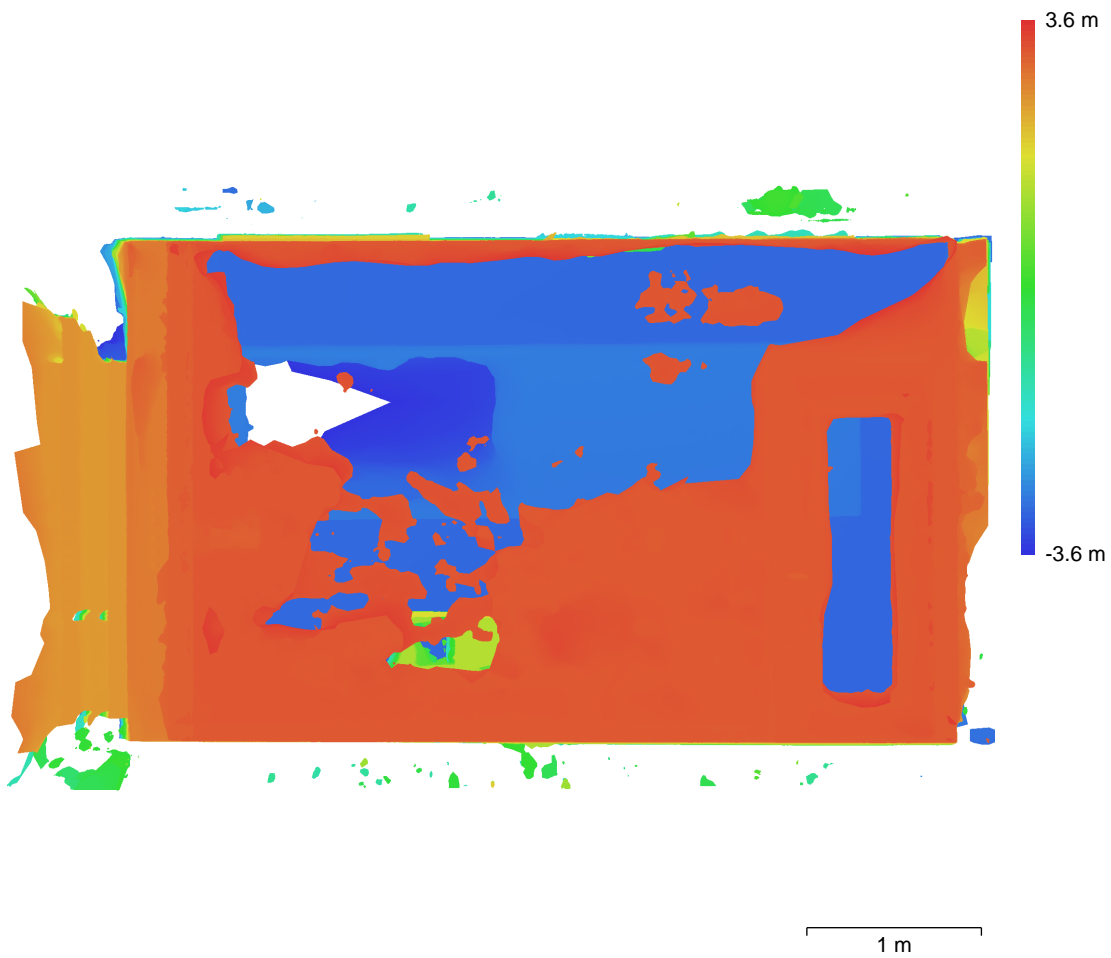


Fig. 24. Reconstructed digital elevation model.

Resolution: 5.28 mm/pix  
Point density: 3.58 points/cm<sup>2</sup>

# Processing Parameters

## General

Cameras	1474
Aligned cameras	1474
Markers	15
Scale bars	9
Coordinate system	Local Coordinates (m)
Rotation angles	Yaw, Pitch, Roll

## Tie Points

Points	1,324,566 of 3,121,014
RMS reprojection error	0.357311 (1.02136 pix)
Max reprojection error	1.51358 (16.8591 pix)
Mean key point size	2.73182 pix
Point colors	3 bands, uint8
Key points	6.98 GB
Average tie point multiplicity	3.90924

## Alignment parameters

Accuracy	Highest
Generic preselection	Yes
Reference preselection	Estimated
Key point limit	60,000
Key point limit per Mpx	1,000
Tie point limit	0
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	29 minutes 30 seconds
Matching memory usage	4.02 GB
Alignment time	11 minutes 11 seconds
Alignment memory usage	19.01 GB

## Optimization parameters

Parameters	f, cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	No
Optimization time	12 seconds
Date created	2023:08:24 00:28:07
Software version	2.0.2.16404
File size	272.18 MB

## Depth Maps

Count	1446
<b>Depth maps generation parameters</b>	
Quality	Medium
Filtering mode	Mild
Max neighbors	16
Processing time	28 minutes 49 seconds
Memory usage	4.81 GB
Date created	2023:08:24 02:13:24
Software version	2.0.2.16404
File size	3.70 GB

## Point Cloud

Points	67,261,841
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## Point attributes

Color	3 bands, uint8
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Normal

**Point classes**

Created (never classified) 67,261,841

**Depth maps generation parameters**

Quality Medium  
Filtering mode Mild  
Max neighbors 16  
Processing time 28 minutes 49 seconds  
Memory usage 4.81 GB

**Point cloud generation parameters**

Processing time 2 hours 13 minutes  
Memory usage 59.51 GB  
Date created 2023:08:24 04:27:46  
Software version 2.0.2.16404  
File size 898.32 MB

**Model**

Faces 1,892,524  
Vertices 948,996  
Vertex colors 3 bands, uint8  
Texture 16,384 x 16,384, 4 bands, uint8

**Depth maps generation parameters**

Quality Medium  
Filtering mode Mild  
Max neighbors 16  
Processing time 28 minutes 49 seconds  
Memory usage 4.81 GB

**Reconstruction parameters**

Surface type Arbitrary  
Source data Depth maps  
Interpolation Enabled  
Strict volumetric masks No  
Processing time 18 minutes 0 seconds  
Memory usage 9.78 GB

**Texturing parameters**

Mapping mode Generic  
Blending mode Mosaic  
Texture size 16,384  
Enable hole filling Yes  
Enable ghosting filter Yes  
UV mapping time 4 minutes 12 seconds  
UV mapping memory usage 2.07 GB  
Blending time 17 minutes 1 seconds  
Blending memory usage 11.22 GB  
Blending GPU memory usage 7.56 GB  
Date created 2023:08:24 04:47:23  
Software version 2.0.2.16404  
File size 318.74 MB

**System**

Software name Agisoft Metashape Professional  
Software version 2.0.2 build 16404  
OS Windows 64 bit  
RAM 255.87 GB  
CPU AMD Ryzen Threadripper 3970X 32-Core Processor  
GPU(s) NVIDIA GeForce RTX 3090  
NVIDIA GeForce RTX 3090  
NVIDIA GeForce RTX 3090