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FracPaQ: a MATLAB™ toolbox for the quantification of fracture patterns

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The patterns of fractures in deformed rocks are rarely uniform or random. Fracture orientations, sizes, shapes and spatial distributions often exhibit some kind of order. In detail, there may be relationships among the different fracture attributes e.g. small fractures dominated by one orientation, larger fractures by another. These relationships are important because the mechanical (e.g. strength, anisotropy) and transport (e.g. fluids, heat) properties of rock depend on these fracture patterns and fracture attributes. This presentation describes an open source toolbox to quantify fracture patterns, including distributions in fracture attributes and their spatial variation.

Software has been developed to quantify fracture patterns from 2-D digital images, such as thin section micrographs, geological maps, outcrop or aerial photographs or satellite images. The toolbox comprises a suite of MATLAB™ scripts based on published quantitative methods for the analysis of fracture attributes: orientations, lengths, intensity, density and connectivity. An estimate of permeability in 2-D is made using a parallel plate model. The software provides an objective and consistent methodology for quantifying fracture patterns and their variations in 2-D across a wide range of length scales.

Our current focus for the application of the software is on quantifying crack and fracture patterns in and around fault zones. There is a large body of published work on the quantification of relatively simple joint patterns, but fault zones present a bigger, and arguably more important, challenge. The methods presented are inherently scale independent, and a key task will be to analyse and integrate quantitative fracture pattern data from micro- to macro-scales. New features in this release include multi-scale analyses based on a wavelet method to look for scale transitions, support for multi-colour traces in the input file processed as separate fracture sets, and combining fracture traces from multiple 2-D images to derive the statistically equivalent 3-D fracture pattern expressed as a 2nd rank crack tensor.