

### 3D Eikonal Solvers, Part III: Amplitude Computation

The amplitude computation requires an accurate approximation for the traveltime gradient and Laplacian. Since it is hard to compute the traveltimes with a second- or higher-order accuracy in realistic media, the difference approximations of the traveltime derivatives may not be suitable for accurate amplitudes unless special cares are taken. This article is concerned with a concurrent simulation of the traveltime and amplitude; strategies for accurate traveltimes and difference approximations of the traveltime derivatives are suggested to compute the amplitude with a positive-order accuracy. Second-order essentially non-oscillatory (ENO) schemes have been introduced for the traveltime Laplacian to compute the amplitude accurately. An ENO scheme for the traveltime second-derivative in the amplitude-marching direction is successfully designed incorporating the mid-step traveltime. To improve accuracy of the traveltime and amplitude particularly near the source, this article introduces a new family of second-order difference method, called quadratic ENO (QENO) scheme which approximates the traveltime derivatives exactly when the wavefront is circular or elliptical. The resulting algorithm integrating the new schemes and strategies turns out to show a second-order accuracy for the traveltime and a first-order accuracy for the amplitude in smooth regions.