# The Use of Unmanned Aerial Vehicles (UAV's) and Structure-From-Motion (SFM) Software for Geohazard Mapping and Kinematic Analysis

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# Common Geohazards in the Appalachia

- Sinkholes
- Floods
- Mass Wasting

# UAV's Benefits

- Change in perspective creates opportunity to find more information

- Allows for lower risk data collection

- Multiple types of cameras and sensors

# Mapping Sinkholes and Floods

- ## Sinkholes
  - Monitor expansion and see the full extent of the sinkhole

- ## Floods
  - Create floodplain maps and be able to asses damages in flooded areas by a pre-programmed mission

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# Mapping Mass Wasting Events

- **Rockfalls**
  - Create 3D models to better use simulation programs, such as "CRSP"

- **Rockslides**
  - Use models to create stereonets to find unfavorable orientations of rock slopes

- **Debris Flows**
  - Create maps of tributaries for monitoring areas that would impact road corridors

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# Kinematic Analysis

- Discontinuity dependent, modes of failure are determined from geometric analysis of rock slopes

- Found dip and dip directions are plotted on stereonets
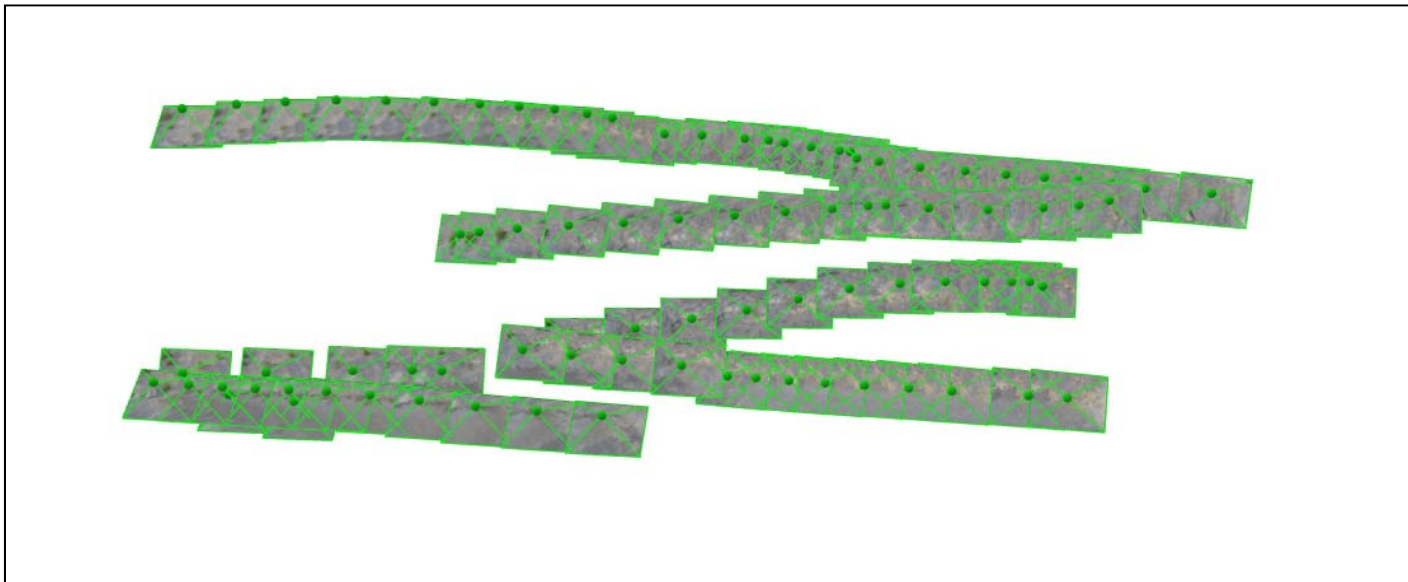
- Use of Markland's Test for finding critical zones
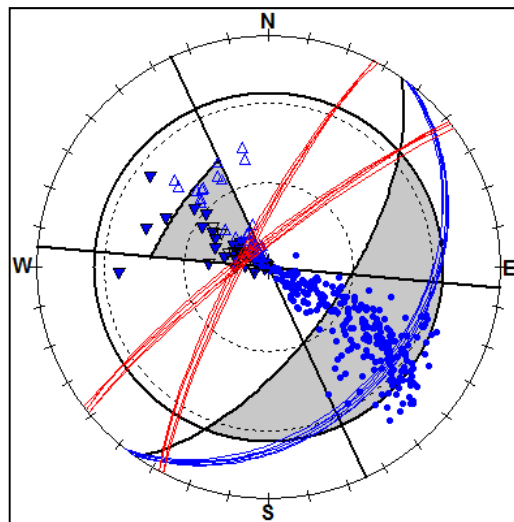
# Structure-From-Motion (SFM) Software

- Photogrammetric method of creating 3D models from 2D images

- From the stereo-pairs, the software creates key points

- Software extracts the geometry of camera positions for accurate maps and 3D models

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Pix4D
simply powerful

# Pix4D Processing

- Once images are collected, they are spatially referenced in the Pix4D software

# Pix4D Processing

- Software finds match points from images that share a key feature
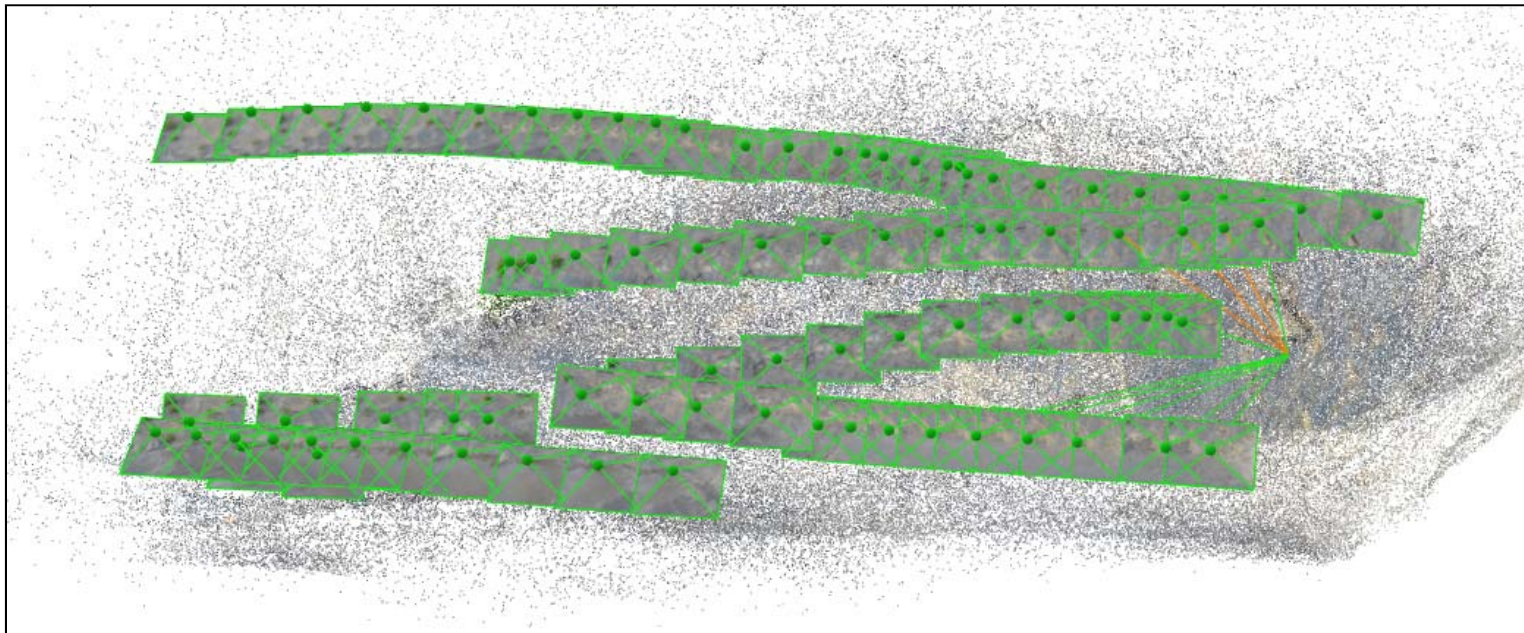
# Pix4D Processing

■ A point cloud is generated after initial processing

# Pix4D Processing

■ A triangular mesh is rendered during the final process to display the model

# Pix4D Processing

- 3D Model Image

# SplitFX

- Used for the extraction of the structural data

- However, specifically designed for LiDar generated point clouds

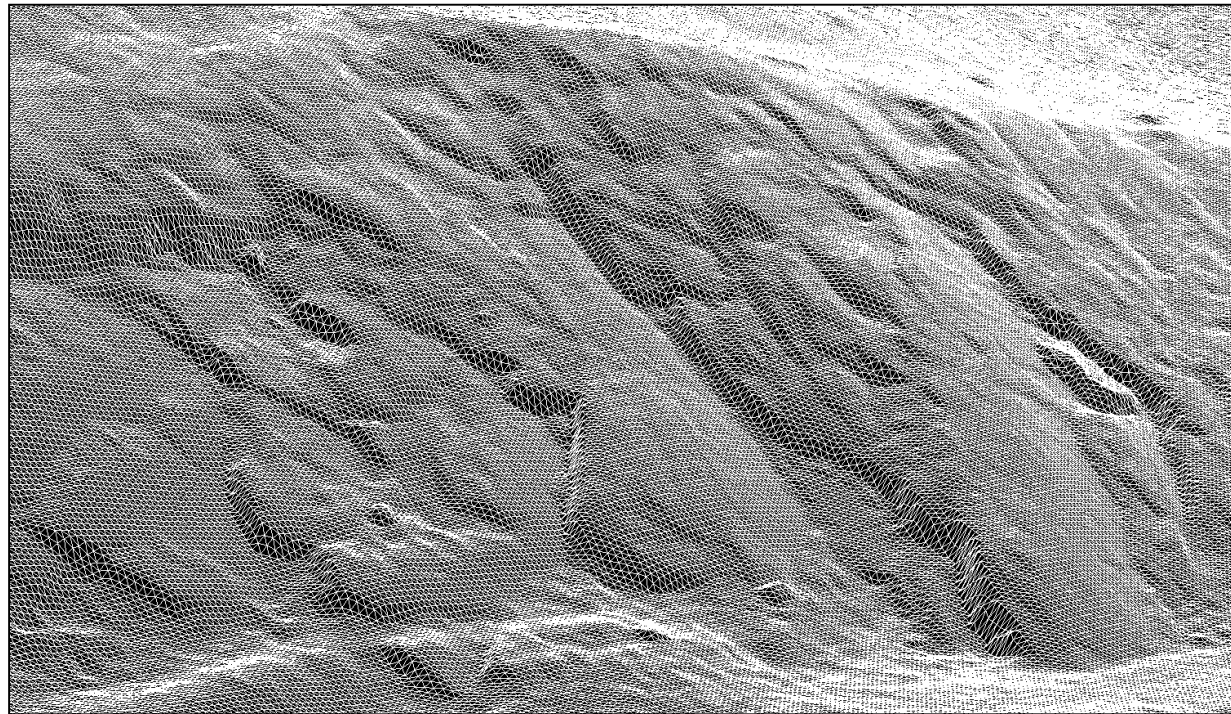- Enables proper orientation of rock slope

# SplitFX

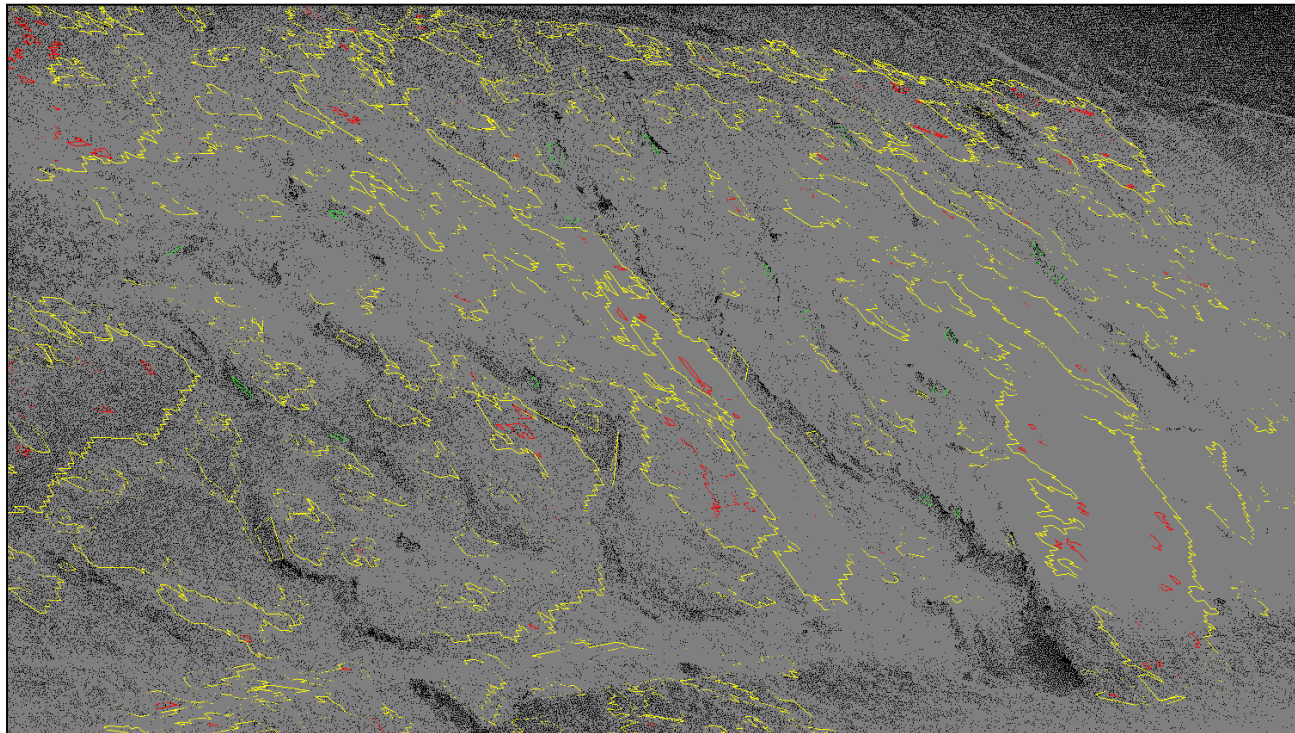■ Point cloud in software
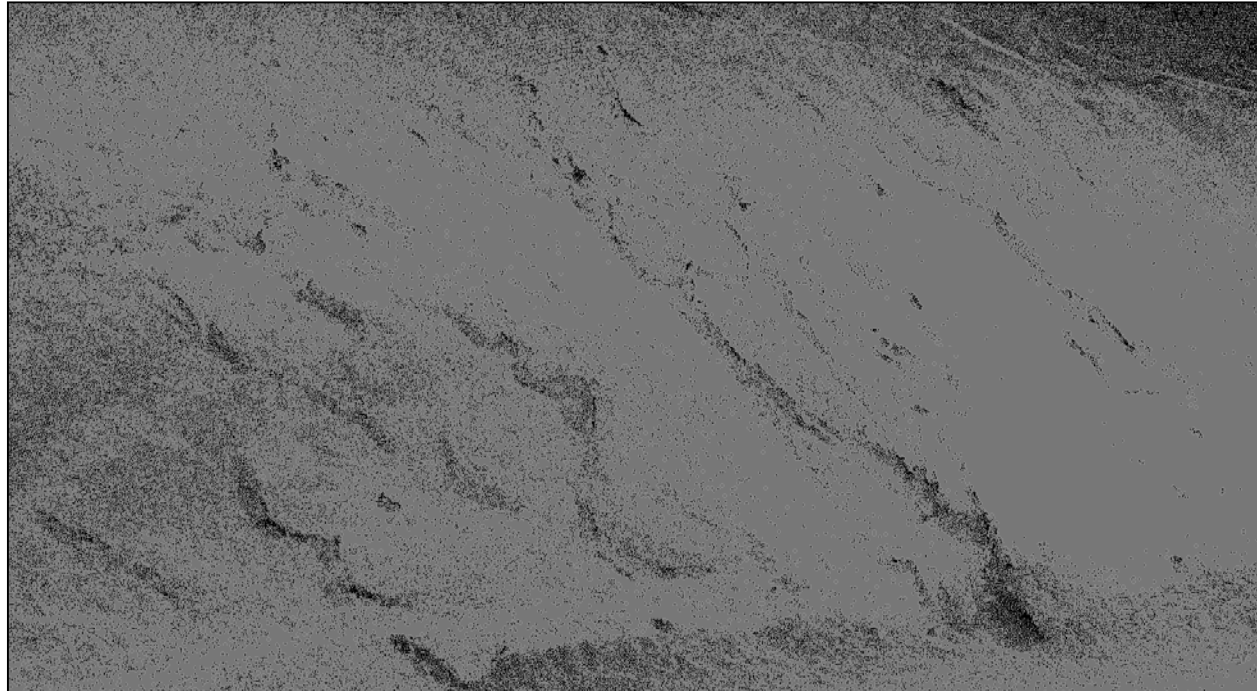
# SplitFX

- Create a triangular mesh, which controls what is considered the same surface

# SplitFX

■ Patches are then found automatically, and some manually for known orientations found in the field
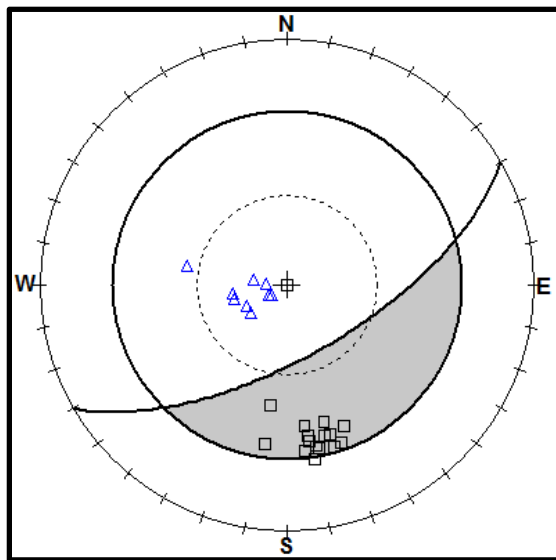
# SplitFX

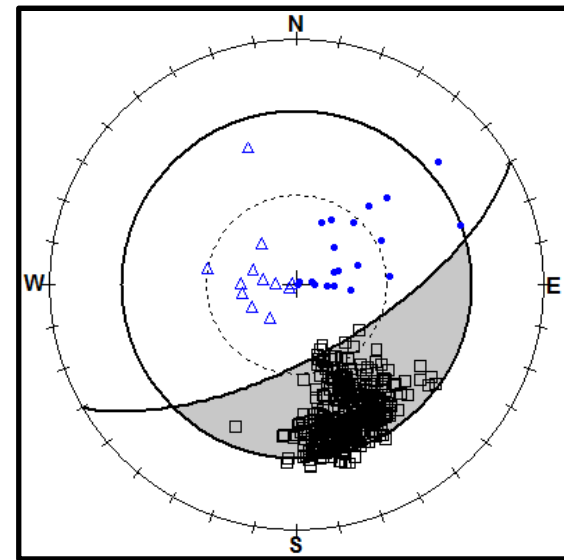■ Known patches are then selected to be oriented to the proper projection
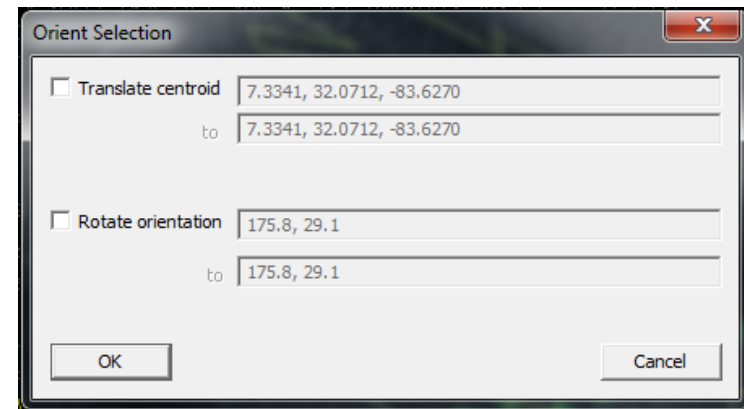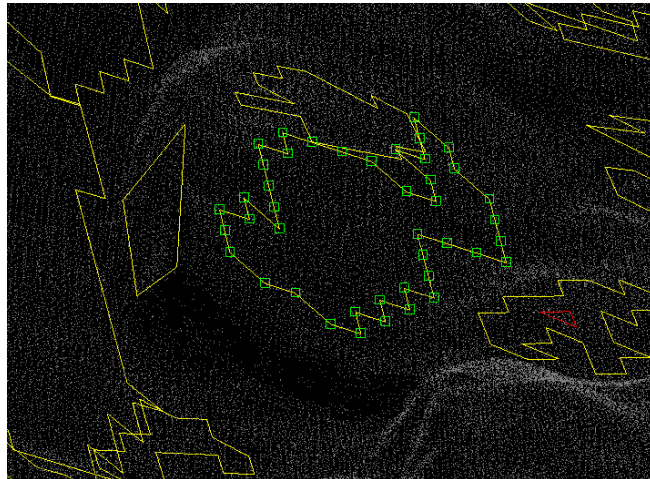
# RockPack III Stereonets

- Once patches are correctly oriented, you can export dip directions and dips
- Plotted in the software, Markland's Test can then be applied



Brunton Compass



Structure-from-motion

# New Window for Commercial Use of UAV's

- Part 107
  - Specific operation limits with waivable restrictions
  - Pilot certifications based on FAA aeronautical knowledge test
  - No FAA airworthiness certification

# Future Applications and Limitations

- In travel corridors, UAV's could pose to be a distraction to drivers
- Rock slopes must be exposed for analysis
- With new regulations, commercial use will begin to open many doors
- Safer analysis of failed rock slopes along travel corridors
- Future research with statistical significance

# Questions?