ABSTRACT

This thesis addresses two major aspects of reservoir characterization (RC); 1) well log correlation, i.e., assessment of similarity between pair of well logs and demarcation of stratigraphic changes, and 2) modeling of reservoir properties from available field data (i.e., well logs and seismic) using the fractal concept, geostatistics and Neuro-Fuzzy (NF) techniques.

In petroleum exploration, studying the similarity between patterns of the same geophysical properties in different wells is an important step of RC processes. In this work, an attempt has been made to assess similarity between well logs using synchronization measures (i.e., Synchronization Likelihood (SL) and Visibility Graph Similarity (VGS)). Higher values of SL and VGS indicate the existence of similarities. This has also been verified from the overlapped plots of well-log data. The similarity of a particular property between wells reflects the similarity in the lithology. Such methods would be helpful for interpolating locations between the available well logs, classification, and clustering of wells. Similar wells can be treated in one cluster for further reservoir modeling.

In the context of well-to-well correlation, the use of well log data for identification of stratal boundaries expressed as lithological interfaces is arguably the most fundamental process in reservoir characterization problems. For this purpose, geophysical well logs are analyzed using wavelet and S-transforms. Stratigraphic discontinuities (i.e., well tops) identified using these two methods are matched with some known well tops. Such well log data analysis is useful in the stratigraphic section guided modeling of reservoir variables.

An integrated concept of fractal geometry and geostatistics is presented for the modeling of reservoir property (e.g., porosity). Moreover, a novel framework is presented where porosity is estimated within a stratigraphic layer using successive random addition (SRA) approach derived from fractal concept.

Finally, a workflow is described for modeling of reservoir properties (e.g., sand fraction) from seismic attributes using NF techniques. This includes pre-processing, modeling and validation followed by post-processing. High values of correlation coefficient and less error between target and predicted sand fraction values reflect the accuracy of the proposed workflow. A comparative study is carried out between Artificial Neural Network (ANN) and NF approach where NF outperformed ANN.

Keywords: *Reservoir characterization, well logs, seismic attributes, well log similarity, synchronization likelihood, visibility graph similarity, wavelet transform, S- transform, well tops, fractal, geostatistics, artificial neural network, fuzzy logic, neuro-fuzzy, ANFIS, porosity, sand fraction.*