DYNAMIC RUPTURE INVERSE MODELING ACROSS BROAD SPATIAL AND TEMPORAL SCALES

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Inference of earthquake source parameters from observational data can be constrained by dynamic rupture modeling, combining an assumed friction law with the elastodynamic equation. We present techniques for dynamic rupture inversions and selected applications, including low-frequency waveform inversions for slip-weakening friction parameters of the 2016 Mw6.2 Amatrice, Italy, and the 2020 Mw6.8 Elazığ, Türkiye, earthquakes. We also introduce recently developed dynamic inversions of i) apparent source time functions of a deep-focus earthquake in Eastern China and ii) apparent source spectra of a Mw4 event in Central Italy. Finally, we present dynamic source inversions with rate-and-state friction law of seismic and geodetic data, inferring jointly parameters corresponding to co- and post-seismic slip and thus bridging time scales from seconds to weeks.

Smooth planar dynamic rupture models tend to underestimate the high-frequency content of observed ground motions. To remedy this issue, we introduce small-scale random fractal perturbations of initial stress and fracture energy, while keeping the efficacy of planar fault simulations. For a generic elliptical Mw6.3 dynamic model and a low-frequency inverted dynamic model of the 2016 Mw6.2 Amatrice, we demonstrate that the random perturbations preserve large-scale characteristics of the original models and introduce small-scale abrupt changes in rupture velocity (undetectable by the low-frequency inversion). The latter improves the fit to the recordings of the Amatrice earthquake and Central Italy ground motion model up to 5-10 Hz. Such physically constrained broadband rupture models will guide further research toward realistic dynamic rupture scenarios for seismic hazard assessment.