Machine Learning Application for Shear Velocity Prediction in Unconventional Reservoirs

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Abstract

The shear wave velocity (Vs) is widely used as quick, easy to use, and cost-effective means of determining the mechanical properties of formations in the petroleum industry. However, shear wave logs are only available in a limited number of wells in an oil field due to the high cost of the log acquisition and the associated difficulty to measure it in the past. For this reason, many attempts have been made in myriad literature to find a correlation between shear velocity and other petrophysical logs. In this study, a set of log data consisting of depth, neutron porosity (NPHI), density (RHOB), photoelectric (PEF), gamma ray (GR), caliper and VP were used to develop a model for shear velocity estimation in five unconventional wells drilled in the Cambro-Ordovician tight gas formation and naturally fractured reservoir of the Ahnat Basin, Algeria. The focus of this paper is to apply machine learning algorithms to synthesize the shear velocity log. Five different algorithms were developed and tested on the dataset, namely: XGBoost, Random Forest regression, AdaBoost regression, Gaussian process regression, and artificial neural networks. Overall, the results showed the R^2 score varied from 0.55 to 0.92, with the XGBoost outperforming the other algorithms. The work presented in this paper paves the road to robustly predict and synthesize missing data using machine learning algorithms and extend it across the rest of the wells to compensate for the lack of data.