Metadata Report

Project Name

Zig Zag Landslide, Snow Basin Road (UT-226), Morgan County, Utah – Aerial reconnaissance and landslide monitoring project (October 2020)

Summary

The Zig Zag landslide is located along the side of Snow Basin Road (UT-226) in Morgan County, Utah. The Utah Geological Survey (UGS) began monitoring the movement with high-accuracy GPS in 2005, and currently collect GPS movement data on a yearly basis. Using Structure from Motion (SFM), the landslide was surveyed in October 2020. The UGS received field assistance from Weber State University (WSU) for this survey campaign.

Personnel

- PI(s)

Adam I. Hiscock (adamhiscock@utah.gov)

- Field staff

Adam I. Hiscock, Ben E. Erickson, Jessica Castleton, Brooklyn Smout

- Additional team members

Dr. Michael W. Hernandez (WSU)

Site Information

- Site description

Landslide along Snow Basin Road (Utah Highway 226) in Morgan County, Utah.

- Site objective

Collect SFM data for the active landslide to assist in landslide monitoring and movement.

- Site location (GPS cords and/or map)

41.215231°, -111.852547°

- Site conditions

Mid-day, cool temperature, clear skies

- Date/time spent at each site

Flights conducted on 10/29/2020 at approximately 12:43 PM

Survey Results

- Equipment used

DJI Mavic 2 Pro drone with 20 MP camera and fixed 10.26 mm focal length for image collection. Trimble R8 GNSS unit for Ground Control Point (GCP) survey data collection.

- GPS solutions

6 GCPs were surveyed using the Utah Reference Network (TURN) real-time kinematic network and processed in WGS 84.

- Errors

Overall point cloud error was 7.10 cm using all 6 GCPs. GCP error was 6.51 cm horizontal and 2.83 cm vertical.

- Alignments
- Collection methods

313 images were acquired from 100 ft (30 m) altitude at nadir. Camera positions, overlaps, and orientations were controlled automatically using Pix4D software running on an iPad. Images were processed using Agisoft Metashape Professional (see below for processing details). GCPs were provided by installing orange, black, and white bucket lid targets for visibility in images. GCPs were surveyed and processed in UTM North Zone 12, WGS 84 Datum, g12aus geoid.

Products

- Date of dataset collection

10/29/2020

- Coordinate system of datasets

WGS 84 datum (EPSG::4326)

- Spatial resolution

Ground resolution – 1.22 cm/pix, DEM resolution 4.89 cm/pix, Point density – 419 points/m^2

- Horizontal Accuracy

17.96 cm

- Vertical Accuracy

1.59 cm

- Data formats

Raw point cloud is provided in .LAZ format. DEM and orthomosaic are provided as geotiff.

- Data processing methods

Point cloud, DEM, and orthomosaic data were generated by Agisoft Metashape Professional.

Misc Notes

Please send any questions about this dataset to adamhiscock@utah.gov

Agisoft Metashape Metadata Report

ZigZag Landslide, October 2020, Trappers Loop Road (UT-167), Morgan County, Utah

19 November 2020

Survey Data

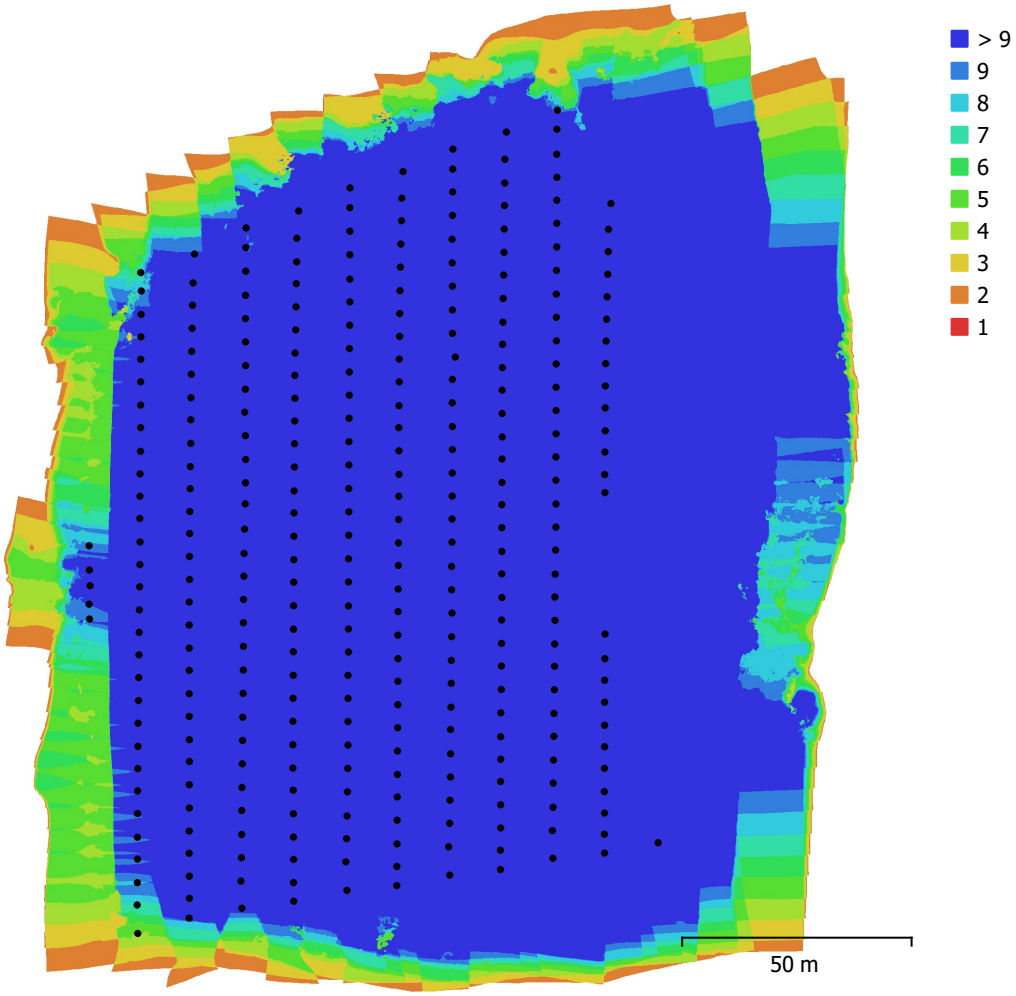

Fig. 1. Camera locations and image overlap.

Number of images:	313	Camera stations:	313
Flying altitude:	54.3 m	Tie points:	126,980
Ground resolution:	1.22 cm/pix	Projections:	849,350
Coverage area:	0.0334 km²	Reprojection error:	0.802 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
L1D-20c (10.26mm)	5472 x 3648	10.26 mm	2.41 x 2.41 µm	No

Table 1. Cameras.

Camera Calibration

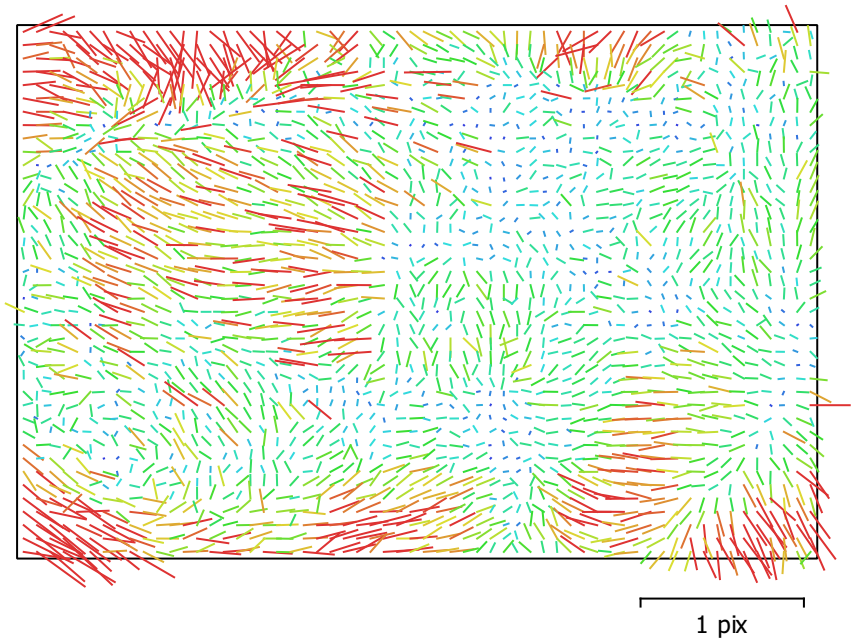

Fig. 2. Image residuals for L1D-20c (10.26mm).

L1D-20c (10.26mm)

313 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5472 x 3648**	**10.26 mm**	**2.41 x 2.41 µm**

	Value	Error	F	Cx	Cy	K1	K2	K3	P1	P2
F	**4364**	3.8	1.00	-0.76	0.78	0.00	0.15	-0.21	-0.03	0.05
Cx	**-0.812602**	0.24		1.00	-0.61	-0.01	-0.11	0.15	0.57	-0.07
Cy	**-13.6388**	0.19			1.00	0.01	0.12	-0.16	-0.06	0.50
K1	**-0.0178473**	0.00022				1.00	-0.87	0.81	-0.08	0.07
K2	**0.0299011**	0.00085					1.00	-0.98	-0.01	0.03
K3	**-0.0365151**	0.001						1.00	0.01	-0.03
P1	**0.000156877**	1.2e-05							1.00	-0.10
P2	**-3.01365e-05**	9.2e-06								1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

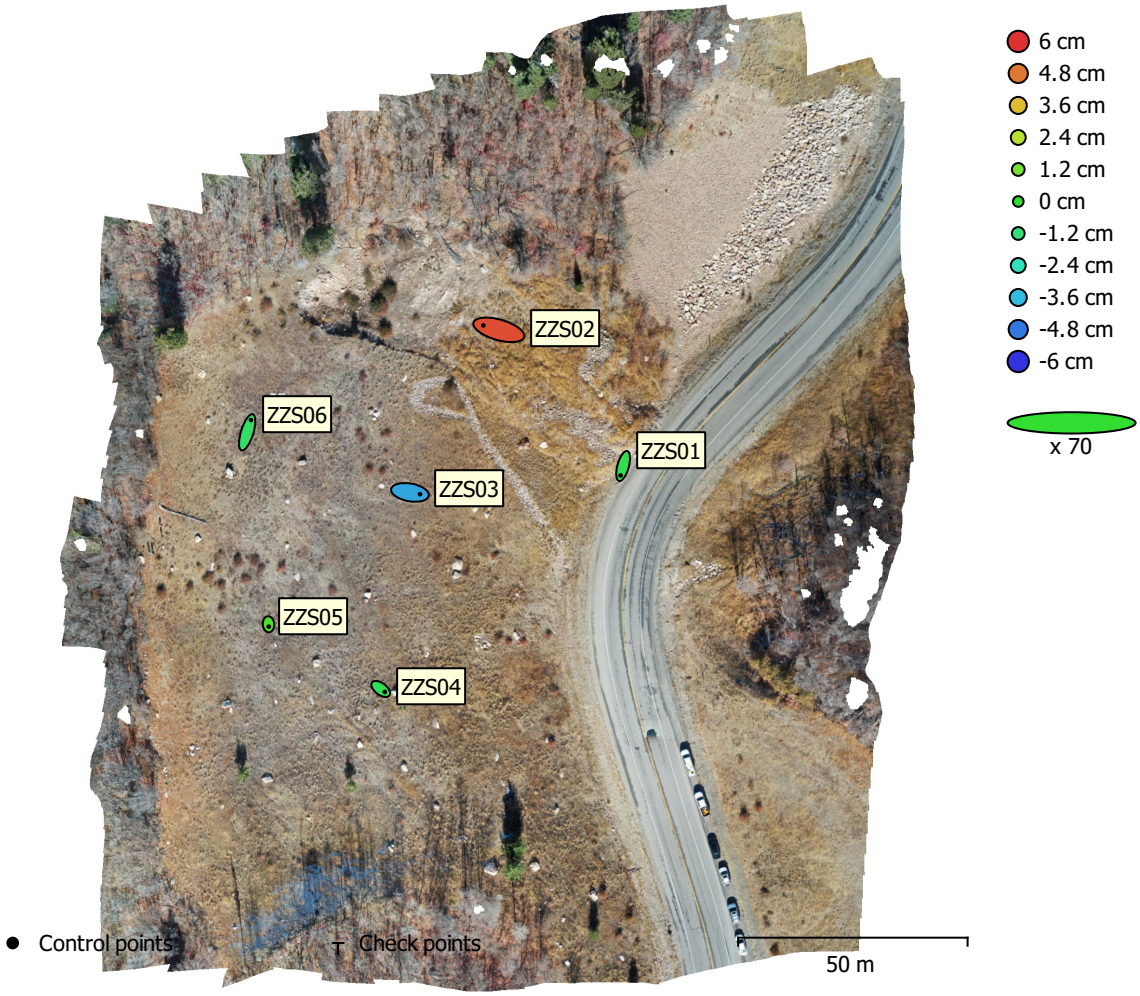

Fig. 3. GCP locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated GCP locations are marked with a dot or crossing.

Count	X error (cm)	Y error (cm)	Z error (cm)	XY error (cm)	Total (cm)
6	4.95201	4.22194	2.83318	6.50747	7.09747

Table 3. Control points RMSE.
X - Longitude, Y - Latitude, Z - Altitude.

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
ZZS01	-1.62482	-5.89504	-0.43603	6.13039	0.527 (55)
ZZS02	-9.65923	2.75781	5.53249	11.468	91.764 (56)
ZZS03	6.25698	-1.09705	-3.993	7.50316	0.529 (67)
ZZS04	2.53373	-1.8951	-0.583724	3.21744	0.494 (52)
ZZS05	0.125057	-1.46365	0.426736	1.52971	0.630 (31)
ZZS06	2.36821	7.59304	-0.946469	8.0099	0.504 (25)
Total	**4.95201**	**4.22194**	**2.83318**	**7.09747**	**40.608**

Table 4. Control points.

X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

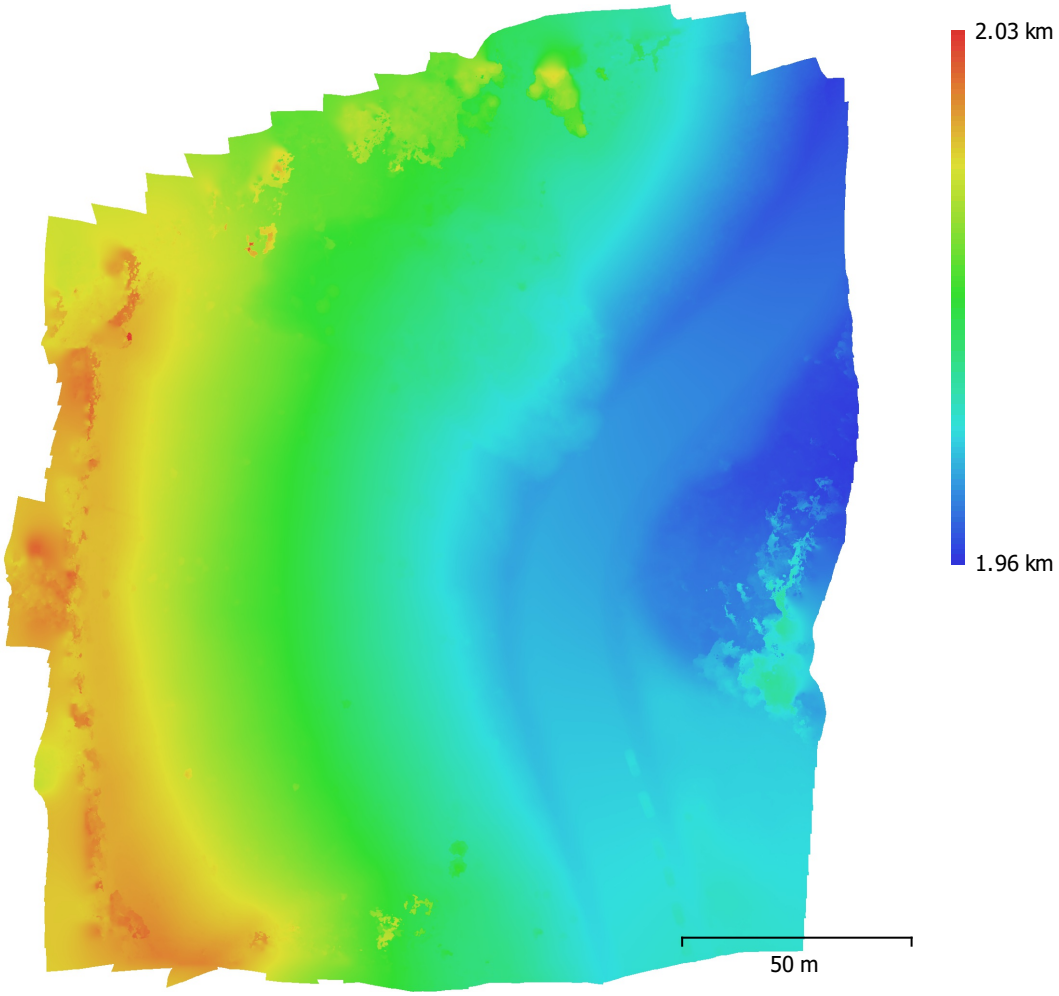

Fig. 4. Reconstructed digital elevation model.

Resolution:	4.89 cm/pix
Point density:	419 points/m²

Processing Parameters

General	
Cameras	313
Aligned cameras	313
Markers	6
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	126,980 of 152,149
RMS reprojection error	0.266599 (0.801865 pix)
Max reprojection error	8.83642 (23.4009 pix)
Mean key point size	3.14361 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	8.9618
Alignment parameters	
Accuracy	High
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Tie point limit	4,000
Guided image matching	No
Adaptive camera model fitting	No
Matching time	13 minutes 2 seconds
Matching memory usage	299.34 MB
Alignment time	3 minutes 44 seconds
Alignment memory usage	202.22 MB
Optimization parameters	
Parameters	f, cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	No
Optimization time	20 seconds
Software version	1.6.2.10247
Depth Maps	
Count	313
Depth maps generation parameters	
Quality	Medium
Filtering mode	Aggressive
Processing time	2 hours 27 minutes
Software version	1.6.2.10247
Dense Point Cloud	
Points	18,062,113
Point colors	3 bands, uint8
Depth maps generation parameters	
Quality	Medium
Filtering mode	Aggressive
Processing time	2 hours 27 minutes
Dense cloud generation parameters	
Processing time	30 minutes 53 seconds
Software version	1.6.2.10247
Model	
Faces	3,612,421

Vertices	1,811,667
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8
Depth maps generation parameters	
Quality	Medium
Filtering mode	Aggressive
Processing time	2 hours 27 minutes
Reconstruction parameters	
Surface type	Arbitrary
Source data	Dense cloud
Interpolation	Enabled
Strict volumetric masks	No
Processing time	13 minutes 9 seconds
Texturing parameters	
Mapping mode	Generic
Blending mode	Mosaic
Texture size	4,096
Enable hole filling	Yes
Enable ghosting filter	Yes
UV mapping time	7 minutes 8 seconds
Blending time	4 minutes 42 seconds
Software version	1.6.2.10247
DEM	
Size	7,612 x 7,655
Coordinate system	WGS 84 (EPSG::4326)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	48 seconds
Software version	1.6.2.10247
Orthomosaic	
Size	15,263 x 17,608
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	11 minutes 54 seconds
Software version	1.6.2.10247
System	
Software name	Agisoft Metashape Professional
Software version	1.6.2 build 10247
OS	Windows 64 bit
RAM	15.92 GB
CPU	Intel(R) Xeon(R) CPU E3-1240 v5 @ 3.50GHz
GPU(s)	Quadro M2000