ABSTRACT

Dry gas distribution through pipeline networks faces significant operational challenges due to unpredictable pressure fluctuations, which risk disrupting the safety and efficiency of the energy supply. This research aims to comprehensively analyze and compare the performance of Long Short-Term Memory (LSTM) and Bidirectional LSTM (BiLSTM) deep learning models in predicting gas pipeline pressure based on historical time-series data. The methodology employed includes data preprocessing, model design, and systematic hyperparameter tuning through a series of experimental scenarios testing variations in LSTM units, learning rate, dropout rate, batch size, and activation functions. Model performance was evaluated using Root Mean Squared Error (RMSE), MSE, MAE, and R^2 metrics. Test results with five trials per architecture show that BiLSTM produces a slightly lower average error than LSTM. However, a pairwise Wilcoxon test on the RMSE, MAE, MSE, and R^2 metrics yielded a p-value > 0.05, indicating that the difference was not statistically significant. Thus, both architectures performed statistically equivalently in this case study.

***Keywords**: BiLSTM, Deep Learning, Gas Pressure, Hyperparameter Tuning, LSTM, Time Series Forecasting, Wilcoxon*