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Extracting and quantifying fracture patterns from a reservoir-scale Virtual Outcrop Model.

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The use of multi-view photogrammetry in building Virtual Outcrop Models (VOMs) represents an increasingly accessible source of high-quality, low-cost geological data. In particular, VOMs are nowadays widely used in the characterization of fractured outcrops, since they allow for the collection of large volumes of fracture data from reservoir-scale outcrops. The extraction and analysis of such a big amount of data can be a time-consuming step of the interpretation workflow and, although several software packages dedicated to structural analysis are currently available, their scope is generally restricted to datasets acquired on flat 2D surfaces oriented roughly perpendicular to fractures. In this study, we present a workflow allowing the extraction of structural data from complex 3D surfaces and their quantification through the integration of free and open-access software.

The study outcrop is located in the Lattari Mts. of the Sorrento Peninsula (Southern Apennines, Italy). It consists of a pyramid-shaped peak, approximately 200 m high and 150 m wide, exposing gently-dipping Lower Cretaceous shallow-water limestones and dolostones affected by vertical fractures, up to few tens of meters in height. In terms of stratigraphy and facies it represents an excellent outcrop analogue for Southern Italy reservoirs. Due to the inaccessibility of the peak, we used an Unmanned Aerial Vehicle (UAV) equipped with a camera to acquire photos necessary for building a photorealistic and georeferenced VOM. Structural data from the VOM were acquired by means of the open source software OpenPlot. Distinct fracture clusters are selected and projected independently on the corresponding fracture-perpendicular plane, minimizing the distortion of the measurements. The obtained 2D fracture pattern is then imported in FracPaQ, a MATLAB toolbox for fracture pattern quantification, to perform spacing analysis.

The presented workflow expands the scope of the software, originally developed to perform structural analysis on 2D images, and allows for extracting quantitative information from 3D datasets, improving our ability to quantify structural data in a quick and robust way.