An Innovative Machine Learning Approach to Unconventional Production Prediction

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Abstract

Several years ago Chevron introduced an innovative data analytic workflow called the Type-Curve Optimizing Geostatistical Array (TOGA). TOGA ties unconventional reservoir and well completion characteristics to historical production and makes robust predictions of well performance. TOGA is built on a foundational geologic framework and leverages random forest machine learning optimized for subsurface data sets. Random forest methods are preferred for unconventional systems because they capture complex, multidimensional and non-linear interactions in noisy databases. TOGA is part of a portfolio of other machine learning and physically-based reservoir engineering tools used by Chevron to reduce uncertainty in unconventional reservoir performance prediction. The workflow generates performance prediction maps by applying the random forest multivariate relationships to grids of the key reservoir predictor variables. These production prediction maps are stacked to form an array of locations that each have a unique expected production profile through time. TOGA output may be used to calibrate existing type curve workflows, define reservoir sweet spots, establish reservoir continuity, and predict ultimate recovery. Data science and machine learning approaches have progressed Chevron's understanding of its assets, especially in the Permian Basin. Unconventional plays were once thought to be relatively unpredictable, highly variable, and having little connection to reservoir properties. TOGA and other proprietary data analytic technologies have enabled the identification of key reservoir performance drivers for each unconventional target zone under development.