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REFLECTIVITY OF SELF-SIMILAR INTERFACES

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The derivation of seismic reflection and transmission coefficients is generally based on the assumption that the medium parameters behave as step-functions of the depth coordinate, at least in a finite region around the interface. However, borehole measurements of e.g. the propagation velocity in the earth's subsurface reveal outliers that can often be parameterized as self-similar singularities.
The angle-dependent reflection and transmission coefficients of self-similar interfaces reveal self-similar properties as well. For a step-function interface (singularity exponent zero) the angle-dependent reflection and transmission coefficients are independent of the frequency; this can be seen as a special case of self-similarity. For a self-similar interface with a non-zero singularity exponent, the reflection and transmission coefficients are constant along specific contours in the rayparameter-frequency plane. These contours are characterized by the singularity exponent of the interface. The self-similarity properties of the reflection and transmission coefficients are reflected in the amplitude and phase behaviour of the seismic response. Conversely, by analyzing the angle-dependent seismic response with wavelet transform techniques, the singularity exponents of the interfaces in the earth's subsurface can be retrieved.

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