EARTHQUAKE GROUND MOTION SIMULATIONS ON GPU-ACCELERATED PLATFORMS WITH SW4-RAJA

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Advances in numerical methods, improvements in rupture models and 3D Earth structure and the inexorable growth of computational power enable higher resolution earthquake ground motion simulations. We are modeling ground motions to frequencies of 5 Hz and higher from large earthquakes (moment magnitude MW 6.5-7.0) on regional scales (∼120 km) using the SW4 4th order summation-by-parts finite difference code. Recently, SW4 was ported to GPU-accelerated platforms (e.g. Sierra, Lassen at LLNL and Summit at ORNL) using RAJA. RAJA is a collection of C++ software abstractions designed to enable architecture portability for mesh-based HPC applications. We show verification of results on different CPU and GPU platforms to machine precision. Porting of SW4 to GPU's greatly improves computational efficiency. We are running site-specific simulations of large ruptures on the Hayward Fault in the San Francisco Bay Area (SFBA). Simulations rely on rupture models from Graves and Pitarka (2016) and a 3D geologic/seismic model from the United States Geological Survey (USGS) including topography. We have shown that simulated motions are consistent with ground motion models, such as those from the PEER NGA-West2 project (Bozorgnia, et al., 2014). In the SFBA, we demonstrate how path- and site-effects in the 3D model bias intensity values and propose a method to account for these epistemic effects in a non-ergodic ground motion model. We have shown how the assumed minimum shear wavespeed in the near-surface geotechnical layer can impact the response.