

ShortTitle: Fracture-3D

Title: Analysis of natural fractures (cracks) from 3D models of outcropping rock formations

Project leads and contact details:

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Suggested team size: 2-4

Logistics: Can work from anywhere, with periodic meetings in Berthoud 143

Project description: Natural fractures (basically, cracks in rock formations) form important pathways for fluid flow in the Earth's subsurface – examples of their societal importance are (1) fractures that allow rainwater to infiltrate the Earth to replenish groundwater resources, and (2) fractures help to connect hydrocarbon and carbon-sequestration reservoirs in the deep subsurface, and (3) fractures control the stability of highway roadcuts and tunnels. This project is not about human-induced fractures (in other words, 'fracking'), but instead focuses on naturally-existing fractures. We are interested in the relationships between rock types and the dimensions of fractures, in other words, which rock cracks the most.

You will help analyze fracture data from drone-derived and iPhone-lidar-derived 3D models of rock outcrops (see Fig. 1). Using python, you will develop semi-automated techniques to identify fractures – from 'facet' detection and analysis using the geometry of a 3D mesh (Fig. 1, left hand side) as well as image analysis (see white fracture in Fig.1 right hand side). The tech stack will be focused in python, using libraries like trimesh, pyvista, vtk, segment-anything, and others, as well as CloudCompare (an open-source 3D modeling software). If time permits, you will help link the data extracted from the models to fine-scale measurements already made on the same rocks by field geologists (using pandas).

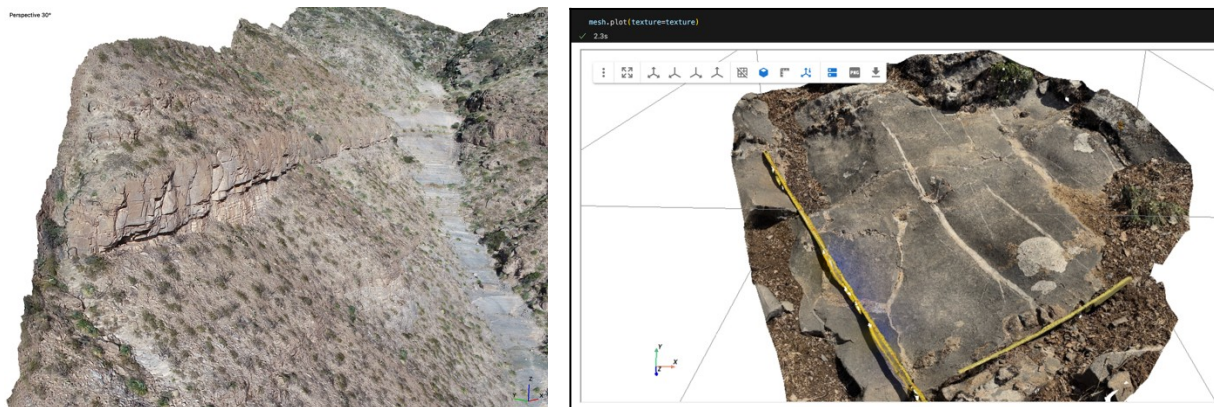


Figure 1. Drone-derived (left) and iPhone-lidar-derived (right) 3D models of outcrops with natural fractures – you will help analyze the fractures (white lines in right-hand image) in these models using 3D-mesh analysis and image-analysis techniques using python (libraries like trimesh, pyvista, vtk, segment-anything, and others) and CloudCompare.