The Use of Neural Networks on Well Logs and Seismic Data for Reservoir Characterization

Dr. M.T. Taner and Dr. M. B. Carr

The methodology to use an artificial neural network to classify two data sets independently, and correlate the two as a means to characterize subsurface lithology is presented. The initial data set for this method was a post stacked seismic amplitude volume, and well log curves from wells within the seismic volume. A specific zone of interest is the focus of this type of reservoir characterization. The seismic and well data are tied via a synthetic seismogram generated from the in situ well log values, and is constrained by check-shot and time to depth values. The Kohonen Self Organizing Map (K-SOM) unsupervised neural network was used to classify both seismic attribute volumes and well logs. The K-SOM algorithm is an n dimensional classifying algorithm that requires little a priori knowledge. The algorithm allows for a large number of classes and multiple topologies to classify each n dimensional sample. Multiple seismic attributes are organized into a large number of classes by the K-SOM algorithm (i.e. 100 classes). Each seismic sample is given a class based on the n dimensional multiple attribute response. The result is a seismic volume of n number of classes. Each class however, does not possess a physical meaning, only a class that results from the n dimensional multiple attribute response. Multiple well log curves were measured for each well. The multiple well log curves were independently input into the K-SOM algorithm, using a similar topology as was used for the seismic data. The result is a new well log curve that organized each sample into a class based on the multiple well log attribute response. The large number of classes was then distilled into a smaller number of classes based on physically and acoustically relevant criteria. For example, the 105 classes from 2 wells were grouped into 12 classes based on acoustic impedance, volume shale, and water saturation. The seismic K-SOM class value was then extracted at each well. The result was a well log curve from the seismic K-SOM algorithm. The seismic K-SOM classes were then grouped into a similar number of classes using the same criteria as with the well log values. The K-SOM seismic volume was then grouped accordingly, resulting in a volume that is calibrated to the wells, and possesses physical characteristics of interest (i.e. pay sand, wet sand, shale, etc). The calibrated K-SOM volume then can be used for further exploration as well as reservoir development with in a given field. This methodology was presented and awarded US Patent # 6,957,146 B1, in October of 2005. The authors would like to thank Rock Solid Images for consent to publish this material.

1. Rock Solid Images, 2600 S. Gessner, Suite 650, Houston, TX 77063
2. Qi Petrophysics, 2150 W. 18th Street, Houston, TX 77008 * Speaker