geoconvention
Virtual Event
September 21-23
2020
CSPG • CSEG • CWLS • GAC • MAC • IAH

# Theory-guided deep learning for reservoir characterization

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## Summary

Deep Neural Networks (DNNs) are explored to predict reservoir properties from well and seismic data. Log properties serve as the targets while the seismic data and attributes serve as the input features. A subset of the well and corresponding seismic data, called the training data, are used to learn a nonlinear relationship, mapping the seismic to the target logs. In order to ensure the relationship generalizes well, it is important to include log data that is representative of the range of the expected geology. Additional data are required to validate the DNN and serve as blind control. These extensive data demands meant that historically machine learning could not be applied for many seismic datasets.

This presentation explores the use of synthetic log and seismic data to train and validate the neural network thus resolving these data requirement issues. The synthetic data are generated from the statistics of nearby well control, rock physics relationships and AVO convolutional modelling. Rock physics theory allows for the generation of the full range of possible data not encountered in the available well control. Since the synthetic logs use only the statistics of the well data, the well control does not need to be within the seismic area, thus allowing for the incorporation of a broader range of geology.

This presentation shows the application of this methodology to a number of datasets from different geologic basins from around the world. The good results obtained suggest that the generation and use of synthetic data is an important tool in performing reservoir characterization using machine learning.