MACHINE LEARNING – A NOVEL APPROACH UTILIZED TO PREDICT LITHOFACIES AND THEIR SIMILARITY BASED ON SYNCHRONIZATION MEASURES TO PREDICT SYNTHETIC LOG

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This study presents a novel unsupervised and supervised workflow for predicting lithofacies in unconventional and heterogeneous tight sandstone reservoirs, which mainly consist of intercalations of heterogeneous facies. The result obtained from the novel two-information criteria clustering identified a means of six distinct facies, which was strictly data-driven and less biased as compared to the manual approach. The demonstration showed that the Gaussian Process Classifiers model accomplished the finest identification outcomes, followed by One-Class Support Vector Machine and Artificial neural networks; however, the Random Forest performed less accurately. The Gaussian Process Classifiers was utilized to predict the lithofacies in the testing dataset and the accuracy of the facies similarity based on synchronization measures was checked to predict synthetic logs. Hereafter, an acoustic impedance vs velocity ratio cross plot of a blind well based on predicted lithofacies was used to generate 2D probability density functions and was used as an input with depth in the neural network to predict synthetic gamma-ray log response. The results obtained from the neural network were visually satisfactory, average log trends of gamma ray log were almost identical, and cross plots between the measured Gamma log and predicted Syn\_Gamma log from the machine learning algorithm at blind wells were also very satisfactory with R2 (0.978). Once the lithofacies is predicted by the final model across all wells where core data were available and unavailable, we classified the predicted lithofacies using the inverted Acoustic Impedance and Velocity ratio volumes and generated a facies prediction volume. The projected facies volume at the well site was found to correlate well with the predicted lithofacies classification.