TOWARDS MULTI-SCALE FAULT SLIP MODELING

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We present our latest work towards multi-scale fault slip modeling. (1) A ”cross-link” constraint method is introduced for numerically modeling dynamic slip on intersecting faults, without prescribing slip (dis-)continuation directions. The fault intersections are constrained by cross-linked split nodes, such that the slip can only be continuous on one of the two-way intersecting faults at a time and space. The method resolves the episodic intersection offset by examining the dynamic fault traction resulting from two sets of constraint equations, one for each slip direction. To verify this method, we modify the SCEC benchmark problems, number 14 and 15, by allowing the branch fault to step across the main fault. (2) A fundamental solution based finite element method is introduced to homogenize heterogeneous elastic medium under static and dynamic loading. This method incorporates Eshelby’s strain perturbation in finite element weak forms. The resulting numerical model implicitly considers the existence of inhomogeneity bodies within each element. To demonstrate this method, we modify a dynamic fault slip problem, SCEC 205, by introducing a fault zone that contains different microstructures than the host matrix. We illustrate the fault zone effect in terms of seismic waveforms, slip contours and frequency contents. These two methods come with an open source finite element code ”Defmod-hybrid” which allows one to build a fault model that spans multiple aseismic and seismic cycles.