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A Geological and Petrophysical Data Driven Approach for Reservoir Reserves Estimation

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Summary

Estimating reserve recoverable of CHOPS reservoirs is critical for assessing reservoir potential and prioritizing optimization opportunities. However, the process is both time consuming and data intensive, typically involving weeks of dedicated SMEs (e.g., engineers, geologists, etc.) reviewing volumes of geological, petrophysical and historical production data of dozens of wells across wide geographical sites. With shrinking budget and limited technical resources, the majority of CHOPS assets across the industry go unreviewed thereby increasing the risk of missing potential opportunities and financial loss from optimizing the wrong reservoirs. There is also a high degree of subjectivity associated with the review process due to reliance on tribal knowledge and questionable quality of public data, e.g., completion records, well and production logs. We present a data-driven solution ingesting and consolidating multiple data sources regardless of inherent quality and reliability issues to support efficient assessment of reservoir potentials and improved review turn-around time.

Method

To overcome the aforementioned challenges, our solution presents an end-to-end advanced analytics approach that consolidates diverse oil wells data, automatically rank offsets based on geological and geographical proximity to subject reservoirs, and forecasts unknown reserves of subjects as a partial function of aggregated fluid behavior of offsets. The solution leverages the power of distributed data processing and cloud computing for scaling both the data preparation and analytics pipelines while adopting a hybrid machine learning and physics-based techniques for modelling. To boost confidence in the solution, the architecture and model parameterization are, wherever necessary, carefully informed by experiential knowledge from engineers and geologists. Although most of test has been performed on vertical and deviated CHOPS wells, the core ideas are designed to be easily extensible for horizontal CHOPS wells and related recovery techniques.

Results and Conclusions

As a first step towards evaluation in the absence of ground-truth data, the solution has gone through iterations of SME review workshops with learnings fed back to improve the solution, most especially the quality of the predicted reservoir offsets and forecasts. To assess the reasonableness of estimated reserve volumes, a back-test performed, using data from over 12,000 CHOPS wells across Western Canada, on 75 optimization jobs spanning 3 years, shows the model accurately enabling engineers in making the right optimization decision in 69% of cases compared to much less than 50% accuracy using the traditional approach. Asides speeding up the review process by orders of magnitude, the solution has also demonstrated great capacity to improve the SMEs productivity as well saves cost.