IESE Institute of Earth Science and Engineering Aotearoa

New Zealand Geothermal Workshop 2011

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

Spatial clustering & magnitudes



Points: Orthographic plan projection (seismic event location)

Spatial clustering & magnitudes



Points: 3D perspective projection (seismic event location)

Spatial clustering & magnitudes



Glyphs: 3D perspective projection (seismic event location)

Spatial clustering & magnitudes



Coded glyphs: 3D perspective projection (seismic event location)

Volumetric data cubes and scalar data



Colour-coded solid cube (synthetic porosity with depth & fracture)

Volumetric data cubes and scalar data



Extracted fracture slab (synthetic porosity)

Volumetric data cubes and scalar data



Extracted high porosity cells (synthetic porosity)

Volumetric data cubes and scalar data



Extracted low porosity slab (synthetic porosity)

Volumetric data cubes and scalar data



Extracted low porosity slab: 3D perspective projection

Volumetric data cubes and scalar data



Extracted low porosity slab: surface mesh

Method 1: Solid volumetric data cubes



3D solid data cube (pressure-wave velocity)

Method 1: Solid volumetric data cubes



3D data cube, threshold value cut-away (pressure-wave velocity)

Method 1: Solid volumetric data cubes



3D data cube, smoothed surface (pressure-wave velocity)

Method 1: Solid volumetric data cubes



3D data cube, wireframe cut-away (pressure-wave velocity)

Method 1: Solid volumetric data cubes



3D data cube, threshold value cut-away (pressure-wave velocity)

Method 2: Volumetric data cubes with transparency



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



Visualization transfer function

Method 2: Volumetric data cubes with transparency



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



Visualization transfer function

Method 2: Volumetric data cubes with transparency



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



Visualization transfer function

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?



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