## **Applications of SfM**



#### **Characterizing hand samples or outcrops**



**Left.** James & Robson (2012). Straightforward reconstruction of 3D surfaces and topography with a camera: Accuracy and geoscience application. *Journal of Geophysical Research*  **Right.** Westoby *et al.* (2012). Structure-from-Motion' photogrammetry: A low-cost, effective tool for geoscience applications. *Geomorphology* 





Fold



https://sketchfab.com/models/ a90062db8a1a4fe1bcbb53c91acfc821





#### **Paleoseismic trenching**



Bemis *et al.* (2014). Ground-based and UAV-Based photogrammetry: A multi-scale, high resolution mapping tool for structural geology and paleoseismology. *Journal of Structural Geology* 

Extracting Fold Form for Scientific Investigations and Education

Max Needle and Juliet Crider



Granite Dells Arizona Fracture systems and Precariously Balanced Rocks

#### **Structure from Motion**



### Landers surface rupture



Johnson, K., Nissen, E., Saripalli, S., Arrowsmith, J R., McGarey, P., Scharer, K., Williams, P., Blisniuk, K., Rapid mapping of ultra-fine fault zone topography with Structure from Motion, *Geosphere*, v. 10; no. 5; p. 1-18; doi:10.1130/GES01017.1, 2014.



Ground-based structure from motion of Landers fault scarp knickpoint in 2016

#### Landslide mapping







Home Hill landslide, Tasmania, surveyed with oktocopter in July and November 2011.

Lucieer *et al.* (2013). Mapping landslide displacements using Structure from Motion (SfM) and image correlation of multi-temporal UAV photography, *Progress in Physical Geography* 

#### Landslide mapping



Lucieer *et al.* (2013). Mapping landslide displacements using Structure from Motion (SfM) and image correlation of multi-temporal UAV photography, *Progress in Physical Geography* 

## **Sinabung Indonesia**

# -simple ground based sfm and differencing for volcano study











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The emplacement of the active lava flow at Sinabung Volcano, Sumatra, Indonesia, documented by structure-frommotion photogrammetry -Carr, et al., in review. Pre-eruption 5 m **DEM** and post eruption SfM registered to unchanged areas

## **SfM from Video**

See also: prompt 3D mapping of the earthquake-triggered lansdlide in Minami-Aso, Kumamoto, Japan

http://geomorphoto.blogspot.de/2016/04/prompt-3d-mapping-ofearthquake.html





Grab 150 frames from the video (equally spaced in frame number)

See this blog entry: http://activetectonics.blogspot.com/2017/10/ structure-from-motion-using-video-from.html I ran the files through the Agisoft Photoscan sequence of alignment (high), build dense cloud (medium), build mesh (medium), and build texture (medium).



#### Edit the resulting textured mesh in Agisoft Photoscan



## SfM from Gazing Satellite Video

See also this blog entry:

http://activetectonics.blogspot.com/2017/10/structure-from-motion-using-video.html

### Higher resolution and video

## ALL IN THE FAMILY – PLANET TO LAUNCH SKYSATS AND DOVES ON MINOTAUR-C

Mike Safyan | September 26, 2017



Planet Team (2017). Planet Application Program Interface: In Space for Life on Earth. San Francisco, CA. https://api.planet.com.

### SkySat-1 Video of Mount Ontake on October 16, 2014



Planet Team (2017). Planet Application Program Interface: In Space for Life on Earth. San Francisco, CA. https://api.planet.com.

#### Skybox Imaging HD Video of Mining Activity in Uşak, Western Turkey



#### Grab 100 frames from the video





Photoscan views from the side and the top of the mine



Planet Team (2017). Planet Application Program Interface: In Space for Life on Earth. San Francisco, CA. https://api.planet.com.

Textured mesh of the mine

Planet Team (2017). Planet Application Program Interface: In Space or Life on Earth. San Francisco, CA. https://api.planet.com.



Planet Team (2017). Planet Application Program Interface: In Space for Life on Earth. San Francisco, CA. https://api.planet.com.

Gazing at the Solar System: Capturing the Evolution of Dunes, Faults, Volcanoes, and Ice from Space

Report of the Keck Institute for Space Studies Workshop June 16 – 20, 2014 California Institute of Technology

> Study Leads: Andrea Donnellan, Jet Propulsion Laboratory Bernard Hallet, University of Washington Sebastien Leprince, Caltech

> > Keck



Figure 1. A gazing instrument would stare at and track targets from a range of vantage points during a single pass. For certain orbits solar illumination would vary between passes.

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#### Idea of gazing has been proposed



AD+Census, Small Adaptive Support Regions + Total Variation (Huber) regularization

Figure 19. DSM extracted using 21 images (1 master and 20 slaves) from a Skybox sequence acquired above Las Vegas Extraction using semi-global matching and Total Variations (TV) regularization and median DSM stacking, courtesy of P. d'Angelo, DLR.

-Keck report, 2014

#### SfM from Unmanned Aerial Systems (UAS)













El Mayor Cucupah earthquake rupture laser scan



LORATION

UCDAVIS DEPARTMENT OF GEOLOGY CICESE

#### SfM exercise

Build your own model using your own photographs of a target on campus. Make sure you have a way of transferring your photos onto the computer!

