Designing Wavefield Extrapolators using a Weighted Least-Squares with a Transition Band Approach

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Abstract

Depth migration using wavefield extrapolation methods are powerful in handling lateral velocity variations. However, the stability of the wavefield extrapolators is a major issue with these methods. The stability problem arises due to the presence of discontinuities at boundaries separating the wavelike and evanescent regions. Least squares methods can be used to design wavefield extrapolators that practically remain stable in a recursive scheme by minimizing the squared error between the desired and actual transforms or "the error".

Least squares methods can be classified into three major categories: unweighted least squares followed by a windowing function applied in space-frequency domain, weighted least squares using a smooth transition function connecting the wavefield and evanescent regions, and weighted least squares using a transition band (zero weight) for the transition region.

Using a transition function like a spline in the least squares approximation has been shown to be capable of designing practical stable operators. This paper shows another extrapolation method that uses weighted least squares with a transition band to design a wavefield extrapolator. This approach changes the error criterion in a particular way in order to remove or reduce the overshoot. That can be done by removing a region from the optimization. That region is called a transition band. Preliminary results for the Marmousi dataset show that this method can be used to design practical stable operators.