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Simulating Large-Scale Earthquake Dynamic Rupture Scenarios On Natural Fault Zones Using the ADER-DG Method

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In this presentation we will demonstrate the benefits of using modern numerical methods to support physic-based ground motion modeling and research. For this purpose, we utilize SeisSol an arbitrary high-order derivative Discontinuous Galerkin (ADER-DG) scheme to solve the spontaneous rupture problem with high-order accuracy in space and time using three-dimensional unstructured tetrahedral meshes.

We recently verified the method in various advanced test cases of the ‘SCEC/USGS Dynamic Earthquake Rupture Code Verification Exercise’ benchmark suite, including branching and dipping fault systems, heterogeneous background stresses, bi-material faults and rate-and-state friction constitutive formulations.

Now, we study the dynamic rupture process using 3D meshes of fault systems constructed from geological and geophysical constraints, such as high-resolution topography, 3D velocity models and fault geometries. Our starting point is a large scale earthquake dynamic rupture scenario based on the 1994 Northridge blind thrust event in Southern California. Starting from this well documented and extensively studied event, we intend to understand the ground-motion, including the relevant high frequency content, generated from complex fault systems and its variation arising from various physical constraints. For example, our results imply that the Northridge fault geometry favors a pulse-like rupture behavior.