From Simulation to Prediction: Machine Learning Feasibility in Hydraulic Fracturing

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Dr. Zhuang Sun is an Industry Process Expert at Dassault Systèmes (the Abaqus company). His presentation will be at 9:00 Central Time on Thursday, April 30, 2026. The topic is **"From Simulation to Prediction: Machine Learning Feasibility in Hydraulic Fracturing."**

Abstract

Hydraulic fracturing simulation is essential for optimizing unconventional reservoir development, yet the high computational cost of physics-based models limits their practical use. This presentation demonstrates high-fidelity finite element simulations in Abaqus®, capturing fully coupled processes including fluid flow, rock mechanics, fracture propagation, proppant transport, and stress shadowing. A machine learning (ML) surrogate model, trained on sampled simulation data, replicates fracture geometry and pressure predictions with R^2 exceeding 90% while reducing computation time from hours to milliseconds. Sensitivity analysis highlights certain parameters as key drivers of fracture development. Results demonstrate the feasibility of ML surrogate modeling as a scalable complement to physics-based simulation for real-time hydraulic fracturing design and optimization.

Biography

Zhuang Sun is an Industry Process Expert at Dassault Systèmes (the Abaqus company). He has extensive experience enabling real world use cases of geomechanics simulations such as hydraulic fracturing, mechanical earth model, wellbore stability, etc. He holds 4 U.S. patents and has authored or co-authored more than 40 technical papers on journals and conferences such as SPE Journal, Fuel, Rock Mechanics and Rock Engineering, etc. He serves as an Associate Editor of Geoenergy Science and Engineering. He is also a recipient of the Future Leader Award (2022) from the American Rock Mechanics Association (ARMA). He holds a Ph.D. degree in Petroleum and Geosystems Engineering from the University of Texas at Austin.