Petascale Dynamic Rupture Modeling

Geoffrey Ely
Leadership Computing Facility
Argonne National Laboratory
gely@anl.gov

Dynamic rupture simulations for modeling large earthquake scenarios pose substantial computational challenges. The relevant phenomena (frictional breakdown, shear heating, effective normal-stress fluctuations, material damage, etc.) controlling rupture are strongly interacting and span many orders of magnitude in spatial scale, requiring high-resolution simulations that couple disparate physical processes (e.g., elastodynamics, thermal weakening, pore-fluid transport, and heat conduction). Compounding the computational challenge, we know that natural faults are not planar, but instead have roughness that can be approximated by power laws potentially leading to large, multiscale fluctuations in normal stress. The capacity to perform 3D rupture simulations that couple these processes will provide guidance for constructing appropriate source models for high-frequency ground motion simulations. Petascale supercomputing is now making this feasible. The Argonne Leadership Computing Facility (ALCF) Early Science Program is supporting work to adapt the Support Operator Rupture Dynamics code (SORD) for Blue Gene/Q architecture. This capability will soon lead to improved seismic hazard estimates, and better preparedness for the "Big One."