Event detection in prestack migration using matched filters

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ABSTRACT
Given a particular statistical measure of signal to noise (S/N), the “matched filter” is the ideal linear filter for maximizing the S/N ratio of a signal amongst random, white noise. A matched filter approach to prestack imaging is proposed, where “signal” is defined as a particular AVO reflection coefficient surface, and all other AVO response surfaces are considered “noise”. Cross-correlation of the prestack data with the signal illuminates reflection events whose AVO response curve matches that of the signal; other reflection energy is suppressed. Matched filter imaging of synthetic P-wave data enhances the detection of Class 2 AVO events. Preliminary tests on converted wave (P-SV) synthetic data yield superior imaging, due to noise cancellation at near offsets.

Conventional Kirchhoff prestack migration involves summing over the scatterpoint energy traveltime surface and placing the energy back at the appropriate scatterpoint location. This procedure is repeated for all scatterpoints in the prestack volume. The proposed matched filter migration method essentially involves crosscorrelating the entire prestack volume by a Zoeppritz-defined reflection coefficient surface, which is considered signal, prior to summation. Scatterpoint energy traveltime surfaces whose AVO response matches the signal are better imaged after migration.