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Introduction of an Integrated Workflow for Optimal Well Placement Using Machine Learning Methods

Thursday, 3 June 2021 20:00 (1 hour)

Petroleum reservoir modeling procedure for production optimization is a complex problem and requires significant computational costs -rooted in reservoir simulation and post-processing. The advent of Artificial Intelligence -particularly supervised machine learning algorithms- in the petroleum industry is gained much popularity because of efficient functionality in terms of high dimensional data, computational cost and time. This study focuses on building an integrated workflow, in which the optimization variables are chosen and revised by the machine learning approaches and at the end, the methods'efficiencies and reliabilities will be compared, all together.
The Extreme Gradient Boosting (xGBoost) and Light Gradient Boosting Machine (LightGBM) algorithms are then used to build intelligent models. Because of the geological complexity, slight adjustments in well operational condition and location could yield dramatic changes in the objective function responses. In this study, the objective function is the net-present-value (NPV) for a specified operational life of the reservoir under study. To obtain the initial data set for models training, several numerical simulations were run by a self-developed simulation code, and based on them, the algorithms suggest the new appropriate location and condition for best response in each step. This effectively reduces the CPU time for the optimization tasks in the workflow. Then a new simulation starts upon the suggested values and at last, the predicted (from optimization algorithms) and simulated responses are compared. In this work there are three case studies: I) a homogeneous reservoir with just one production well, II) a heterogeneous channelized reservoir with just one production well, III) a heterogeneous channelized reservoir waterflood flooding.
In the first scenario, both algorithms show satisfying predictions and the optimum location of single well was selected correctly (R-squared of 0.943 and 0.999 for LightGBM and xGBoost, respectively). As a sub-result, the LightGBM algorithm can find this point sooner than xGBoost algorithm. In scenario II, the LightGBM and xGBoost show a similar response. Both methods reveal reliable results in the third scenario. Furthermore, the number of required simulations runs for LightGBM is slightly less to that for the xGBoost model.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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