IMAGING COMPLEX STRUCTURES USING BAND LIMITED GREEN'S FUNCTIONS

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Preface

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Abstract

One of the most efficient algorithms for accurate imaging of seismic data is prestack Kirchhoff migration. It has been shown to fail in areas of complex structure, when it is implemented using Green's functions based on first arrival traveltimes. I present a new method for calculating traveltimes that estimates the traveltime of the maximum energy arrival, rather than the first arrival. The estimate is calculated in the seismic frequency band rather than the usual high frequency approximation.

Instead of solving the eikonal equation for the traveltime, I solve the Helmholtz equation to estimate the Green's function for a few frequencies. The Helmholtz equation is solved using a paraxial approximation in a polar coordinate frame. Once a few frequencies have been calculated I perform a parametric fit to the wavefield to estimate a traveltime, amplitude, and phase. The problems associated with aliasing, caused by the coarse sampling in frequency, are avoided by simultaneously extrapolating the wavefield and the traveltime estimates outwards from the source point in the polar coordinate frame.

The images created by using these parametric Green's functions are superior to those created using first arrival traveltimes, or those created by using maximum amplitude traveltimes calculated by paraxial ray tracing. They are comparable in quality to the images created by a full-wavefield downward-continuation scheme.

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