

Software Tools

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by Brad Aagaard — last modified Mar 01, 2012 11:01 AM

Tools for numerical modeling of crustal dynamics and earthquake faulting.

See the [workflow diagram](#) for how combinations of these tools are usually used in the context of numerical modeling of crustal dynamics.

Geologic Structure

Gocad

Commercial software for constructing and interpreting models of geologic structure. Primarily used in oil, gas, mining, and environmental work. Good for constructing fault surfaces from geologic data sets. Exports surfaces in ASCII Tsurf format. Used to construct the SCEC Community Fault Model and SCEC Community Velocity Model-H (i.e., the Harvard model).

Website: www.earthdecision.com

Availability: commercial

Earth Vision

Commercial software for constructing and interpreting models of geologic structure. Primarily used in oil and gas work. Can export surfaces in ASCII Tsurf format. Used to construct the USGS Northern CA 3-D geologic model.

Website: www.dgi.com

Availability: commercial

Mesh Generation

CUBIT

Sandia National Laboratories developed mesh generation tool for structured and unstructured 2-D and 3-D models. Support for unstructured hex meshing and its GUI and scripting interfaces make this a popular tool. Importing complex geologic models (e.g., Tsurf files) can be difficult. Export to Exodus files allows seamless integration with PyLith.

Website: cubit.sandia.gov (US gov't agencies)

Tutorials: cubit.sandia.gov/public/tutorials.html

SOFTWARE TOOLS

Availability: non-commercial; small, one time acquisition fee for US Gov't agencies

Trelis

Commercial version of CUBIT for non-US gov't agencies. We are finding small, subtle differences with CUBIT in terms of portability of journal files.

Website: csimsoft.com (Academic and non-US gov't agencies)

Tutorials: csimsoft.com/tutorials.jsp

Availability: commercial

LaGriT

Los Alamos Grid Toolbox (LaGriT) for generation of unstructured triangular and tetrahedral meshes. User interface is the command line or an input file. Steeper learning curve than CUBIT but has rich features for manipulating the mesh and improving element quality. Seamless import of Tsurf files. Export to GMV/Pset files allows seamless integration with [PyLith](#).

Website: lagrit.lanl.gov

Availability: free; Binaries for Mac, Linux, and Sun; no longer under active development

Gmsh

Open source code for generating structured and unstructured meshes. Graphical user interface for geometry construction and meshing. Similar to CUBIT but geometry tools are more limited.

Website: geuz.org/gmsh/

Availability: open source (C++)

TetGen

Open source code for generating tetrahedral meshes. Volume mesh created from surface meshes.

Website: tetgen.org

Availability: open source (C++)

Physics Code

PyLith

SOFTWARE TOOLS

CIG developed open-source code for modeling 2-D and 3-D dynamic and quasi-static crustal deformation. Elements supported include linear triangular, quadrilateral, tetrahedral, and hexahedral cells.

Website: www.geodynamics.org/cig/software/pylith

Availability: Source code with binaries for several platforms.

Relax

Open-source code developed by Sylvain Barbot and supported by CIG for modeling 2-D and 3-D quasi-static crustal deformation. Relax implements a semi-analytic Fourier-domain solver and equivalent body forces to compute quasi-static relaxation of a stress perturbation.

Website: www.geodynamics.org/cig/software/relax

Availability: Source code with binaries for several platforms.

GeoFEST

NASA/JPL developed code for modeling quasi-static crustal deformation. Includes adaptive mesh refinement using Pyramid. Supports tetrahedral cells.

Website: www.openchannelsoftware.org/projects/GeoFEST

Availability: source code ©; development status unknown

Abaqus

Commercial finite-element code. Primarily used in mechanical engineering work.

Website: www.simulia.com Availability: commercial

Visualization

ParaView

Open-source, VTK-based 3-D visualization software. Easy to use GUI with Python scripting capabilities. Seamless visualization of PyLith output. Some documentation via builtin help, but detailed documentation is sold by Kitware.

Website: www.paraview.org

Tutorials: www.paraview.org/Wiki/The_ParaView_Tutorial

Availability: source code with binaries for several platforms.

SOFTWARE TOOLS

Visit

Open-source, VTK-based 3-D visualization software. Easy to use GUI with Python scripting capabilities. Seamless visualization of PyLith output. Extensive documentation.

Website: visit.llnl.gov

Availability: source code with binaries for several platforms.

Matlab

Widely used commercial visualization and data processing software. 3-D visualization is somewhat limited compared with most 3-D visualization tools.

Website: www.mathworks.com

Availability: commercial

Mayavi

Open-source, VTK-based 3-D visualization software. Easy to use GUI with extensive Python scripting capabilities. Moderate learning curve due to limited documentation. Can be difficult to install due to many dependencies.

Website: <http://code.enthought.com/projects/mayavi/>

Availability: open source

Contributed Utilities

Matlab interface to Okada 1992, Noah Fay, 2006

Tarball with Matlab scripts and Fortran code to compute dislocations for Strike-Slip and Reverse quasi-static problems in the Crustal Deformation Modeling benchmark suite.

(https://github.com/geodynamics/pylith_benchmarks).

- [okada1992_noahfay.tgz](#) (2 MB, uploaded by Lorraine Hwang 3 years 9 months ago)