AAPG
3rd Edition
AAPG Decision Based Integrated Reservoir Modeling GTW
24-26 November 2025 | Al-Khobar, Saudi Arabia

From Interpretation to Automation: AI- Driven Innovation in Reservoir Modeling

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Abstract

Geoscientists face increasing complexity in modeling reservoirs, where data is heterogeneously complicated, and workflows are fragmented. To address this, we present a machine learning-driven approach that integrates surface drilling parameters with petrophysical log predictions, enhancing real-time decision-making in drilling operations. Our methodology leverages ensemble neural networks and Long Short-Term Memory (LSTM) networks to generate synthetic logs from gamma-ray and drilling parameters, bridging the gap between data availability and real-time decision-making.

We demonstrate the effectiveness of this approach multiple examples in different reservoirs, showcasing excellent agreement between synthetic and actual logging-while-drilling (LWD) density logs. Our analysis highlights the potential of integrating surface drilling parameters with machine learning to improve geo-steering and reservoir characterization, enabling operators to make more informed decisions and optimize well placement.

By combining machine learning with geoscience reasoning, our approach enhances drilling efficiency and reservoir understanding, emphasizing the role of data-driven solutions in modern workflows. We also discuss the challenges of deploying such AI-driven systems in practice, highlighting concerns related to trust, transparency, and integration with legacy workflows. Our human-in-the-loop design ensures that expert oversight remains central to model generation and interpretation refinement, paving the way for a new class of digital co-pilots in geoscience.