Seismic Textures – a new interpretation tool

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Abstract

A seismic attribute is any measure of seismic data that helps us better visualize or quantify features of interpretation interest. Seismic attributes have proliferated in the last three decades at a rapid rate and have helped in making accurate predictions in hydrocarbon exploration and development (Chopra and Marfurt, (2005)). They are widely used for lithological and petrophysical prediction of reservoir properties.

Active development of new and prominent attributes has led to the introduction of texture attributes. Inspired by the Sangree and Widmier's (1979) suggestion that zones of common seismic signal character are related to the geologic environment in which their constituent sediments were deposited, Love and Simaan (1984) attempted to extract patterns using texture analysis. If a given signal character can be represented in the form of a 2-D amplitude template, then it would be possible to classify every pixel by matching its local texture with the template of each feature. Further improvements to this template matching process were made by incorporating artificial intelligence into the classification process. While such efforts were supposed to help with automatic analysis of large amounts of 2-D surface seismic data in a regionally consistent manner, they enjoyed very limited success. Part of this lack of success was due to the low S/N ratio of the data and out-of-the-plane artifacts on 2-D data. However, we feel the biggest handicap was that the 2-D stratigraphic patterns could not be standardized. 20 years later, with 3-D data routine, we now realize the main problem was due to the limitations of 2-D seismic stratigraphy. Seismic patterns classified alternatively as 'parallel', 'sigmoidal', or 'hummocky clinoforms' could all describe the same fan system – but the appearance depending on the orientation of the 2-D acquisition over the over the fan, not on the geology.

More recently the idea of studying seismic 'textures' has been revived. While the term was earlier applied to seismic sections to pick out zones of common signal character (Love and Simaan, 1984), studies are now underway to use statistical measures to classify textures using gray-level co-occurrence matrices (Vinther et al., 1995; Vinther, 1997; Whitehead et al., 1999; West et al., 2002; Gao, 2003, 2004). Some of the statistical measures used are energy (denoting textural homogeneity), entropy (measuring predictability from one texel or voxel to another), contrast (emphasizing the difference in amplitude of neighboring voxels) and homogeneity (highlighting the overall smoothness of the amplitude). Homogeneity, contrast and entropy have been found to be the most effective in characterizing seismic data.

Texture attributes are promising and can aid the geophysicist for making more accurate interpretations.

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