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Distributed Seismic Moment Fault Model, Spectral Characteristics and Radiation Patterns

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We implement a Distributed Seismic Moment (DSM) fault model, a physics-based representation of an earthquake source based on a skewed-Gaussian slip distribution over an elliptical rupture patch, for the purpose of forward modeling of seismic-wave propagation in 3-D heterogeneous medium. The elliptical rupture patch is described by 13 parameters: location (3), dimensions of the patch (2), patch orientation (1), focal mechanism (3), nucleation point (2), peak slip (1), rupture velocity (1). A node based second order finite difference approach is used to solve the seismic-wave equations in displacement formulation (WPP, Nilsson et al., 2007).
Results of our DSM fault model are compared with three commonly used fault models: Point Source Model (PSM), Haskell's fault Model (HM), and HM with Radial (HMR) rupture propagation. Spectral features of the waveforms and radiation patterns from these four models are investigated.
The DSM fault model best incorporates the simplicity and symmetry of the PSM with the directivity effects of the HMR while satisfying the physical requirements, i.e. smooth transition from peak slip at the nucleation point to zero at the rupture patch border. The implementation of the DSM in seismic-wave propagation forward models comes at negligible computational cost.

Reference:
Nilsson, S., Petersson, N. A., Sjogreen, B., and Kreiss, H.-O. (2007). Stable Difference Approximations for the Elastic Wave Equation in Second Order Formulation. SIAM Journal on Numerical Analysis, 45(5), 1902-1936.