Towards Crustal Reservoir Flow Structure Modelling

Interactive 3d Visualization of MEQ & MT Field Data

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Outline

• Overall Theme: 3D graphics visualization used to leverage the power of the human visual pattern recognition system

• Geophysical field data visualized:
  – Micro-seismic event locations
  – Fracture and porosity distributions
  – Seismic wave speed distributions
  – Fracture density distribution
  – Magnetotelluric resistivity distribution

• Discussion and future direction
Scientific data visualisation (implementation)

- Goal of scientific visualization:
  
  *Facilitate informed data exploration*

- Interactive graphics
  - Viewing parameters under user control
  - Performance: Real-time response
  - Stereoscopic viewing option
Micro-seismic event locations
Spatial clustering & magnitudes

Points: Orthographic plan projection (seismic event location)
Micro-seismic event locations
Spatial clustering & magnitudes

Points: 3D perspective projection (seismic event location)
Micro-seismic event locations
Spatial clustering & magnitudes

Glyphs: 3D perspective projection (seismic event location)
Micro-seismic event locations
Spatial clustering & magnitudes
Fracture and porosity distributions
Volumetric data cubes and scalar data

Colour-coded solid cube (synthetic porosity with depth & fracture)
Fracture and porosity distributions
Volumetric data cubes and scalar data

Extracted fracture slab (synthetic porosity)
Fracture and porosity distributions
Volumetric data cubes and scalar data

Extracted high porosity cells (synthetic porosity)
Fracture and porosity distributions

Volumetric data cubes and scalar data

Extracted low porosity slab (synthetic porosity)
Fracture and porosity distributions
Volumetric data cubes and scalar data

Extracted low porosity slab: 3D perspective projection
Fracture and porosity distributions
Volumetric data cubes and scalar data

Extracted low porosity slab: surface mesh
Seismic wave speed distributions
Method 1: Solid volumetric data cubes

3D solid data cube (pressure-wave velocity)
Seismic wave speed distributions
Method 1: Solid volumetric data cubes

3D data cube, threshold value cut-away (pressure-wave velocity)
Seismic wave speed distributions
Method 1: Solid volumetric data cubes

3D data cube, smoothed surface (pressure-wave velocity)
Seismic wave speed distributions
Method 1: Solid volumetric data cubes

3D data cube, wireframe cut-away (pressure-wave velocity)
Seismic wave speed distributions
Method 1: Solid volumetric data cubes

3D data cube, threshold value cut-away (pressure-wave velocity)
Seismic wave speed distributions
Method 2: Volumetric data cubes with transparency

3D solid data cube with transparency
(pressure-wave velocity)

Visualization transfer function
Seismic wave speed distributions
Method 2: Volumetric data cubes with transparency

3D solid data cube with transparency, (depth normalized pressure-wave velocity)

Visualization transfer function
Seismic wave speed distributions
Method 2: Volumetric data cubes with transparency

3D solid data cube with transparency,
(depth normalized shear-wave velocity)

Visualization transfer function
Seismic wave speed distributions
Method 2: Volumetric data cubes with transparency

Depth normalized pressure-wave velocity

Depth normalized shear-wave velocity
Fracture density distribution
Thin shell volumetric “iso-surfaces”

3D data cube (crack density)
Magnetotelluric resistivity distribution
Complex volumetric structures with transparency

3D data cube (synthetic conductivity with fracture)
Magnetotelluric resistivity distribution
Complex volumetric structures with transparency

3D data cube (synthetic conductivity with thermal outcrop)
Discussion & Questions?