Excitation of Seismic Pulse Coda Waves in Random Heterogeneous Earth

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Seismic pulse waves in homogeneous half space earth have been studied extensively by the space-time Fourier Transform. However the earth is not homogeneous, and seismic pulse waves in random heterogeneous earth include both coherent and incoherent waves. The incoherent component is called the "Coda" wave and is a wave train following the coherence pulse. The coda wave is produced by the random fluctuating medium, and it is important to study the medium's statistical characteristics and the total earthquake energy, but it has received much less attention.

This paper presents the space-time Fourier Transform solution of pulse acoustic waves in random elastic heterogeneous earth. We consider two-dimensional problems, and the wave is expressed by scalar and vector potentials; the boundary conditions at the earth-air boundary are that the normal stress and the tangential stress are zero. The poles in the space-time Fourier Transform give the Rayleigh surface wave. The far fields can be expressed by P and S waves and the Rayleigh surface wave. This is used to find the two-frequency mutual coherence function, which gives the coherent pulse wave and the incoherent coda wave.

This paper discusses several important points with respect to coda waves. P waves and S waves are cylindrical waves called the "body" wave. Rayleigh waves are surface waves and decay exponentially from the surface. It is important to note that the total energy, which is the sum of coherent and incoherent P, S, and Rayleigh waves, is conserved.

Numerical examples are shown for the surface displacement vector as functions of space and time. Also noted is the importance of coda waves in relation to the medium characteristics and the total seismic radiation energy.