CIG Business Meeting

December 11, 2007

Short-Term Crustal Dynamics Working Group

Brad Aagaard

Computational Infrastructure for Geodynamics

National Science Foundation
WHERE DISCOVERIES BEGIN

Workshops

- Community Finite-Element Modeling workshop, June 25–29, 2007
  - 6th annual workshop
  - Sponsored by CIG, SCEC, NSF, NASA
  - 60 participants
  - Mixture of science talks, training, and discussion of working group priorities for CIG

- Numerical Modeling of Crustal Deformation workshop, June 23–27, 2008, Colorado School of Mines
  - Seeking funding from same sponsors
  - Expect similar number of attendees
  - Mixture of science talks, training, and discussion of working group activities
  - Suggestions for science talks welcome!
  - Emphasis on application of codes to research problems

Current Working Group Activities

- PyLith 1.0 (Brad Aagaard, Charles Williams, Matthew Knepley)
  - Parallel, 1-D, 2-D and 3-D finite-element code for modeling crustal deformation associated with earthquake faulting and elastic and/or viscoelastic rheologies
  - Version 1.0.0 released at CFEM 2007 workshop
  - Version 1.0.2 released Dec 5
  - Expect 5 additional releases in next 2 years (2–3 before workshop)
- Cataloging of semi-analytic codes (Rob Mellors)
  - Collect codes useful for utility calculations and benchmarking
  - May request help from CIG to make most valuable codes more accessible
- Benchmarking crustal deformation codes
  - Working with CIG (Luis Armendariz) to develop infrastructure for benchmarking codes (PyLith, GeoFEST, COMSOL)

Long-Term Plans

- PyLith
  - Resolve 4-D elastic, plastic, and viscoelastic deformation associated with earthquake faulting
  - Integrate computing quasi-static and dynamic deformation
- Data assimilation
  - Need tools for using EarthScope data as constraints in modeling
- Adjoint methods
  - Meaningful error estimation
  - Adaptive mesh refinement
  - Inversion of earthquake source parameters and rheologies

Links to Other Working Groups

- Computational infrastructure
  - Sieve/PETSc - Finite-element operations and linear algebra
  - Pyre - Simulation framework for getting user input and driving simulations
  - Mesh generation for realistic geologic structure
  - Efficient, scalable solvers/preconditioners for multiscale problems

- Understanding the Earth
  - Physical properties (bulk and fault rheologies)
  - Earthquake dynamics
    - Deformation associated with earthquake faulting
    - Earthquake rupture is input to Computational Seismology
  - Tectonic deformation
    - Deformation associated with strain accumulation and post-seismic relaxation
    - Plate motion is output from Mantle Convection
    - Fault evolution is output from Long-Term Crustal Dynamics

Obstacles

- Mesh generation for realistic geologic structure
- Efficient, scalable solvers/preconditioners for multiscale problems
- Understanding sensitivity of modeling results to uncertainty in geological structure and numerical discretization
- Building/installing complex software with many dependencies