USE OF SYNTHETIC FRACTURES IN THE ANALYSIS OF NATURAL FRACTURE APERTURES

E. ISAKOV, P. GLOVER & S. OGILVIE

Department of Geology and Petroleum Geology, University of Aberdeen, UK.

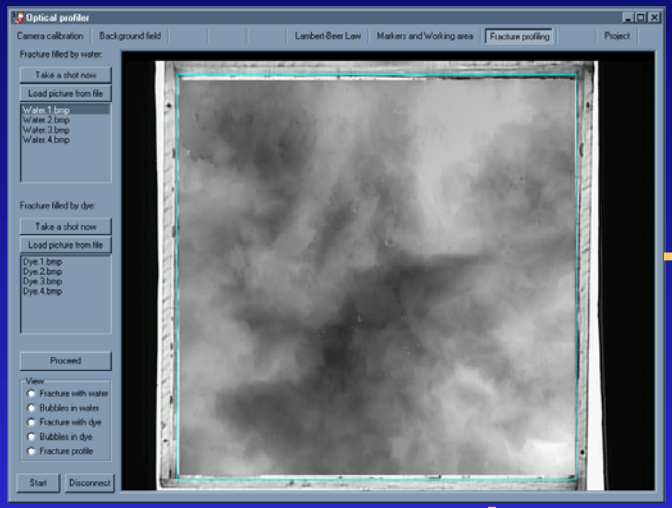
μ2M

Aberdeen University AU PG Petrophysics Group

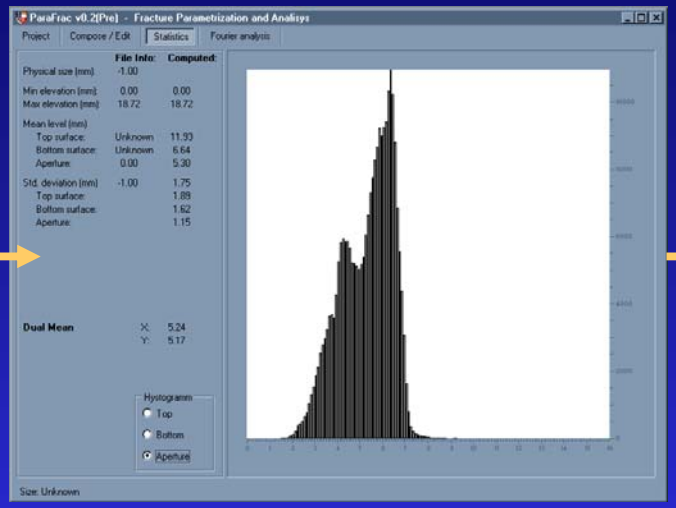
Natural Environment Research Council

petrophysics.webhop.net

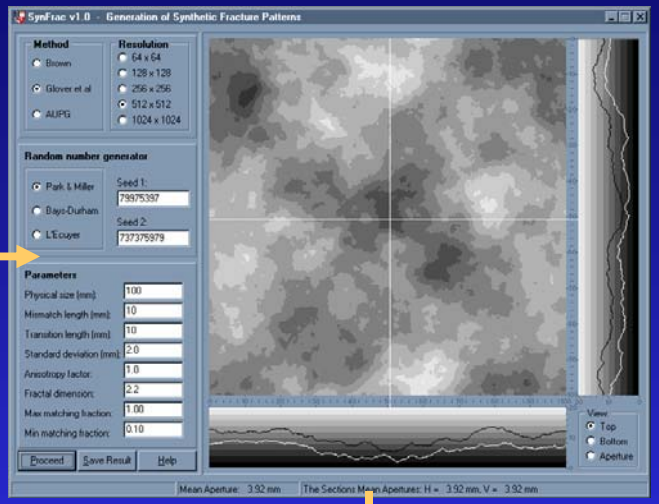
The Framework



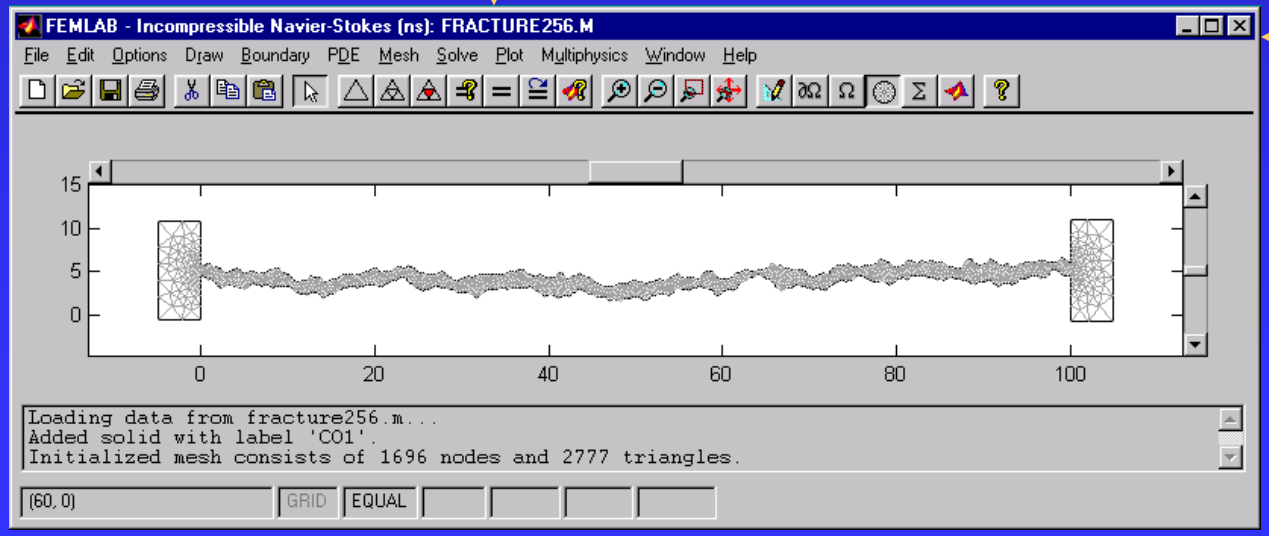
OptiProf (v.0.8)



ParaFrac (v.0.5)

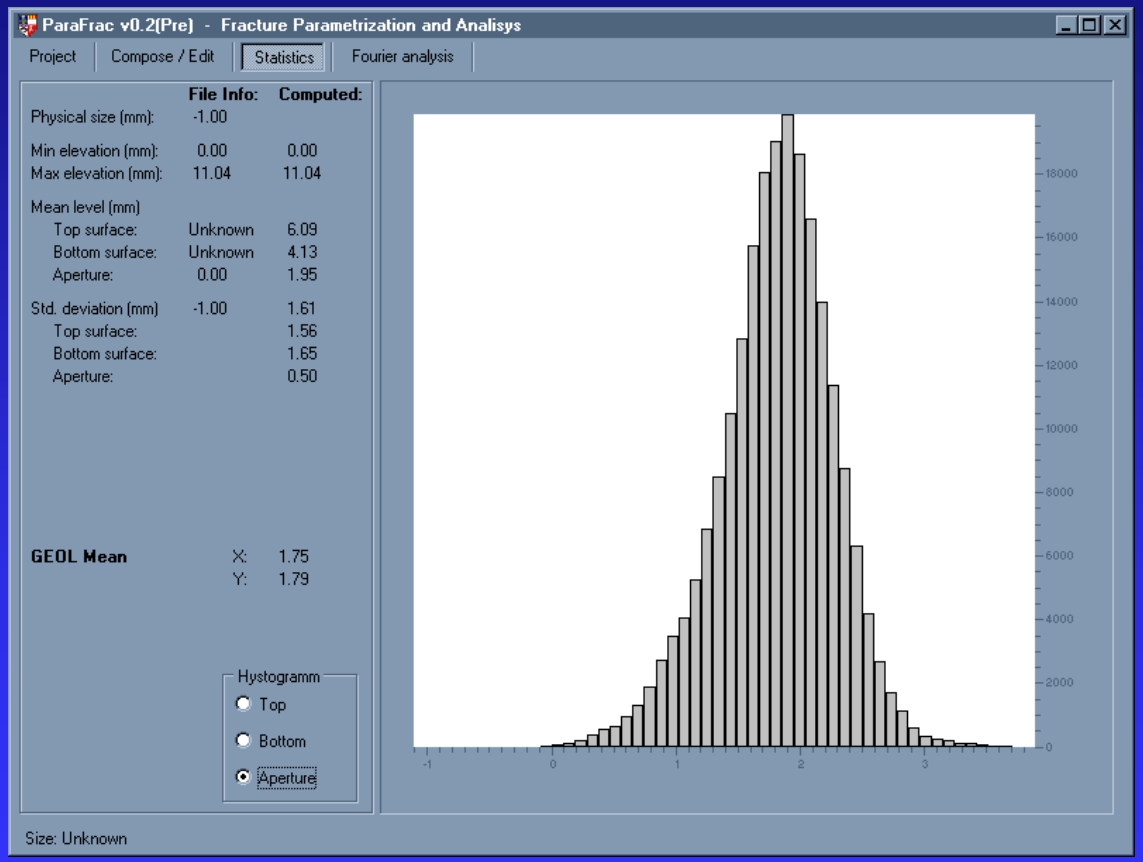


SynFrac (v.1.0)



Comsol FEMLAB software for physical processes modelling

Fracture Parameterisation



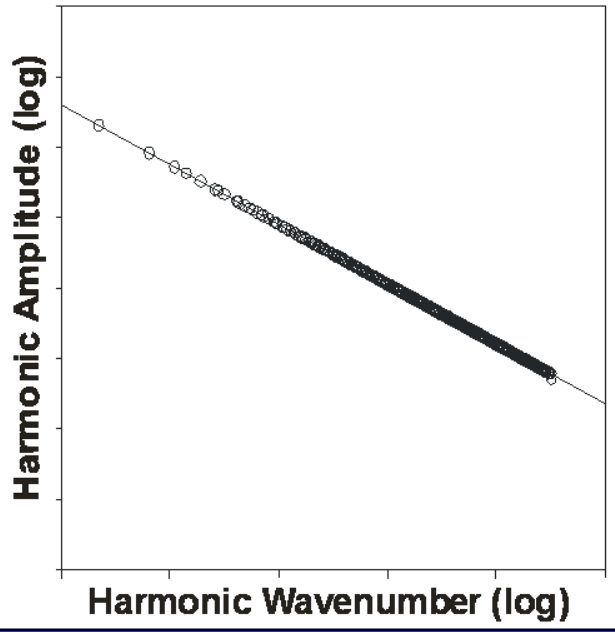
- Statistical Analysis
- Spectral Analysis
- Fractal Analysis
- Correlative Analysis

↓

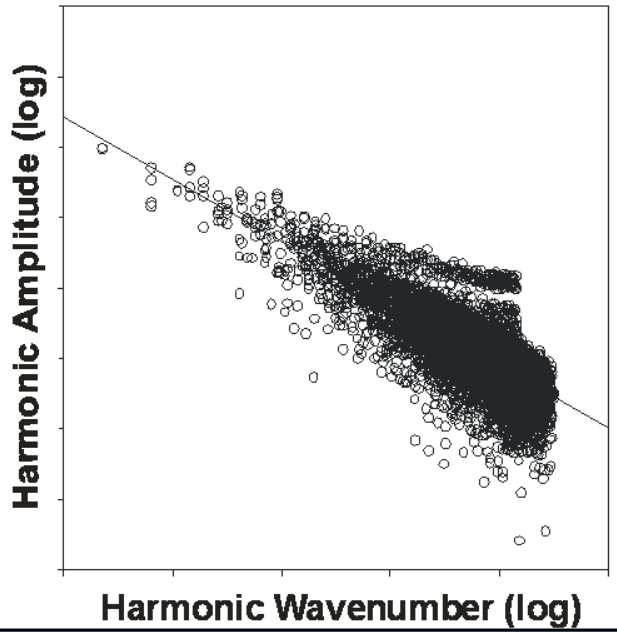
Set of Fracture Parameters

Fractal Spectrum Analysis

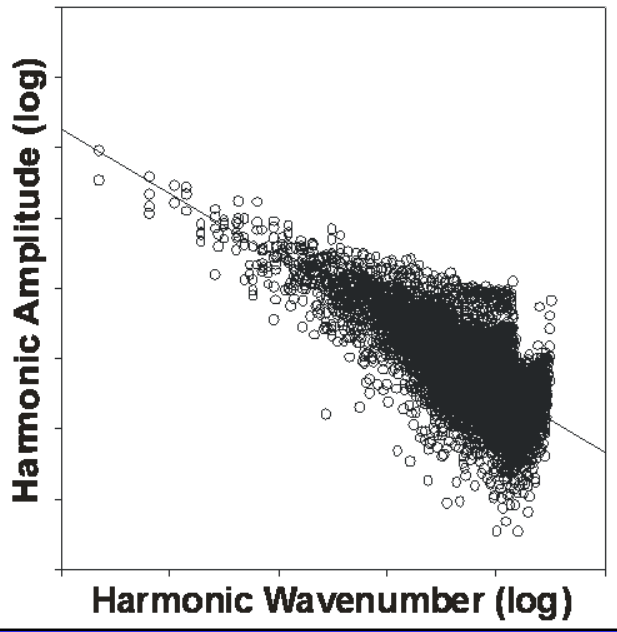
Spatial Spectrum of an Ideal (Periodic) Fractal Surface



Spatial Spectrum of an Aperiodic Fragment of Ideal Fractal Surface



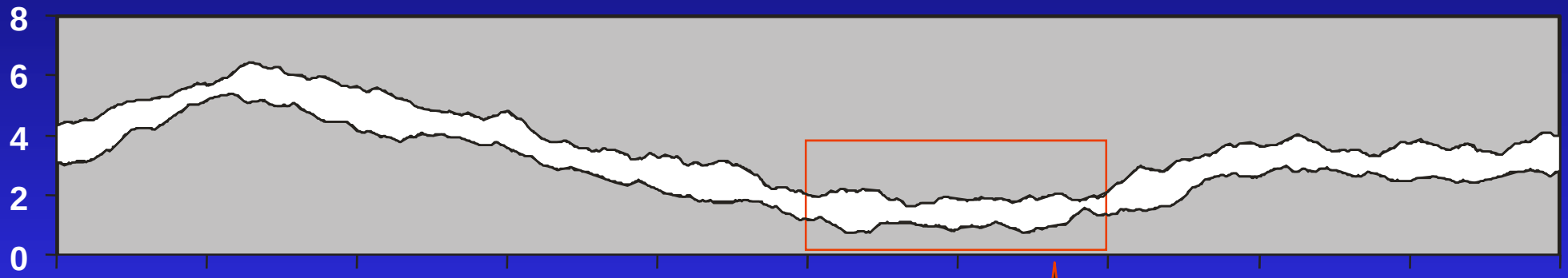
Spatial Spectrum of a Real Surface of a Rock Fracture



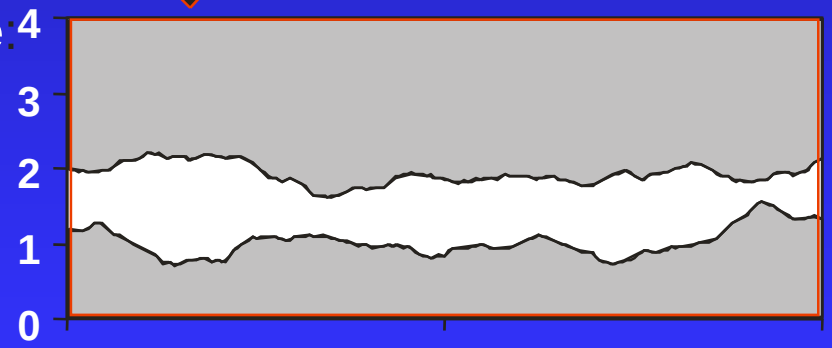
Numerical Synthesis of Fractures

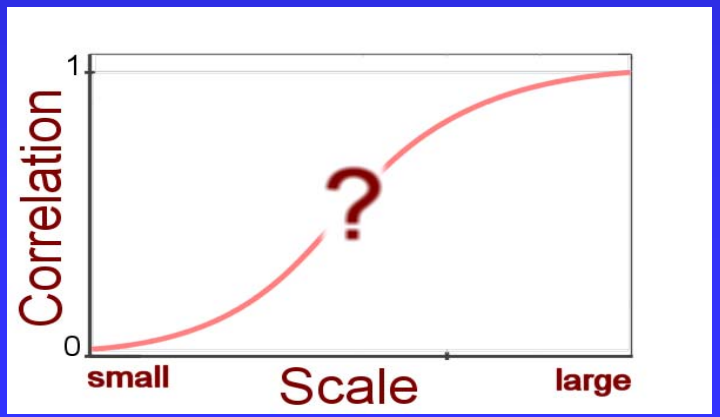
- Fractal synthesis is used to generate fracture surfaces.

Fracture surfaces match at macroscale:

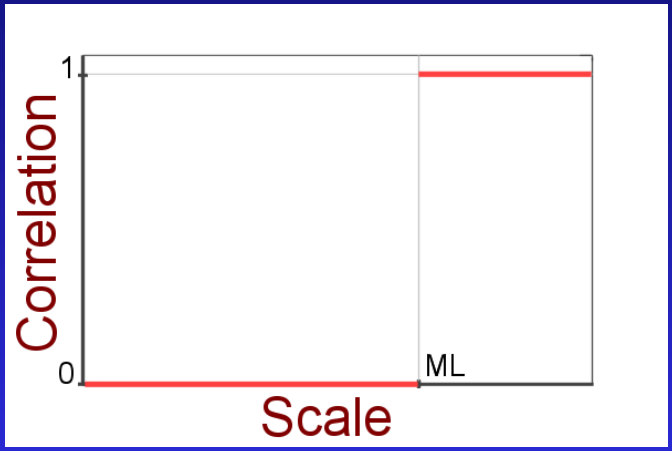


…And relatively independent at microscale:

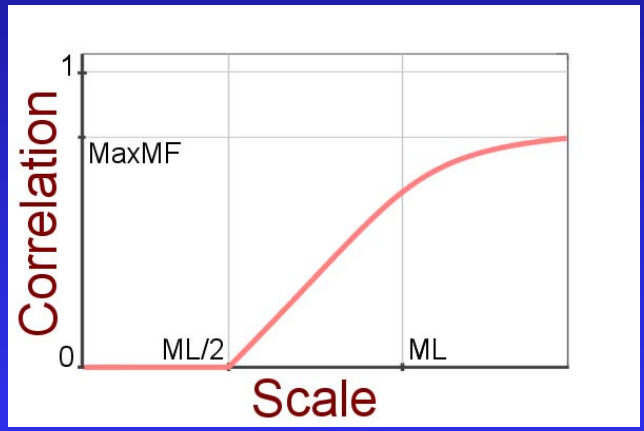




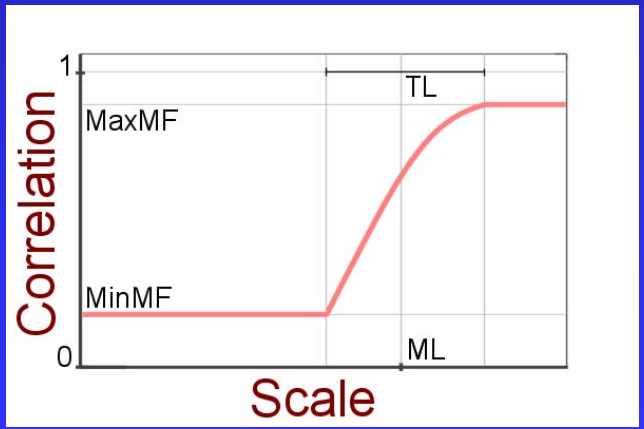
Synthesis methods



Brown (1995)

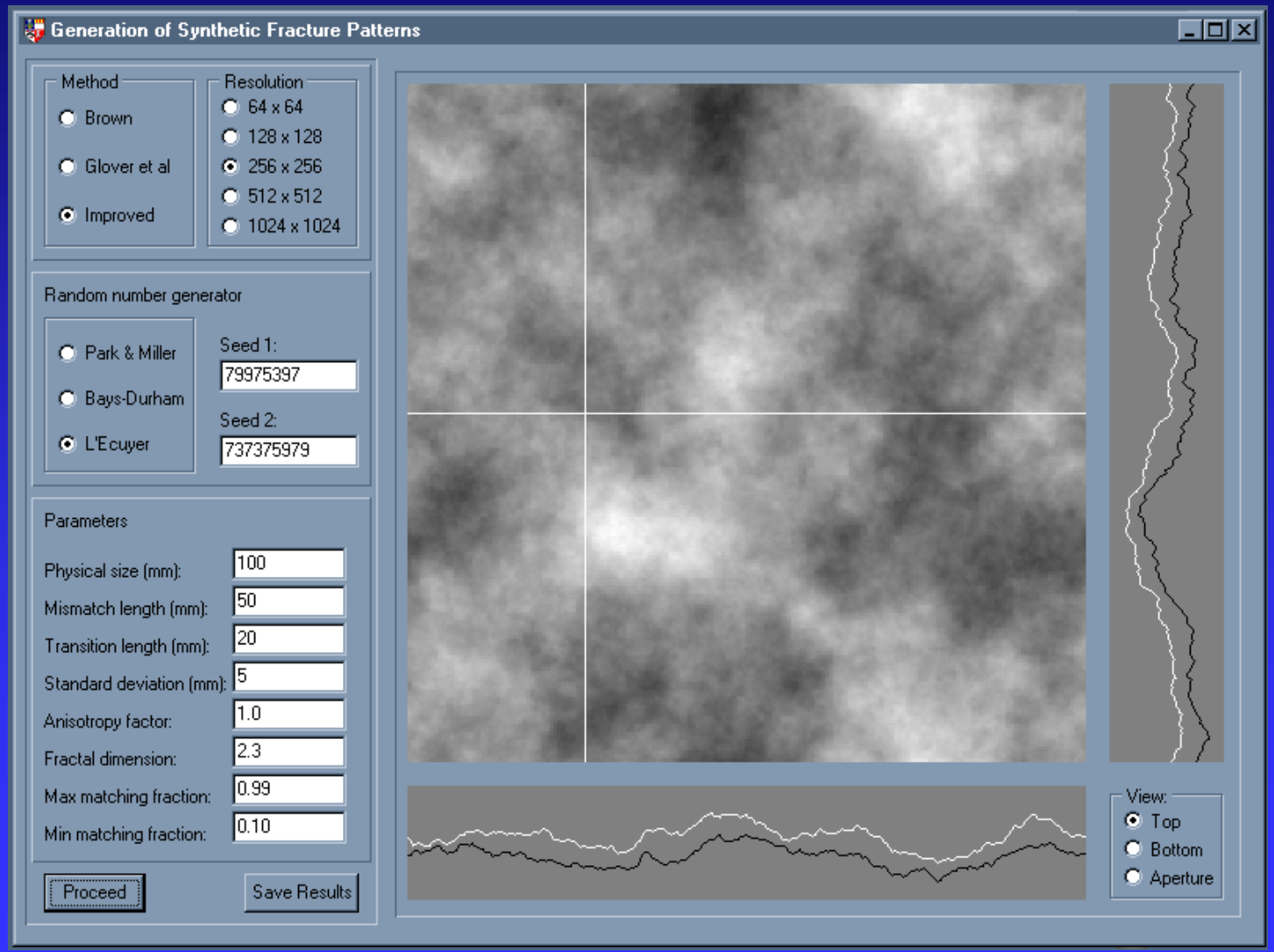


Glover et al. (1998)

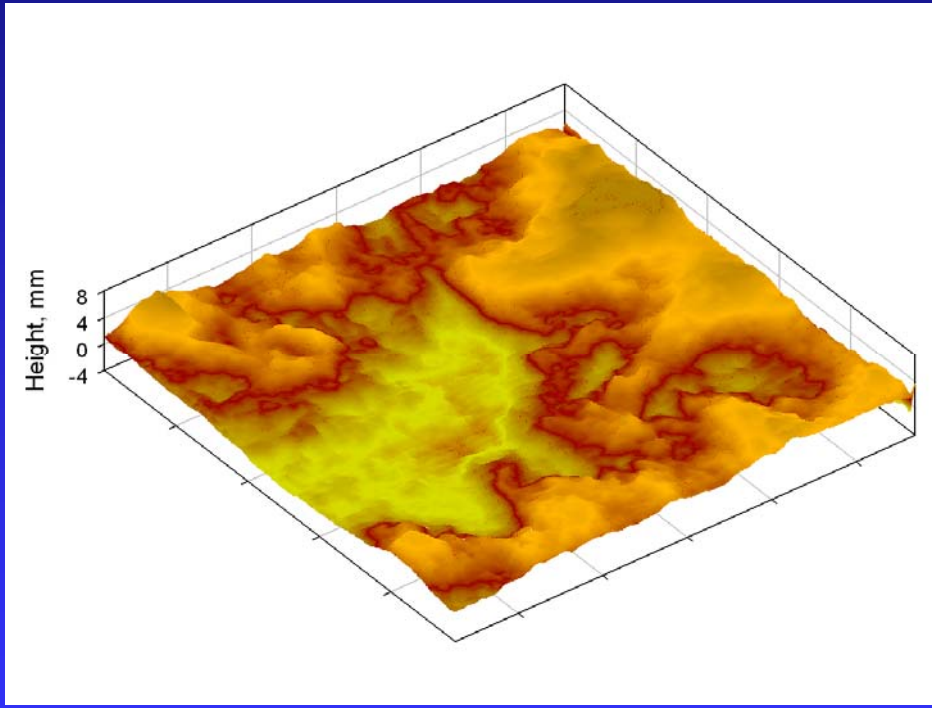


Present method

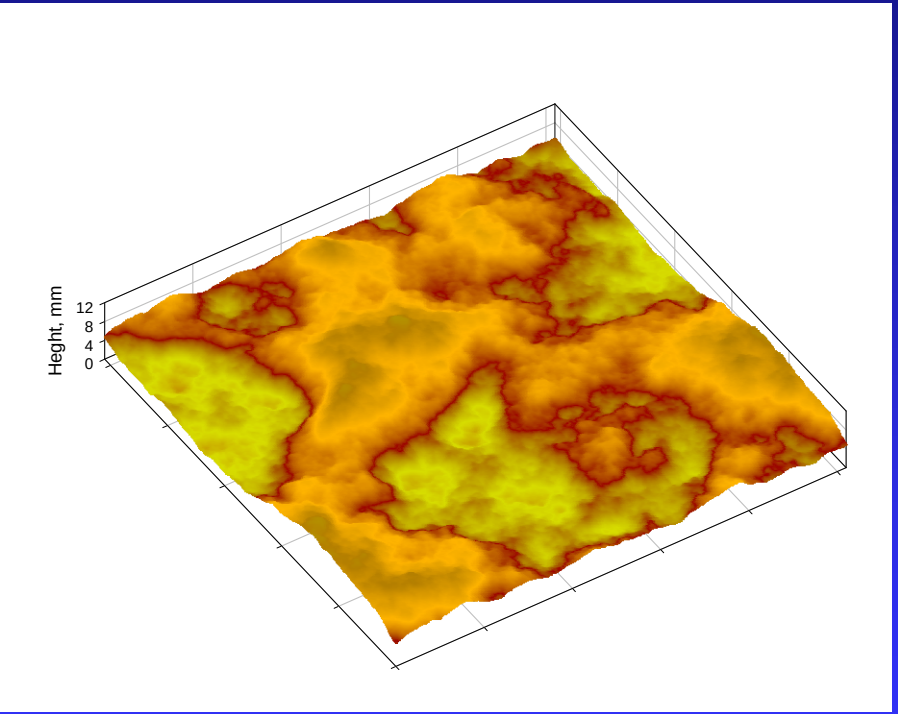
Software for Numerical Synthesis



Result of Numerical Synthesis



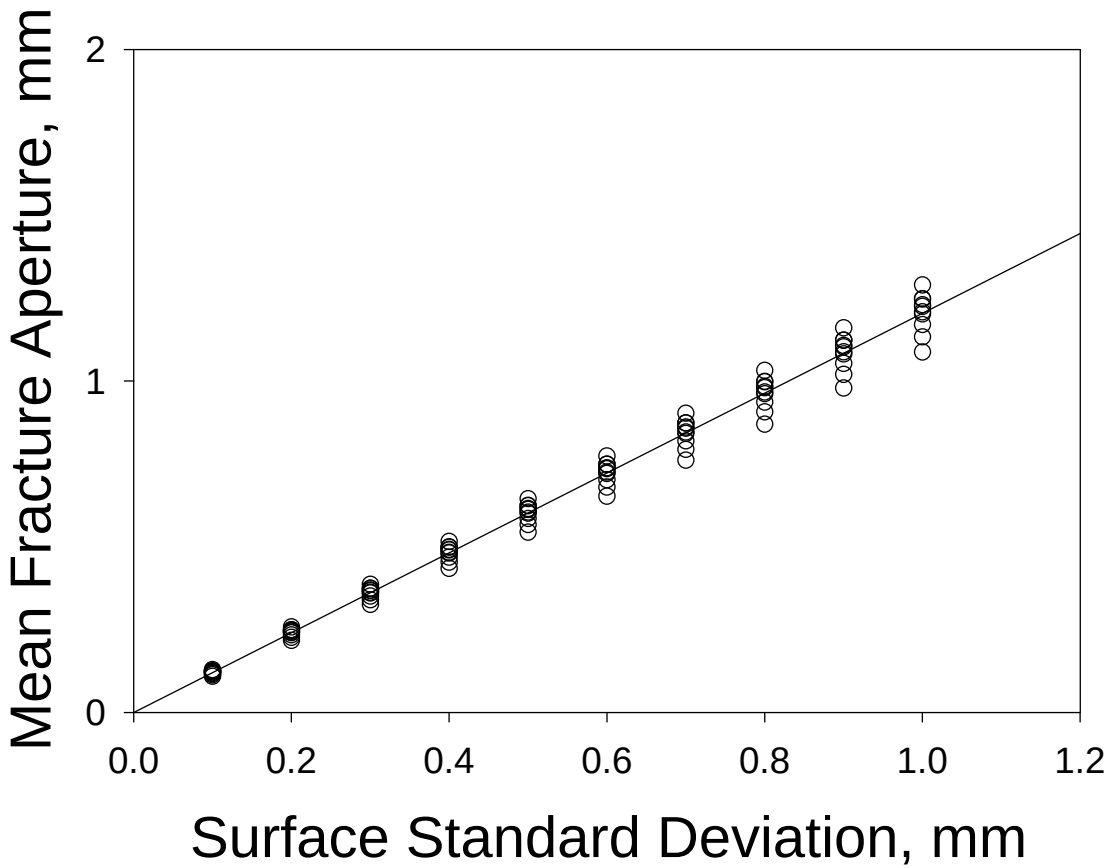
Pearly granite fracture surface



Synthesized fracture surface

Analysis of Synthetic Fracture Apertures

Surface Asperity Height Distribution



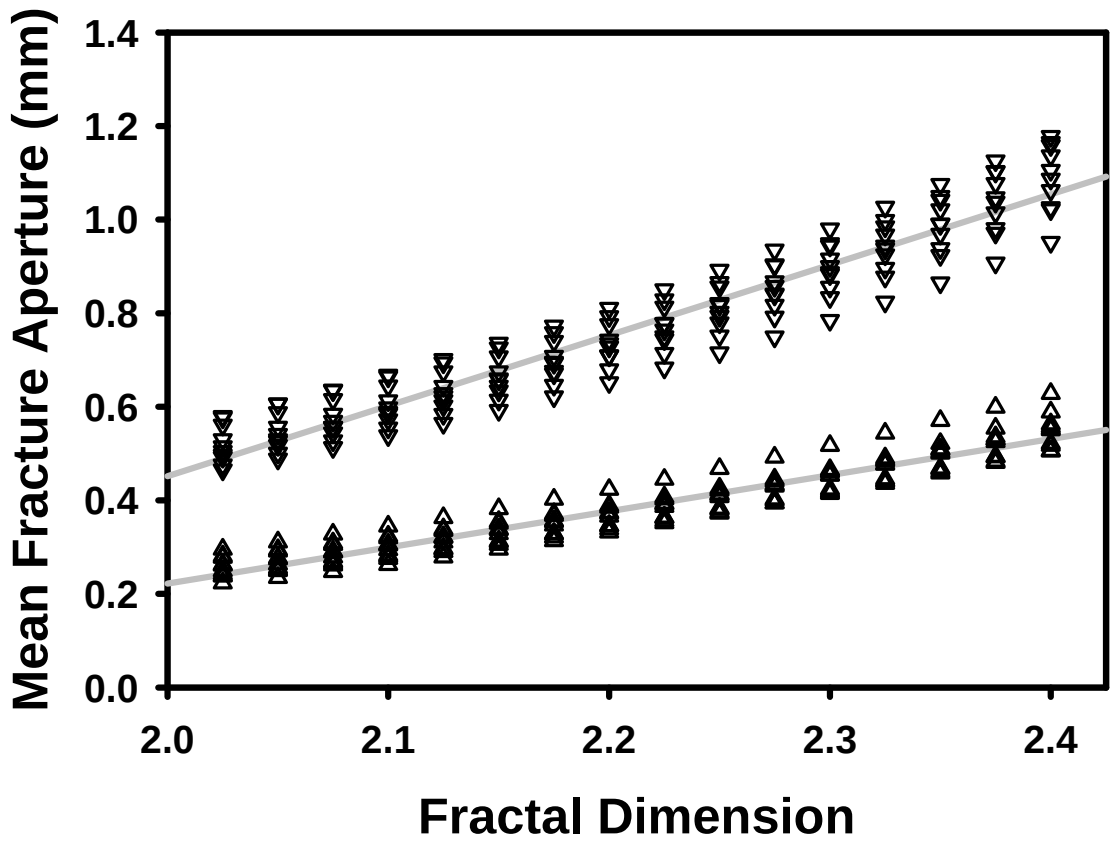
Method: AUPG

ML = 10 mm

TL = 20 mm

FD = 2.2

Fractal Dimension



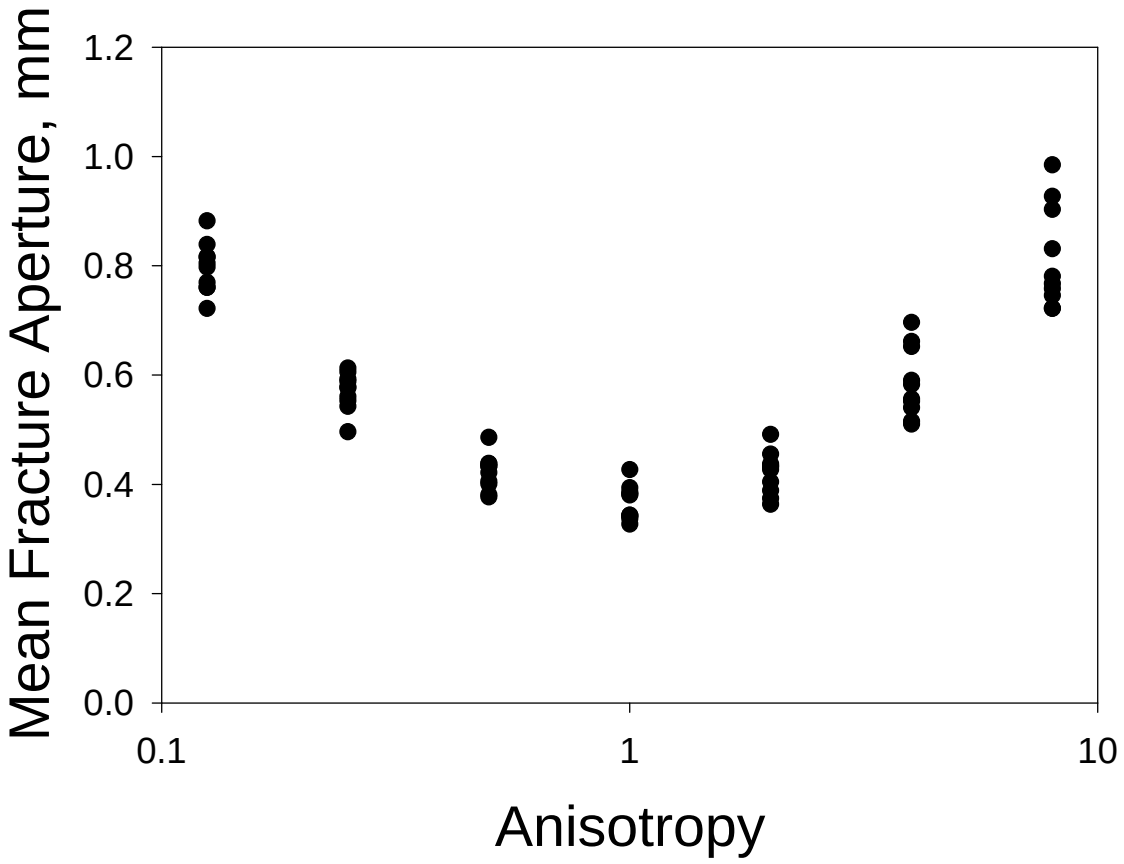
Method: AUPG

ML = 10 mm

TL = 20 mm

StD = 0.3; 0.6 mm

Surface Anisotropy



Method: AUPG

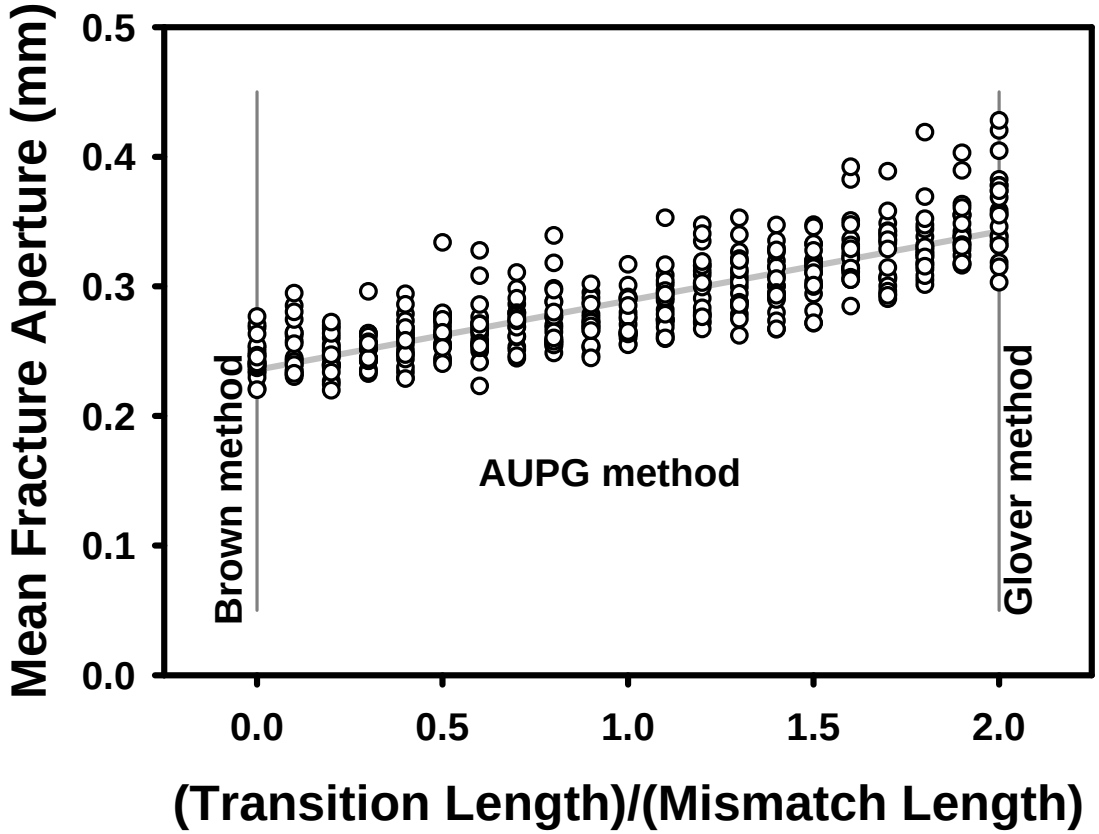
ML = 10 mm

TL = 20 mm

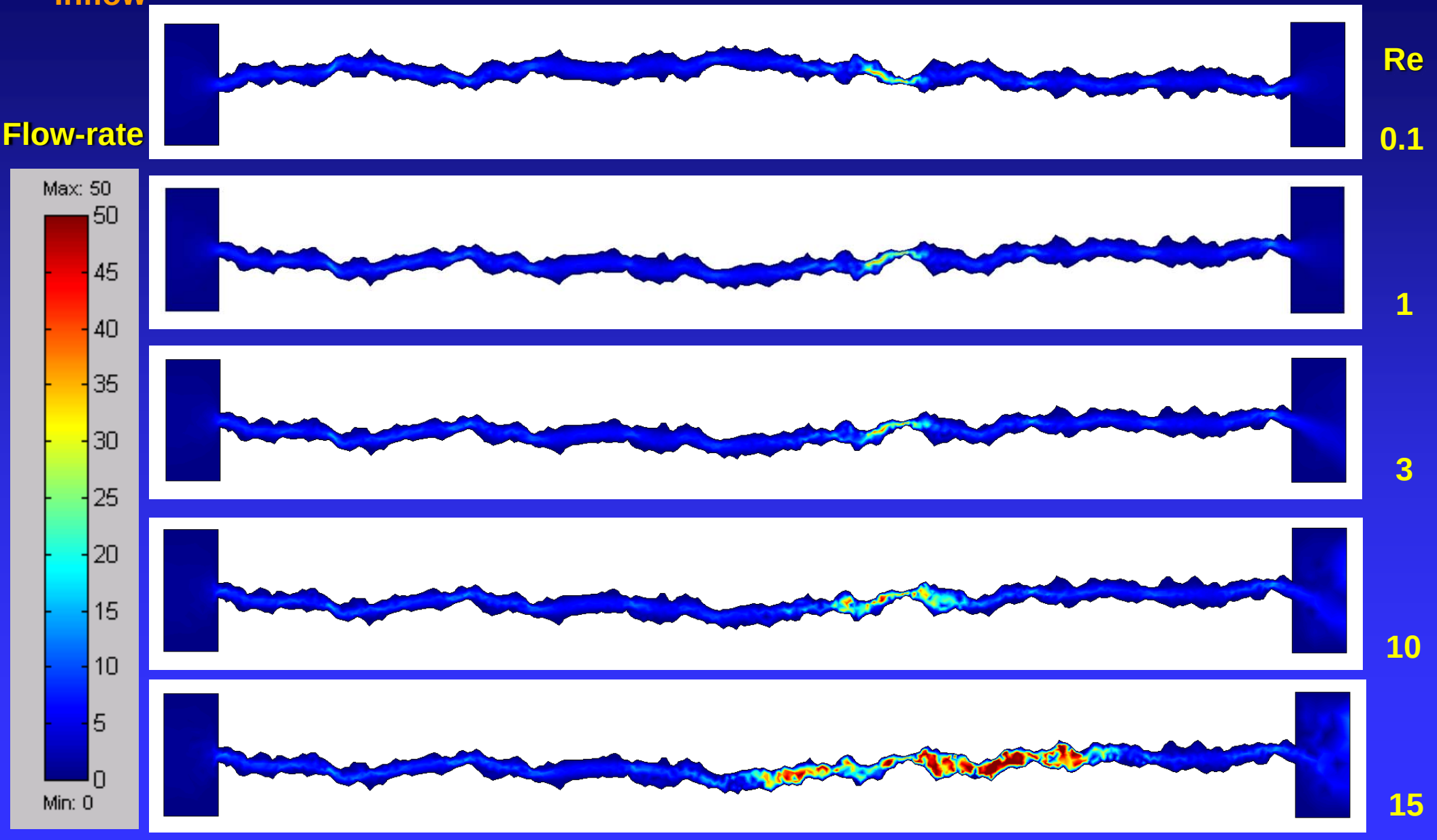
StD = 0.3 mm

FD = 2.2

Comparison of Different Methods



2-D Flow Modelling



Summary

- A new methodology was developed to generate a synthetic numerical models of rough fractures in rocks.
- The technique allows to parameterise surfaces of a real fractures in rocks.
- After tuning parameters of the numerical model, the synthetic numerical fracture surfaces have properties, which are quite close to real ones.
- Both numerical and real fracture surfaces can be used in computational flow modelling.

This work is funded by NERC as part of Micro to Macro thematic programme ongoing in the U.K.

http://petrophysics.webhop.net