Abstract

A Regionalized Multiple Point Statistics Approach To Conditioning Process-based Geological Models

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Objectives/Scope: The process-based geological modeling mimics the physical laws that govern depositional and diagenetic processes, thus can generate geologically realistic models. However, these models do not necessarily honor well logs and other areal data. This is because these data are not directly integrated in the process-based modeling, but rather used to infer a set of model input parameters. Conditioning process-based models to data is critical and has been challenging for decades.

Methods, Procedures, Process: Traditional approach to data conditioning of process-based geological models lies in further tuning the input parameters by trial-and-error or through an automated inverse procedure. This can improve the model calibration to data but can rarely reach a fully satisfactory conditioning. We start from a process-based model, which is calibrated as close as possible to well data by tuning its input parameters. For further data conditioning, we propose a regionalized multiple point statistics approach where the process-based model is used as a training image.

Results, Observations, Conclusions: The training image, defined on the same grid of the geological model, presents in general geological trends or non-stationarity. Thus, the conventional multiple point statistics method cannot directly be applied. However, the proposed method can effectively capture geological patterns as well as trends in the training image, then reproduce them in the resulting geological model while honoring well data. In addition to well data conditioning, this method can also be extended to seismic data conditioning by deriving a rock physics model from the process-based geological model. The process-based and the rock physics models together constitute a couple of training images for geological pattern recognition and regeneration under seismic data constraint.

Novel/Additive Information: The proposed method differs from the conventional multiple point statistics method in three folds: 1) The training image is a process-based geological model, thus not necessarily stationary as required by the conventional method; 2) There is no need to partition the non-stationary training image into pseudo stationary ones like in the conventional approach; 3) Multiple point statistics are fully inferred from the training image instead of involving a probability combination scheme of the conventional method.