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Challenges and Opportunities for Advancing Reservoir Simulation with AI

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Abstract

Artificial Intelligence (AI) is rapidly transforming reservoir simulation and subsurface modeling, offering unprecedented opportunities to accelerate computational workflows while addressing complex data integration challenges. This talk provides a comprehensive industry perspective on the current state and future potential of AI-driven reservoir simulation technologies.

Recent breakthroughs in deep neural networks and neural operators have demonstrated remarkable capabilities in creating high-fidelity surrogate models that can replicate complex multiphase flow behavior at computational speeds orders of magnitude faster than traditional simulators. Applications ranging from production optimization to uncertainty quantification show promising results, with some operators reporting 1000x speedup over traditional simulators for specific reservoir forecasting tasks.

However, significant barriers limit widespread adoption. Ensuring physical consistency, achieving robust generalization, and building trust in high-consequence engineering applications are ongoing concerns. Adoption within industry remains limited due to skepticism toward black-box models and the complexity of integrating ML tools into established workflows. Additionally, high-quality labeled training datasets remain scarce despite the industry's vast data generation. Addressing these issues necessitates an approach focused on systematic benchmarking and consistent validation of current AI models. This talk outlines strategies for developing standardized datasets, benchmarks, and evaluation protocols to accelerate the transition from research to field deployment of AI based reservoir simulators.