Multiple-point Geostatistics: Integration of Geological Concepts with Numerical Data

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Integrating the highly conceptual geological knowledge with different types of measured data to build a numerical reservoir model has always been a challenge. In traditional reservoir modeling, the depositional facies maps are delineated by geologists and geophysicists after careful consideration of all data sources, such as well data, seismic reflection data, and depositional environment information. This is a time-consuming and error-prone process due to the intensive human involvement. Traditional two-point geostatistics utilizes variogram models, typically inferred from data, to characterize the spatial structure of data. But variogram, a two-point statistical measure, can not capture curvilinear structures and/or shapes of geological bodies such as channels. Therefore, variogram-based geostatistical model cannot take full advantage of existing prior geological knowledge about facies patterns and distribution.

In multiple-point geostatistics, a training image is used to depict the prior purely conceptual geological concepts. This training image captures the shapes, patterns and distributions of geological objects, it need not be conditional to any location-specific reservoir data. Then a sequential pixel-based simulation is performed to generate multiple equi-probable numerical models of the reservoir. All these alternative models are conditioned to the location-specific well and seismic data, and reproduce the shapes and patterns displayed by the training image. Thus multiple-point simulation amounts to taking the training image patterns, morphing and anchoring them to location-specific reservoir data. In this paper, we present some multiple-point simulation examples.