Enhancing the FOCI Algorithm by Using a Weighted Least-Squares Approach

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Abstract

Depth migration using the forward operator and conjugate inverse (FOCI) is a wavefield extrapolation method that uses Wiener filtering to design nearly stable wavefield extrapolators and dual operator tables for evanescent filtering. In the current design of FOCI, the forward operator is simply a windowed version of the exact operator for a half step. The inverse operator is designed as a band-limited inverse of the first. The least-squares FOCI operator is formed as a convolution of the first operator with the conjugate of the second. As a final step, the least-squares operator may either be used directly or shortened with a Hanning window. The limitations of the first option are that the operator has to be long to ensure stability, and evanescent filtering cannot be applied at every depth step where dual tables have to be used. On the other hand, while the second option gives short operators with evanescent filtering at every depth step where only one table is needed, short operators attenuate higher wavenumbers due to using a Hanning window.

We introduce some enhancements to the current design by using a weighted least-squares approach. This approach is used to obtain the forward operator instead of using a Hanning window, and to obtain the windowed operator, instead of the Hanning window, in an optimal way. With these enhancements to FOCI, it is possible to design operators as short as 9 points. The migration results obtained with these enhancements show that short operators can generate good images very efficiently.