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Conditioning Facies Simulations with Connectivity Data

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When characterizing and simulating underground reservoirs for flow simulations, one of the key characteristics that needs to be reproduced accurately is its connectivity. More precisely, field observations frequently allow the identification of specific points in space that are connected. For example, in hydrogeology, tracer tests are frequently conducted that show which springs are connected to which sink-hole.

To account for this type of information, we propose an algorithm to condition stochastic simulations of lithofacies to connectivity information. The algorithm is based on the multiple-point philosophy but does not imply necessarily the use of multiple-point simulation. The challenge lies in generating realizations such that the connectivity information is honored as well as any prior structural information (e.g. as modeled through a training image).

The algorithm consists of using a training image to build a set of replicates of connected paths that are consistent with the prior model. This is done by scanning the training image to find point locations that satisfy the constraints. Any path (a string of connected cells) between these points is therefore consistent with the prior model. For each simulation, one sample from this set of connected paths is sampled to generate hard conditioning data prior to running the simulation algorithm.