

A Detailed Survey on Machine Learning (ML) Techniques in Oil and Gas Industry

Ms. S. Bharathi

Ph.D Research Scholar

School of Computing Sciences

Vels Institute of Science, Technology and Advanced Studies

Chennai, India

karupanneer@gmail.com

Dr. P. Sujatha

Professor

Department of Information Technology

Vels Institute of Science, Technology and Advanced Studies

Chennai, India

suja.research @ gmail.com

Abstract

This survey paper presents the concepts for extending and improving ML algorithms for mining in the field of Oil and Gas (O&G Industry). The concept of this survey is to take ML based energy efficiency analysis from O & G fields and use the concept of big data, which means that ML is a knowledge mining technique, and then analyze how this method is applied in the O & G field. The gas industry has found some difficulties, such as incomplete data, not suitable for large industries or large industries, and some inaccurate results. Therefore, some existing difficulties have arisen, and it will be a higher level. This article aims to analyze the best and accurate results of energy data, and make quick predictions (early predictions) of O & G fields from the analyzed data. This paper analyzes how ML algorithms change a critical piece of the energy area in the oil and gas industry. Basing on the investigation of ML application prospects and the survey of existing applications, we frame the latest patterns in creating ML-based tools and distinguish their consequences for speeding up and de-risking with processes in the industry.

Keywords— soft computing, ML, oil and gas, big data, energy efficiency, review.

I. INTRODUCTION

In the industry of O & G, a key focus, ML has been slower to develop. This is mainly because the industry has failed to realize its potential. However, this situation is slowly changing. ML in O & G can be used to improve the capabilities of this increasingly competitive industry. It doesn't just help optimize the workforce. The technique can also be used to optimize mining and generate accurate models. These benefits are why ML techniques in O & G are becoming increasingly important.

One of the main effects of ML on the Oil and Gas -driven industry is the means by which it can change the disclosure cycle. Applications involving ML in the O&G Industry permit PCs to investigate a lot of information rapidly and precisely. This incorporates the capacity to channel sign and commotion from seismic information precisely. Subsequent to gathering and investigating this data, current programming applications can fabricate precise topographical models. This empowers administrators to precisely foresee what will occur beneath the surface prior to boring starts. It is trusted that assuming took on across the business; this will lessen the quantity of dry openings by 10%.

The utilization of ML in O and G in its ongoing type of displaying empowers designers to follow Jurassic seismic skylines consequently. This should be possible with a couple of hand seed focuses. The most recent age of calculations produces results that are more point by point and exact than any past model. These calculations likewise don't lose precision when requested to investigate troublesome landscape. Models generally should be checked. Up until this point, be that as it may, the application has demonstrated to be quicker and more precise than life sized models.

Notwithstanding these advances, ML can further develop boring tasks; researchers have been delayed to understand the advantages of ML in the O&G Industry. This permits clients to make the most of devices like NPV, IP30 or EUR. One of the forerunners in this field is Drilling Info's DI Transform wise application, a product arrangement that upholds client driven geophysical and geographical information mining, hearty information quality control, and strong demonstrating. A nitty gritty, exact and dependable model, like one constructed utilizing ML, is important. We should you know precisely where to penetrate and what to bore. This makes it conceivable to fix issues nearly before they are found. By utilizing these models, organizations can set aside cash and increment efficiency. Obviously, this will be a significant application for the O and G business.

The utilization of ML in O and G tasks can take care of mind boggling issues rapidly and proficiently. Specifically, ML calculations can be utilized for case-based thinking (CBR). This implies that the calculation can be utilized to rapidly gather enormous information bases of enrolled issues. The calculation was then ready to recognize comparable circumstances. When a case or comparable circumstance is recognized, the product decides how the issue was recently settled.

One more sure effect of ML in O and G is prescient upkeep. The O&G Industry depends on an assortment of enormous and costly machines at each stage from investigation to conveyance. On the off chance that none of these work and are not all around kept up with, deferrals can happen and cash will be lost. By involving prescient upkeep ML in the business of O and G, machines will remain focused.

ML in O and G won't totally supplant human administrators. While this addresses some improvement, a human administrator is as yet required. Involving ML in the O&G Industry will make talented laborers more proficient. At long last, the reception of more ML-driven applications in O and G could make the business more secure. Geoscientists actually need to have solid essential geoscience abilities and that won't ever change. Nonetheless, as ML in O and G turns out to be more typical, geo-researchers will likewise require a few different abilities. They should take on cutting edge ML in their industry based toolsets. Geo-researchers who truly do so will actually want to flourish in the upcoming business. They will be furnished with a mixed arrangement of abilities joining studies of the planet with numerical familiarity, coding abilities and inventive critical thinking. Cross-area correspondence is likewise important to empower an expansive crowd to get to and grasp data.

II. LITERATURE SURVEY

TABLE I. REVIEW OF LITERATURES

Reference ID	Publication Year	Methodologies	Objective(s) of the study
[1]	2021	Hybrid Models of ML Algorithms	Improving Energy Consumption Efficiency in the O&G Industry Using Hybrid ML Algorithms
Findings: - Four types of mixture models were analyzed using ML algorithms (ELM, SVM, ANN, and linear regression). - The performance evaluation indicators were analyzed (RMSE: Mean Squared Error, MAE: Mean Absolute Error, MAPE: Mean Absolute Percentage Error, R: Correlation Coefficient) - Energy efficiency datasets are too complex - Linear regression model is not suitable - ANN with ELM yields higher accuracy			
[2]	2021	ANN algorithms	Application of different ML methods to different

			tasks in O & G field
Findings: - Identify the differences between supervised and unsupervised learning methods. - ML algorithms are suitable for large datasets - Neuro-Fuzzy Logic Methods for Recognizing Patterns in Large Datasets - Data Structures for Efficient Decision Making - ANN and supervised learning methods are suitable for forecasting in the O&G industry			
[3]	2021	ML Algorithms, Gradient Boosting Algorithm	The implemented XGBoost-based model can classify complications during drilling better than other models in the O&G Industry.
Findings: - Python with the scikit-learn library is a better use of finds - Analyze the fitted and optimized values for split training and test sets - The gradient boosting algorithm is supported by one of the hybrid models of ML algorithms - Teach the performance of classification algorithms and how to process data. - Analyzed performance methods (Accuracy, Recall, F-Score)			
[4]	2021	AI and ML techniques	ML techniques offer great potential for solving almost all problems involving forecasting in the O&G Industry.
Findings: - AI uses much of the O & G industry for forecasting, classification, and grouping. - The collection and creation of datasets in the O & G industry is complex. - Artificial intelligence trained on past data. - A large number of samples are needed to test the accuracy of data in AI, it provides higher accuracy. - Improved soft calculation tools and quadratic equations will help improve prediction rates.			
[5]	2020	Artificial intelligence, ML, Big data analytics	Provides the rank of AI, ML tools and techniques used in the O&G Industry.
Findings: - Overview of AI and ML Algorithms and Techniques - Drilling and production are complex areas of the O & G industry. - Defining the effective use of field decision-making techniques - Decision-based pattern recognition methods are improving forecasting efficiency - Hybrid models of tree-based ML algorithms provide higher accuracy.			
[6]	2021	ML and Analytics Techniques	Assess the application and scope of ML Data Analytics in O&G Industry
Findings: - Huge datasets should be utilized to overcome under fitting. - Crossover models can be utilized rather than basic ML procedures. - Regularization ought to be done to decrease under fitting and over fitting issues. - The most recent component determination and decrease strategies ought to be utilized for ideal model execution. - Upgraded information learning strategies ought to be utilized rather than ML and NN			
[7]	2020	Mathematical and Simulation Models using MATLAB	Using Mathematical and Simulation Models to Improve Development Efficiency in the O&G Industry
Findings: The blend of numerical model and reproduction model is dissected.			

• The log connection, log reproduction, well test design distinguishing proof, stream forecast and choice are audited. • Combining mathematical and simulation models to reduce costs • Artificial lift selection methods help improve decision making • MATLAB for better prediction results and accuracy			
[8]	2021	ANN, Finite Fourier Transform	This work analyzes methods and techniques related to NN to improve energy efficiency in the O&G Industry.
Findings: • Using probabilistic methods to retain biased data in test data will reduce processing time by 5%. • Correlations and coefficients are the main performance factors for prediction • Analyze the index factor as the probability value of accurately diagnosing defects • Finite Fourier Transform (FFT) algorithm for spectral analysis • The ANN is used to analyze the performance indicators of the O & G industry for the maintenance and improvement of equipment.			
[9]	2019	ANN, Multilayered NN	Identify mathematical control systems to reduce false quantification and improve reliability of oil recovery energy efficiency
Findings: • ANN are mainly used for dynamic object models. • Developed an algorithm to train ID block NN using back propagation algorithm • A hybrid model using ANN and back propagation algorithm is used to improve performance. • A multilayer NN is used to identify blocks. • ANN adaptation reduces error rate.			
[10]	2021	ANN, Grid Search Algorithm, XGBoost	Accurate oil productivity analysis using ANN and XGBoost algorithms to improve data analysis in the O&G Industry.
Findings: • Research applications of supervised learning data • Hyper parameters are stored in a dictionary. This will perform cross-validation and choose the parameter that causes the smallest error. • ANN algorithms accurately estimate performance. • Using XGBoost and Decision Tree to determine the improvement of computational time efficiency • Performance evaluation metrics (RMSE - root mean square error and R-Correlation Coefficient) are analyzed			

III. CONCLUSION

Based on the literature survey and the other researchers work on ML applications in the O&G Industry, the following observations can be made:

This paper examined the improvement of tools in ML for oil and gas industry. Obviously despite the fact that ML is an arising pattern in oil and gas, there are applications that have previously brought countable worth. This work have given a few instances of how ML aides accelerate and de-risk numerous business processes related with the investigation of hydrocarbon assets, the advancement of oil and gas fields. There is an on-going analysis on the adaptability of ML across the entire business. Here this survey has examined the specialized drivers of such versatility as well as the non-specialized factors also. Also assessed the impact of training, authoritative disposition, and information accessibility on the speed and heading of ML penetration to oil and gas fields.

REFERENCES

- [1] Jun Li , Yidong Guo,Xiangyang Zhang, and Zhanbao Fu, "Using Hybrid Machine Learning Methods to Predict and Improve the Energy Consumption Efficiency in Oil and Gas Fields", Hindawi Mobile Information Systems Volume 2021, Article ID 5729630, 7 pages

- [2] Anirbid Sircar, Kriti Yadav, Kamakshi Rayavarapu, Namrata Bist, Hemangi Oza, "Application of machine learning and artificial intelligence in oil and gas industry", Chinese Petroleum Society, Petroleum Research, 2021, 379-391.
- [3] Islamov, S.; Grigoriev, A., Beloglazov, I., Savchenkov, S., Gudmestad, O.T., "Research Risk Factors in Monitoring Well Drilling—A Case Study Using Machine Learning Methods." *Symmetry* 2021, 13, 1293. <https://doi.org/10.3390/sym13071293>
- [4] Zeeshan Tariq, Murtada Saleh Aljawad, Amjed Hasan, Mobeen Murtaza, Emad Mohammed, Ammar ElHusseiny, Sulaiman A. Alarifi, Mohamed Mahmoud, Abdulazeez Abdulraheem, "A systematic review of data science and machine learning applications to the oil and gas industry", *Journal of Petroleum Exploration and Production Technology*, 2021, 114339–4374
- [5] Sachin Choubey, G. P. Karmakar, "Artificial intelligence techniques and their application in oil and gas industry", *Artificial Intelligence Review*, Springer Nature B.V., 2020,
- [6] Rakesh Kumar Pandey, Anil Kumar Dahiya, Ajay Mandal, "Identifying Applications of Machine Learning and Data Analytics Based Approaches for Optimization of Upstream Petroleum Operations." *Energy Technology*, 2021, Volume 9, Issue 1, doi: 10.1002/ente.202000749
- [7] R.Yu. Zimin, V.N. Kuchin, "Improving the Efficiency of Oil and Gas Field Development through the Use of Alternative Energy Sources in the Arctic", 2020 International Multi-Conference on Industrial Engineering and Modern Technologies (FarEastCon), 2020, 978-1-7281-6951-4/20
- [8] Korolev, N., Kozyaruk, A., Morenov, V., "Efficiency Increase of Energy Systems in Oil and Gas Industry by Evaluation of Electric Drive Lifecycle.", *Energies* 2021, 14, 6074. <https://doi.org/10.3390/en14196074>
- [9] A M Sagdatullin, "Improving the energy efficiency of oil production using identification and prediction of operating modes of production wells based on data analysis methods, machine learning and neural networks", *E3S Web of Conferences* 124, 05031, 2019,
- [10] Ricky Simanjuntak, Dedy Irawan, "Applying Artificial Neural Network and XGBoost to Improve Data Analytics in Oil and Gas Industry", *Indonesian Journal of Energy* Vol. 4 No. 1, 2021, 26 – 35
- [11] Doma, V., & Pirouz, M., "A comparative analysis of machine learning methods for emotion recognition using EEG and peripheral physiological signals." *Journal of Big Data*, 7(1). 2020,
- [12] Khan, M. R., Alnuaim, S., Tariq, Z., & Abdulraheem, A. "Machine learning application for oil rate prediction in artificial gas lift wells." *SPE Middle East Oil and Gas Show and Conference.*, 2019,.
- [13] Filatova, I.; Nikolaichuk, L.; Zakaev, D.; Ilin, I. "Public-private partnership as a tool of sustainable development in the oil-refining sector: Russian case." *Sustainability* 2021, 13, 5153
- [14] Zhukovskiy, Y.L.; Korolev, N.; Filatova, I. "Asynchronous motor drive operability field with two-link structure of frequency converter." *J. Phys. Conf. Ser.* 2020, 1661, 012127.
- [15] Lavrik, Y. Zhukovskiy, A. Buldysko, "Features of the Optimal Composition Determination of Energy Sources During Multi-Criterial Search in the Russian Arctic Conditions", *Proceedings of the 2nd 2020 International Youth Conference on Radio Electronics, Electrical and Power Engineering, REEPE*, 2020, article number 9059215
- [16] Lantham A, "Why explorers are in the grip of an existential crisis: exploration's role to undergo profound change as energy transition gains pace." *Wood Machenzie, Society of Petroleum Engineers*, 2019.
- [17] Mesbah M, Soroush E, Rezakazemi M, "Development of a least squares support vector machine model for prediction of natural gas hydrate formation temperature." *Chin J Chem Eng* 25(9):1238–1248, 2017.
- [18] Rahmanifard H, Plaksina T, "Application of artificial intelligence techniques in the petroleum industry: a review." *Artif Intell Rev*, pp 1–24, 2018.