

Stochastic ray-path method for the synthesis of vector-wave envelopes in 2-D random elastic media

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Seismograms of regional earthquakes are complex in high frequencies due to scattering by random inhomogeneities in the earth. When the wavelength is much smaller than the correlation distance, the parabolic approximation is applicable since forward scattering is dominant. Stochastic treatment of wave equation, known as the Markov approximation, has been successfully used for the synthesis of scalar-wave envelopes. When random media are divided into many layers, scattering of waves can be interpreted as a successive ray bending processes. Williamson [1972] proposed the stochastic ray-path method that uses the Monte Carlo method to simulate the ray bending process for scalar waves. Extending his method to adopt the energy partition into two components, we propose a method to simulate vector-wave envelopes in 2-D random elastic media. For the case of isotropic source radiation, we confirmed the coincidence of the envelopes by the stochastic ray-path method with those newly obtained by the Markov approximation for the two frequency mutual coherence function. Transverse-component amplitude for a P-wavelet (radial-component amplitude for an S wavelet) is a good measure of randomness, since the time integral of the mean square envelope linearly increases with travel distance increasing. The stochastic ray-path method well simulates envelopes at different azimuths for the case of a point shear dislocation source. A peak delay from the onset and a smooth decay after the peak are common to envelopes in all azimuths. Scattered waves are excited even at receivers in the nodal direction, and amplitudes become independent of azimuths as lapse time increasing.