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Supershear Ruptures in Earthuqakes Under the Influence of Ground Surface

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We extended the boundary integral equation method (BIEM), which is popular in the numerical simulation of dynamic rupture on fault (especially complex fault system) but limited to full-space medium model to date, to exactly including the effect of free surface by applying the exact Green's function for half space. Hypersingularities involved in the integral kernels are removed, and numerical technique is developed to speed up the computation. By applying this extended BIEM, dynamic rupture on a dipping fault with effect of ground surface can be investigated in detail. For earthquake faults intersecting the ground surface, a common case for devastating large earthquakes, one of the complexities of seismic sources comes from the geometry of fault-ground configuration. We report an important feature of earthquake rupture with such configuration: A strike-slip faulting, as long as the rupture nucleus is able to grow, eventually evolves to a supershear rupture rather than alternatives between subshear and supershear; however, earthquake rupture with dip-slip propagates always with subshear speed once propagating, although its slip rate along ground surface can be extraordinary large. In any case, ground surface enhances the earthquake rupture and thus the ground shaking.