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Use of Seismic Character for Intelligent Facies Analysis and Reservoir Property Estimation

This paper will describe an approach for integrating different data and their quantitative analysis using artificial neural network technology. Data in the Geologically Driven Integration (GDI) method are integrated according to a geological framework. Non-linear interrelationships between various data types are then studied at the natural scale levels defined by the integration framework. The method is used for horizon based facies analysis, reservoir characterization, hydrocarbon detection, and volume-based porosity estimation, and reservoir fluid / lithology prediction.

The ideas behind this seismic character method is to relate geologic facies and reservoir properties to the seismic response. We show how attributes and/or waveforms extracted from multiple input seismic cubes are used to obtain the facies. Unique in the method are the pseudo-wells used to relate seismic patterns to the underlying rock and reservoir properties and use such relationships in training the supervised neural networks. The pseudo-well simulator generates stratigraphic columns with the corresponding well logs using a constrained Monte Carlo simulation with different perturbations of log properties. For each pseudo-well, synthetic seismograms (both post stack and pre-stack) are generated to yield a fully integrated data set to aid the quantitative interpretation task.

The paper will show examples from several case histories to highlight various applications of the method. Specifically examples of waveform segmentation for facies analysis, volume transformation (porosity / litho class), pseudo well generation, rock physics analysis, reservoir fluid detection, and time lapse (4-D) analysis, distinguishing between commercial versus non-commercial gas saturation, and determination of risk factors, confidence interval and model probabilities.