Seismic Facies Classification Using a Visual-Based Method, Part 1: Theoretical Basis

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Abstract
Seismic interpreters have been analyzing seismic facies in a qualitative way for over three decades in an effort to define and analyze stratigraphic features of interest. Automated seismic facies analysis, using unsupervised or supervised neural networks, became available in the past decade. This approach produces a map showing the spatial distribution of different classes (facies) of seismic traces. The interpreter then analyzes this color-coded map to look for stratigraphic features of importance. A significant problem with this approach is that the interpreter must choose the number of classes to look for in the data, which in turn determines the output of the classification procedure. The fundamental problem is that the interpreter typically does not have a priori knowledge of the number of natural clusters in the data.

We sought to address this problem by finding a computational technique that would effectively determine the number of natural clusters in the seismic data. The assumption is that the natural clusters represent end-member seismic facies that, in turn, are indicative of the number of different stratigraphic features being imaged seismically. We generated 2-D seismic models with variable lateral geology, and then tested a variety of techniques to look for natural clusters in the data. The input data consisted of the seismic amplitude traces, rather than a subset of seismic attributes. Of the methods we tested, a visual-based method that incorporates self-organizing maps, parallel coordinate plots and geographic mapping is most robust for automated pattern recognition within highly correlated and continuous seismic data.