Forecasting Water Production from Oil and Gas Wells Using Machine Learning Models, a Case Study from the Paradox Basin, Utah

Omar Bakelli[1], Rohit Ramgire[2], Ting Xiao[2], Eric Edelman[2], and Brian McPherson[2]

[1]Energy & Geoscience Institute, University of Utah
[2]University of Utah

Abstract

Accurate forecasting of water production from oil and gas wells is essential for effective resource management, environmental protection, and operational efficiency. The Paradox Basin, with its complex geological formations, poses significant challenges for predicting water production rates. This study investigates the application of Long Short-Term Memory (LSTM) networks and AutoRegressive Integrated Moving Average (ARIMA) models to forecast water production solely based on historical production data from wells in the Paradox Basin. Our dataset comprises time-series water production records from multiple wells, which were preprocessed to handle missing values and anomalies. We applied the ARIMA model, a classical statistical method renowned for its effectiveness in univariate time series forecasting, and the LSTM network, a type of recurrent neural network capable of capturing long-term dependencies in sequential data. The models were trained and evaluated using a time-based cross-validation approach to ensure robustness and generalizability. Key performance metrics such as mean absolute error (MAE), root mean square error (RMSE), and R-squared (R^2) were used to assess the predictive accuracy of each model. The LSTM model demonstrated superior performance in capturing the temporal dynamics and variability of water production compared to the ARIMA model. This research highlights the potential of LSTM networks in accurately forecasting water production in the Paradox Basin, providing a valuable tool for optimizing water management strategies in oil and gas operations. Our findings underscore the effectiveness of leveraging advanced machine learning techniques for time series forecasting in complex subsurface environments.