Weighted Stacking of Seismic AVO Data using Hybrid AB Semblance and Local Similarity

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Abstract

The common-mid-point (CMP) stacking technique plays an important role in enhancing signal-to-noise ratio (SNR) in seismic data processing and imaging. Weighted stacking is often used to improve the performance of conventional mean stacking in further attenuating random noise and handling the amplitude variations in real seismic data. In this study, we propose to use a hybrid framework of combining AB semblance and local similarity weighted stacking scheme. The objective is to achieve the optimal stacking of the CMP gathers with class II amplitude-variation-with-offset (AVO) polarity-reversal anomaly, which happens quite often in the seismic reflections from the class II gas sands. The selection of high-quality near-offset reference trace is another innovation of this work. We propose to use the near-offset trace, instead of the mean stacked trace, as the reference trace for similarity-weighted stacking because of its better preservation of useful energy. Numerical examples on synthetic and field AVO CMP gathers demonstrate a great improvement by our approach in correctly capturing true locations of weak reflections, distinguishing thin-bed tuning artifacts, and effectively attenuating random noise. In the synthetic data examples, SNR in the improved CMP stacked trace is greatly enhanced compared with the conventional stacking methods. At the same time, the reflections in the deep part of the CMP stacked trace by our method are exactly visible which appear as thin-bed tuning artifacts in the conventional stacking methods. In the field data examples, higher SNR is achieved and weak reflections are also correctly captured in the proposed approach. Both the synthetic and field examples illustrate the feasibility and improvement of our proposed method.