2013

Earthquake Rupture Dynamics using Adaptive Mesh Refinement and High-Order Accurate Numerical Methods

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Kozdon, J.E., Wilcox, L. (2013) Earthquake Rupture Dynamics using Adaptive Mesh

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Details

Meeting	2013 Fall Meeting
Section	Study of Earth's Deep Interior
Session	State of the Art in Computational Geoscience I Posters [SWIRL_CM.CU]
Identifier	DI31A-2198
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Index Terms	Numerical solutions [0560] High-performance computing [1932] Earthquake dynamics [7209] Computational seismology [7290]

Abstract

Our goal is to develop scalable and adaptive (spatial and temporal) numerical methods for coupled, multiphysics problems using high-order accurate numerical methods. To do so, we are developing an opensource, parallel library known as bfam (available at http://bfam.in). The first application to be developed on top of bfam is an earthquake rupture dynamics solver using high-order discontinuous Galerkin methods and summation-by-parts finite difference methods. In earthquake rupture dynamics, wave propagation in the Earth's crust is coupled to frictional sliding on fault interfaces. This coupling is two-way, required the simultaneous simulation of both processes. The use of laboratory-measured friction parameters requires near-fault resolution that is 4-5 orders of magnitude higher than that needed to resolve the frequencies of interest in the volume. This, along with earlier simulations using a low-order, finite volume based adaptive mesh refinement framework, suggest that adaptive mesh refinement is ideally suited for this problem. The use of high-order methods is motivated by the high level of resolution required off the fault in earlier the low-order finite volume simulations; we believe this need for resolution is a result of the excessive numerical dissipation of low-order methods. In bfam spatial adaptivity is handled using the p4est library and temporal adaptivity will be accomplished through local time stepping. In this presentation we will present the guiding principles behind the library as well as verification of code against the Southern California Earthquake Center

dynamic rupture code validation test problems.

Cite as: Author(s) (2013), Title, Abstract DI31A-2198 presented at 2013 Fall Meeting, AGU, San Francisco, Calif., 9-13 Dec.
