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탄성파 자료를 이용한 시추자료 물리적 특성 예측 기술 자립을 위한 상업용 소프트웨어 활용 사례

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Bench marking of a commercial software for predicting of log properties from seismic data

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Key word : gas-hydrate(가스 하이드레이트), BSR(가스 하이드레이층 하부 경계면), MNFL(다중반사면 포워드 네트웍), PNN(가상신경네트웍)

Abstract

The integration of well log and seismic data has been a consistent aim of geoscientists who involved the gas hydrate project in Korea. The progress of gas hydrate exploration is not so advanced. As the very limited information about the physical properties of BSR is known to our Korean researchers. Therefor the extraction of log properties from seismic data has became the very important topic.

A new method for predicting well-log properties from seismic data was published by Hampson-Russell Software Service Ltd. It seems that the results came from this software can be very useful to our AVO analysis project for gas hydrate exploration. We are going to attempt understanding the algorithm and theory of this program. The contents of this study is the results of bench marking of this program and understanding of it's fundamental theory.

The analysis data consist of a series of target logs from wells which tie a 3-D seismic volume. The target logs theoretically may be of any type; however, the greatest success to date has been in predicting porosity logs. From the 3-D seismic volume a series of sample-based attributes is calculated. The objective is to derive a multiattribute transform, which is a linear or nonlinear transform between a subset of the attributes and the target log values. The selected subset is determined by a process of forward stepwise regression, which derives increasingly larger subsets of attributes. An extension of conventional crossplotting involves the use of a convolutional operator to resolve frequency differences between the target logs and the seismic data.

In the linear mode, the transform consists of a series of weights derived by least-squares minimization. In the nonlinear mode, a neural network is trained, using the selected attributes as inputs. Two types of neural networks have been evaluated: the multilayer feedforward network (MLFN) and the probabilistic neural network (PNN). Because of its mathematical simplicity, the PNN appears to be the network of choice.

To estimate the reliability of the derived multiattribute transform, crossvalidation is used. In this process, each well is systematically removed from the training set, and the transform is rederived from the remaining wells. The prediction error for the hidden well is then calculated. The validation error, which is the average error for all hidden wells, is used as a measure of the likely prediction error when the transform is applied to the seismic volume.

The method is applied to two real data sets. In each case, we see a continuous improvement in predictive power as we progress from single-attribute regression to linear multiattribute prediction to neural network prediction. This improvement is evident not only on the training data but, more importantly, on the validation data. In addition, the neural network shows a significant improvement in resolution over that from linear regression.

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