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Comparison exercise of 2D dynamic rupture problems by different numerical methods

H. Aochi (1), S. Bernardie (1), G. Festa (2), N. Kame (3), E. Manglou (1,4), R. Madariaga (5), H. Modaressi (1), A. Modaressi-Farahmand Razavi (6), and J. P. Vilotte (7)

(1) BRGM (French Geological Survey), Orleans, France (h.aochi@brgm.fr), (2) RISSC Lab, Dipartimento Scienze Fisiche, Napoli, Italy, (3) Kyushu University, Fukuoka, Japan, (4) Polytech'Paris - UPMC, Paris, France, (5) Ecole Normale Supérieure, Paris, France, (6) Ecole Centrale Paris, Chatenay-Malabry, France, (7) Institut de Physique du Globe de Paris, Paris, France

Numerical approaches have been powerful tools to model the dynamic rupture process of the earthquakes for understanding its physics and for assessing the resultant seismic hazard. The dynamic process has a strong non-linearity combined with any fault constitutive law (friction law or rupture criterion), one has to understand the sensibility of the numerical solutions in order to correctly interpret the rupture phenomena. We exercise two simple comparison tests of 2D dynamic rupture problem with different numerical methods. We use a boundary integral equation method (BIEM), a finite difference method (FDM), a finite element method (FEM), a spectral element method (SEM) and a hybrid method using boundary integral equations and finite difference approaches (HDBM). The first test is an instantaneous stress drop on a fixed crack length. This is extremely a discontinuous phenomena leading to inevitable oscillations. The second test is a spontaneous rupture propagation case with a simple slip weakening, but this is initiated by an instantaneous stress drop on a finite crack length. All the methods converge into a suitable solution with proper parameters, but one has to pay attention to the difference in the physical description (due to the discretization) of the given problem. This work was held in the framework of the French national project SEISMULATORS (http://seismulators.brgm.fr) through some international collaborations.