

ENVELOPE SYNTHESIS OF VECTOR WAVES IN NONISOTROPIC RANDOM ELASTIC MEDIA ON THE BASIS OF THE MARKOV APPROXIMATION

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Although the source duration is short, the apparent duration of observed seismogram of a small earthquake increases with travel distance increasing, which is known as envelope broadening. The amplitude excitation is observed even on the transverse component for P-waves, on the longitudinal component for S-waves. These phenomena are well explained by scattering around the global ray due to random velocity inhomogeneities of the earth medium. When the wavelength is shorter than the correlation distance of random media and the inhomogeneity is weak, we are able to synthesize directly vector-wave envelopes in random elastic media statistically characterized by a nonisotropic autocorrelation function (ACF) for the incidence of a plane wavelet. In the case that the ray direction is parallel to one of the principal axes of a Gaussian ACF, we can analytically solve the stochastic master equation for the two-frequency mutual coherence function (TFMCF) of the potential field. The Fourier transform of TFMCF gives mean square (MS) envelopes of band-pass filtered wave traces. The envelope broadening and the excitation in the orthogonal component are well characterized by the product of the MS fractional velocity fluctuation, the ratio of the longitudinal correlation distance to the transverse correlation distance, and the ratio of the travel distance to the transverse correlation distance. Envelope broadening becomes longer and the transverse (longitudinal) component amplitude increases for a P-wavelet (for an S-wavelet) when the transverse correlation distance becomes smaller. When the vertical correlation distance is shorter than the horizontal one as seen in the real earth, the envelope broadening for a horizontal ray path is large compared with that for a vertical ray path. Comparing vector envelopes simulated with those by finite difference simulations in nonisotropic random elastic media in 2-D for the incidence of a plane wavelet, we examine the applicable range of the Markov approximation.