

Application of Novel Machine Learning Algorithms for Facies Classification

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The task of the reservoir geologist is to identify the nature and the challenges of hydrocarbons reservoirs. For this, one needs to be able to classify reservoirs into lithofacies. Various techniques have been used, relying on statistics analysis. However with the development of information technology, sophisticated processing algorithms have allowed to create automated classification methodology.

Machine Learning brings algorithms at the frontier between Artificial intelligence and Data Mining. Machine Learning consists of 3 phases: (1) 'learn' general patterns, classify a sample of historical data (2) build a model and evaluate the validity of the model(s), and (3) , use the model to predict results for new cases, then eventually, use the prediction to alter organizational behavior.

Based on a dataset of generic West African reservoir facies, we examined 6 Machine Learning algorithms: K-Nearest Neighbor, Support Vector Machine, C4.5 Classification Trees, Naïve Bayes, Random Forest and CN2 Rule inducer. We also introduced Hierarchical Cluster Analysis in order to perform quick qualitative comparisons of the facies and their attributes.

Facies needs to be classified depending on a class. We took the sand control problems during production operations. After performing the classification of the facies, we benchmarked the results of the algorithms using a set of solid indicators, Receiver Operating Curves (ROC) and Lift Curves. We were then able to select the 3 best fitting algorithms.

Finally, the association of cost to ROC and Lift curves allowed us to calculate the optimal probability threshold level where sand control mitigation measures have to be applied. It also gave us a stochastic evaluation of the cost impact.