Studying the Effect of Fault Roughness on Strong Ground motion

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Natural faults manifest geometric complexities with a broad range of scales ranging from large features such as extensive bending and segmentation spanning over tens of kilometers conspicuous in the field to small topography variations on fault slip surface in microns revealed in the lab. Previous studies have suggested that the geometrical properties of the fault can have strong influence on the static stress distribution around the fault and the dynamic process of earthquake ruptures. An important question here is what components and what length scales of the fault geometrical complexity are most prominent in affecting the characteristics of strong ground motion such as high-frequency content and peak values of acceleration and velocity of the seismic radiation field. With the goal of providing some insights into this problem, we perform 2D and 3D numerical simulations of dynamic rupture along a fault with self-affine roughness distributions. The roles of off-fault plasticity and type of friction law are also examined. Calculations are carried out using the Support Operator Rupture Dynamics (SORD) code capable of handling non-planar boundaries. Having a highly scalable parallel implementation with MPI, SORD will also allow us to explore roughness models that cover an extended range of length scales by utilizing large high-performance computing clusters. Detailed analysis of our simulation results will be presented at the workshop.