2006 Fall Meeting
Search Results

Cite abstracts as Author(s) (2006), Title, Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract xxxxx-xx

Your query was: ampuero

HR: 0800h
AN: **S41B-1336**
TI: Dispersion Analysis and High-Order Symplectic Time Schemes in Spectral-Element Based Seismic Wave Propagation

AU: *** Mercerat, D**
EM: mercerat@ipgp.jussieu.fr
AF: Departement de Sismologie. Institut de Physique du Globe de Paris, 4, Place Jussieu. Tour 24-25 Case 89, Paris cedex 05, 75252 France
AU: **Ampuero, J**
EM: ampuero@erdw.ethz.ch
AF: ETH Zurich. Institute of Geophysics., ETH Honggerberg HPP O13.1, Zurich, CH-8093 Switzerland
AU: **Nissen-Meyer, T**
EM: tarje@princeton.edu
AF: Department of Geosciences. Princeton University, 312 Guyot Hall Princeton University, Princeton, NJ 08544 United States

AB: Some problems in global seismology require the computation of synthetic seismograms with particularly high accuracy for waves travelling over very long distances. For instance the R3 and R4 phases (Rayleigh waves propagating twice around the globe) can improve data coverage and provide valuable information about the Earth structure. The spectral element method (SEM) is now widely applied in seismic wave propagation, owing to its often claimed geometrical flexibility and high accuracy. It appears however that a complete theoretical analysis of the dispersion properties of the SEM has been missing, or that existing results have had little exposure in the computational seismology community. We have analyzed the dispersion properties of the spectral element method (SEM) for the wave equation, with an emphasis on practical issues for the numerical modelling of seismic wave propagation. The asymptotic behavior of the dispersion error is given in closed form. We show how to select the polynomial order p, the element size h and the timestep Δt in order to minimize the computational cost for a given accuracy goal. When the accuracy requirements are stringent, we show that the spectral convergence of the SEM is wasted by the usage of low-order time integration schemes such as Newmark and centered differences. In these cases, we reduce the dispersion error by applying high-order symplectic time schemes developped in astrophysics and molecular dynamics. These schemes are easy to implement in existing codes and have low memory and CPU cost. We show how to select the optimal order of the time scheme that meets a prescribed accuracy while minimizing the computational cost. We will report on our efforts to further optimize the symplectic family for the wave equation, and illustrate the advantages in applications ranging from local to global scale seismic wave propagation. This work is partly funded by SPICE, a Marie-Curie Research and Training Network.

DE: 7255 Surface waves and free oscillations
DE: 7260 Theory
DE: 7290 Computational seismology
SC: Seismology [S]
MN: 2006 Fall Meeting

New Search