On the Computation of Theoretical Seismograms for Multimode Surface Waves

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It is needlessly expensive to use standard computational techniques, when applying inverse Fourier transformation to construct theoretical seismograms from frequency-domain data for multimode surface waves. Such techniques require the evaluation of dispersion and attenuation information for each mode, at each of a dense set of points which are equally spaced in frequency. These evaluations are by far the most expensive part of the computation of theoretical seismograms for surface waves. By further development of a method proposed by Aki, and departing from the standard, equal-frequency-interval computational techniques, it is possible to decrease the required number of dispersion and attenuation evaluations. With our new method we obtain an increase in computational efficiency of 200% for the fundamental mode and 500% for the higher modes. With the proposed techniques: (a) a quadratic fit to the amplitude spectrum is applied in each frequency interval, (b) a linear or quadratic fit to the phase spectrum is used in each interval, (c) automatic control over the accuracy of the theoretical seismograms is maintained, and (d) with this control feature we can apply the method over as extensive a period range as one desires, irrespective of how rapidly the group velocity varies.

Reference

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On the Excitation of the Earth's Seismic Normal Modes

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The excitation of the earth's normal modes is formulated as an initial value problem. The static state of the earth, stressed from its hydrostatic reference situation, is considered as the initial state. The initial state is relaxed, at the time of the earthquake, by the removal of the forces maintaining the departure from hydrostatic equilibrium. Expressions are derived for the coefficients giving the relative excitation of the individual modes for the cases where these forces are compensating volume forces or compensating tractions on the faces of a dislocation. It is demonstrated that a point slip dislocation has a body force equivalent in the form of a double couple with a deviatoric moment tensor. However, for a source with volume change no moment tensor equivalent can be found. The