Benchmark 5 - OLD

Benchmark 5

Viscoelastic (Maxwell) relaxation of stresses from a single, finite, dip-slip earthquake in 3D without body forces. The analytical solution for the elastic displacement (available at geoweb.mit.edu/fe) is applied at the boundaries and held fixed through time.

Benchmark 5a: For at least 1 run, evaluate the model behavior on a specified mesh (available at geoweb.mit.edu/fe). Also investigate other meshes (grid spacing, element types, etc.) as allowed by the code.

Benchmark 5b: Using a mesh of your choice, investigate accuracy as a function of the number of nodes near the fault tip. Also consider variations in how the discrete fault tip is buried within the viscoelastic medium (i.e., # of nodes in transition, transition distance, etc.).

Benchmark 5c: Approximate pinned boundaries at infinite distances from the fault (either using infinite elements or extending the boundaries a far distance from the fault, using mesh grading).

GOALS

- Benchmark 5a: Evaluate accuracy efficiency of codes as a function of meshing technique and element type.
- Benchmark 5a: Code comparison.
- 5b: Test accuracy of code near fault tip.
- Benchmark 5b: Investigate ‘best’ methods for 1) discretizing the mesh near the fault tip and 2) approximating the brittle-ductile transition.
- Benchmark 5c: Comparison to semi-analytical solutions (e.g. VISCO1D).

DETAILED DESCRIPTION

- Model size: 24 km by 24 km by 24 km (0 km ? x; y ? 24 km; -24 km ? z ? 0 km) Top layer: -12 km ? z ? 0 km; Bottom layer: -24 km ? z ? -12 km
- Elastic material properties: Poisson solid, G = 30 GPa
- Maxwell viscoelastic material properties: Top layer: ? = 102^{5} Pa-s (essentially elastic) Bottom layer: ? = 10^{18} Pa-s
- Density and Gravity: None
- Boundary conditions: Bottom and all sides except the symmetry plane (y = 0 km) have analytical solution imposed (available at geoweb.mit.edu/fe) Side at y = 0 km has 0 y-displacement (i.e., symmetry condition applied) Top free
- Coarse mesh node spacing: dx = dy = dz = 2 km
- Fault specifications: Type: 45° dipping fault Location: Top edge at x = 4 km; Bottom edge at x = 20 km
- km ? y ? 16 km; -16 km ? z ? 0 km

- Slip distribution: 1 m of uniform thrust slip (0.707 m in the z-direction and -0.707 m in the x-direction) for 0 km ? y ? 12 km and -12 km ? z ? 0 km with a linear taper to 0 slip at y = 16 km and z = -16 km.

ESTED OUTPUT AND RESULTS

/ariations: As memory, time, and patience allow, run models at 1/2, 1/4, and 1/8, etc. the original coarse spacing, investigate variable mesh spacing, and/or employ a variety of element types.

Benchmark Variations:

Stresses and displacements along three lines parallel to the y-axis at 0, 1, and 5 km from the fault plane at the depths of 0, 12, 16, 17, and 21 km (e.g. at the surface x=4, 5, and 9 km, at z = -12, x=16, 17, and 20 km); and three lines parallel to the x-axis at y = 12, 17, and 21, at depths of 0, 12, 16, 17 and 21 below the surface, all results at times of 0, 1, 5 and 10 years.
CPU time, wallclock time, memory usage info, compiler info, and platform info

used to generate an elastic solution. The 'best' viscoelastic answer will be derived via mesh refinement the distance to the model boundaries. Analytical solutions to the viscoelastic solution are being sought nformation.

NOTES

parisons involving variations in rheology across the fault, please also build in layer boundaries at z = -6 ging wall side of the fault and z = -10 km on the footwall side of the fault.

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oblem definitions: http://www-gpsg.mit.edu/fe/Meshes.html

_2d_refine_tip
_2d_uniform
_3d_tet

create mesh:

2D triangle and 3D tetrahedral mesh:

ne_tip.gmv
ne_tip.inp
form.gmv

form.inp
s.gmv
s.inp

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