Setting Up, Solving, and Visualizing a Simple Problem Using CUBIT/PyLith/ParaView

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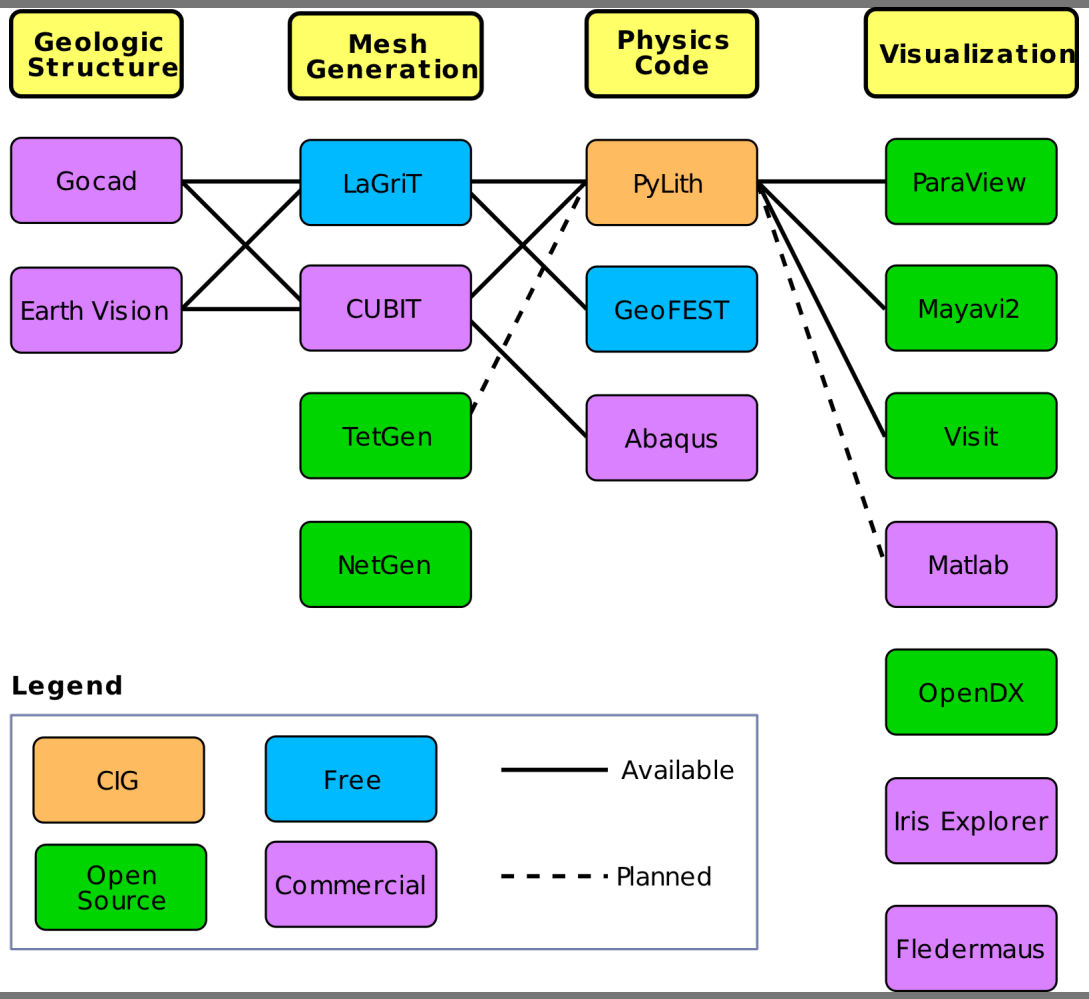
Computational Infrastructure for Geodynamics

Workflow for typical problem



Steps in setting up a PyLith simulation

- Generate mesh
  - Make sure to represent all desired boundaries
  - Make sure to create material groups for each possible material type
- Create .cfg files
- Create spatial databases
- Run simulation(s)
- Visualize results (may need postprocessing)

Configure (.cfg) files

- pylithapp.cfg: parameters common to all simulations
  - Journal options
  - Mesh
  - Materials (may be overridden) and quadrature
  - Solver settings
- stepxx.cfg: parameters specific to problem
  - Boundary condition and fault parameters
  - Non-default material settings
  - Time step parameters
  - Output parameters
  - Additional parameters (gravity, initial stresses, nonlinear solver, etc.)

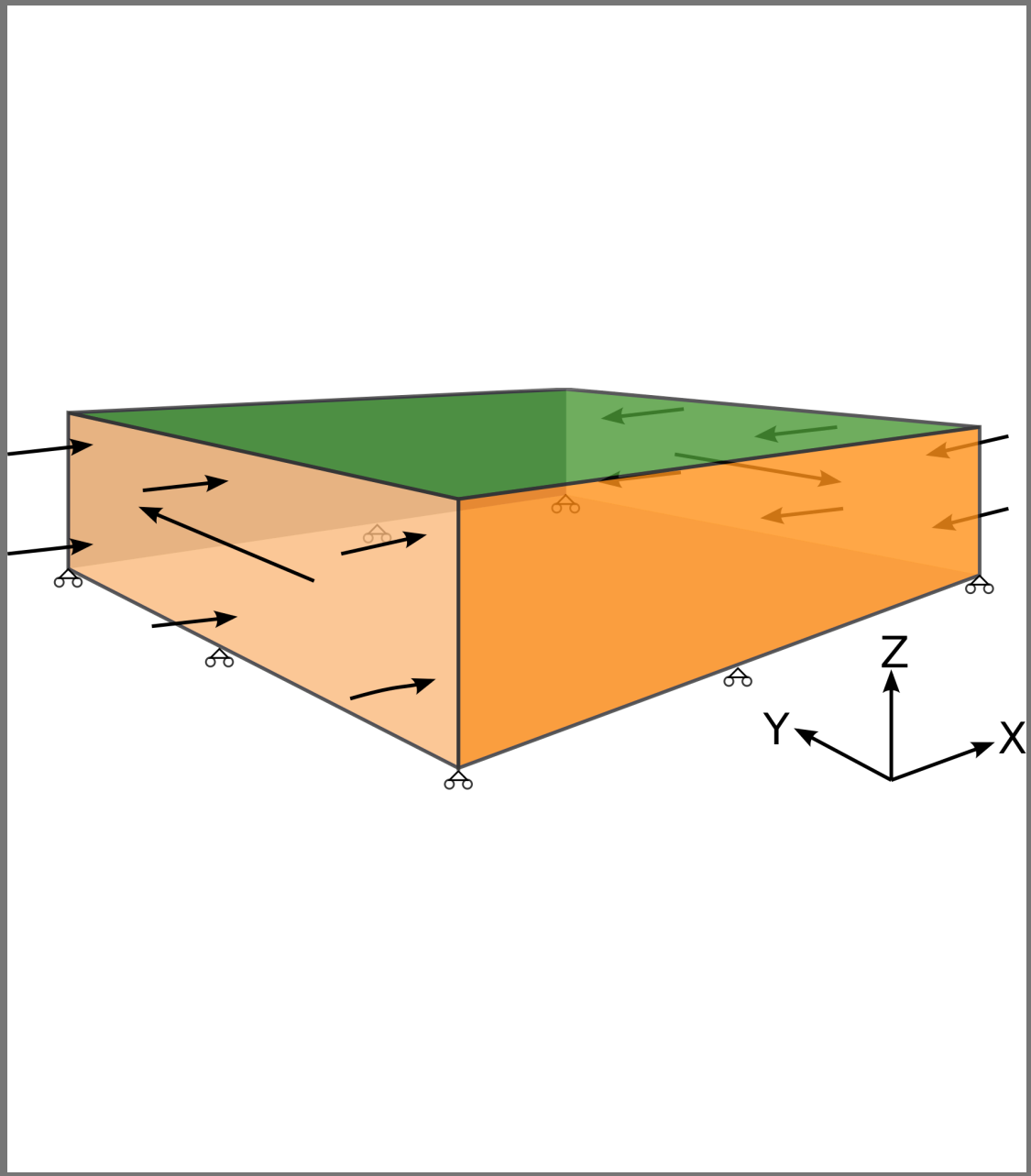
Example step01

Shear displacements applied along –X and +X.

Fixed Z-displacements along –Z.

Purely elastic.

Single time step.



Files needed for example step01

- Mesh (used for all simulations)
  - mesh/box_hex8_1000m.exo
- .cfg:
  - pylithapp.cfg
  - step01.cfg
- spatialdb:
  - spatialdb/mat_elastic.spatialdb
    - Elastic properties
  - spatialdb/fixeddisp_axial_shear.spatialdb
    - Shear displacement BC

Example step03

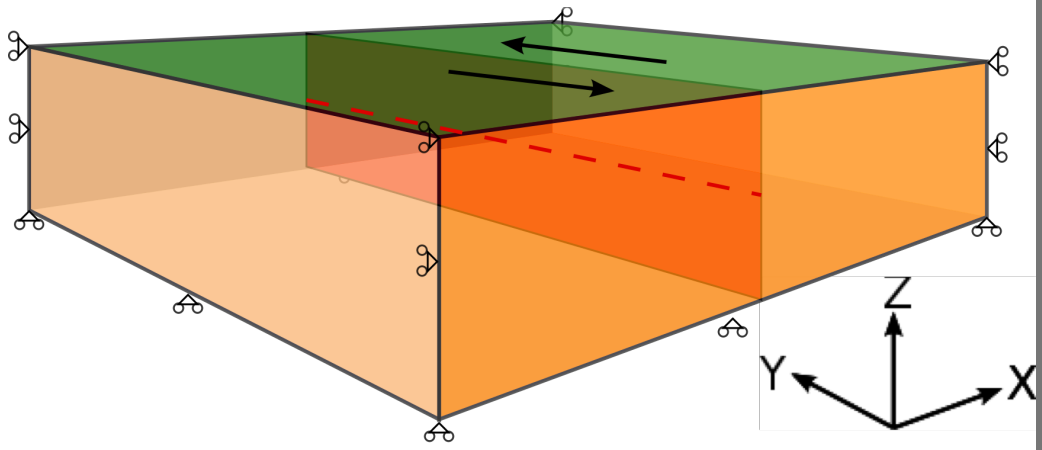
X and Y displacements fixed on +X and –X

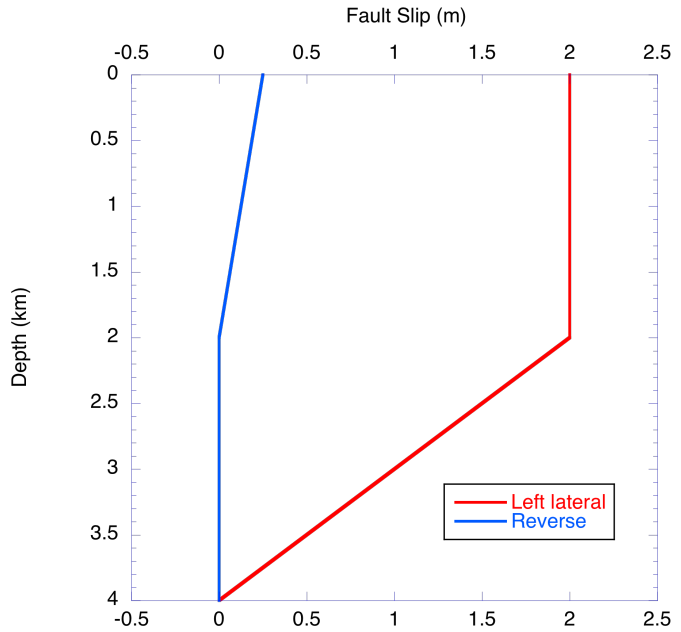
Z displacements fixed on -Z

Depth-varying fault slip, primarily left-lateral

Purely elastic

Single time step





Files needed for example step03

- Mesh (used for all simulations)
  - mesh/box_hex8_1000m.exo
- .cfg:
  - pylithapp.cfg
  - step03.cfg
- spatialdb:
  - spatialdb/mat_elastic.spatialdb
    - Elastic properties
  - spatialdb/finalslip.spatialdb
    - Applied slip
  - spatialdb/sliptime.spatialdb
    - Time at which slip initiates

Example step06

X and Y displacements fixed on +X and –X

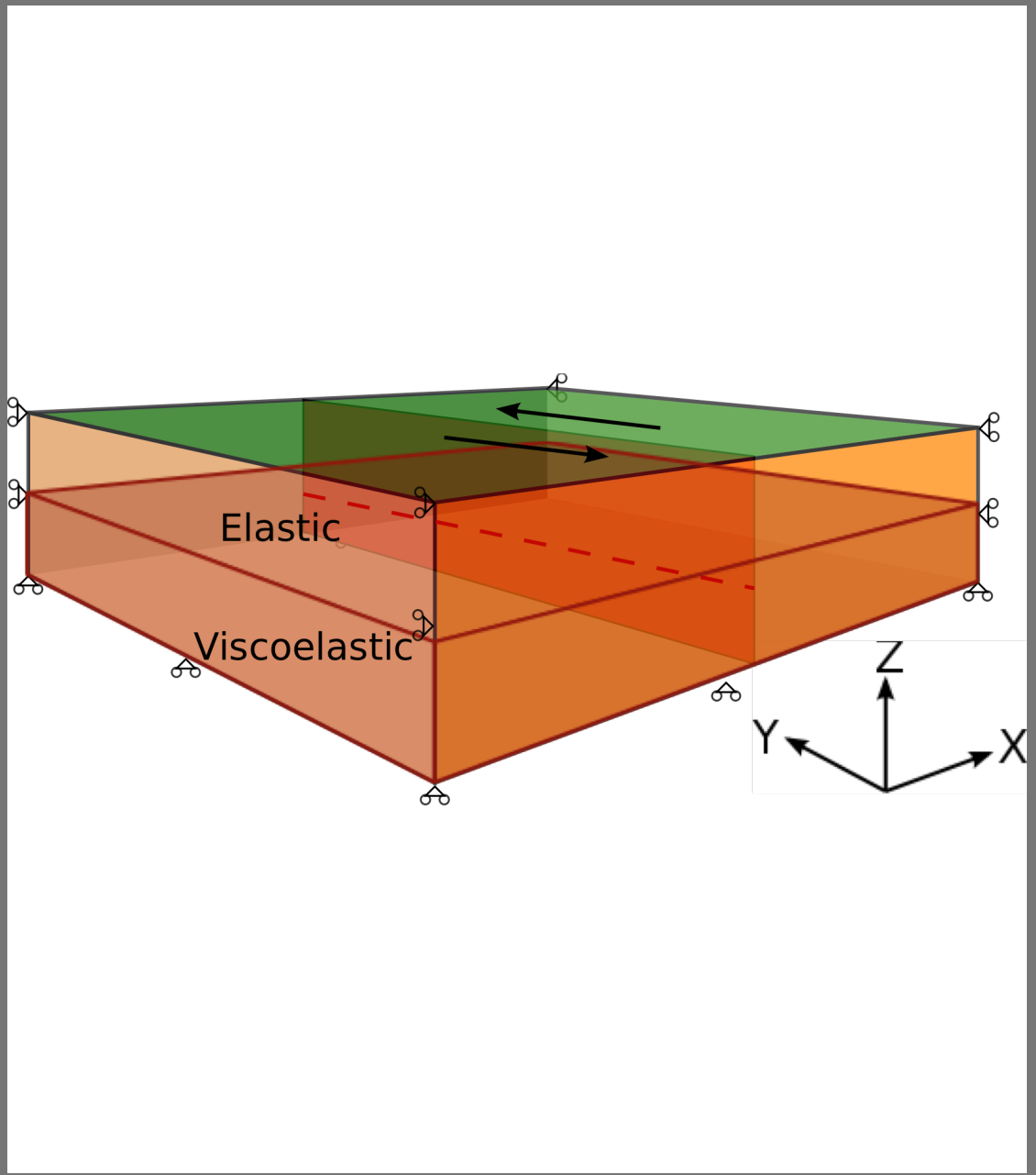
Z displacements fixed on –Z

Upper portion of fault ruptures at regular intervals

Lower portion of fault slips at steady rate

Upper material is elastic, lower material is Maxwell viscoelastic

Simulation runs for 700 years



Files needed for example step06

- Mesh (used for all simulations)
  - mesh/box_hex8_1000m.exo
- .cfg:
  - pylithapp.cfg
  - step06.cfg
- spatialdb:
  - spatialdb/mat_elastic.spatialdb
    - Elastic properties
  - spatialdb/mat_maxwell.spatialdb
    - Viscoelastic properties
  - spatialdb/finalslip_rupture.spatialdb
    - Slip applied for each rupture
  - spatialdb/sliptime.spatialdb
    - Time at which slip initiates
  - spatialdb/sliprate_creep.spatialdb
    - Slip rate for creeping portion