SandstoneSim

PoreSim RESEARCH CONSORTIUM

Overview

SandstoneSim provides two options for creating computer-generated sandstones. The option is a process-based simulation similar to models developed by others (e.g., Oren and Bakke, 2002; Keehm et al., 2001). The second option is direct generation of a voxel image based on a set of target morphological statistics.

Algorithms

The process-based model begins with a particle-scale description of a granular material. The consolidated sandstone is then created by simulating diagenetic processes such as compaction and cementation. Traditionally, sphere packings are used as the base unconsolidated material. However, computer-generated packings of non-spherical particles and/or particle-scale data sets obtained from tomography images of real sands may provide better starting points.

An advantage to using computer-simulated packings for the process-based models is that much larger data sets can be used (tens or hundreds of thousands of particles), provided that the subsequent flow simulation and/or network generation steps do not require the structure to be voxelized. In contrast, data-sets obtained from tomography of real sands are generally much smaller (in terms of particle numbers), but they capture the morphologic complexity found in real materials.

Either approach provides a valuable complement to direct imaging of real sandstones because they provide the opportunity to study the consequences of different diagenetic processes on structure and transport.

The other option for generating computer-simulated sandstones involves direct generation of voxel images using a simulated annealing algorithm (see the description of the MembraneSim program.) Using this approach, target statistics are obtained from a real material. The simulated annealing algorithm can then be used to realize different structures (with equivalent statistics). Alternatively, the target statistics can be manipulated to create a variety of structures.

Examples

The process-based model is at a preliminary stage of development. Figure 1 is an example of a structure obtained using a sphere packing as the base material. Figure 2 is a computer-generated voxel image, for which the target statistics were taken from a real material (see Thompson et al., 2005).

References

Keehm, Y., T. Mukerji, and A. Nur, "Computational rock physics at the pore scale: Transport properties and diagenesis in realistic pore geometries," *The Leading Edge*, Feb., 180-183 (2001).

Oren, P.-E., and S. Bakke, "Process based reconstruction of sandstones and prediction of transport properties," *Transport in Porous Media*, **46**, 311-343 (2002).

Thompson, K.E., C.W. Willson, C.D. White, S. Nyman, J. Bhattacharya, and A.H. Reed, "Application of a new grain-based reconstruction algorithm to microtomography images for quantitative characterization and flow modeling," paper SPE 95887, proceedings of the Annual Technical Conference and Exhibition, Dallas, TX, 9-12 Oct. (2005).

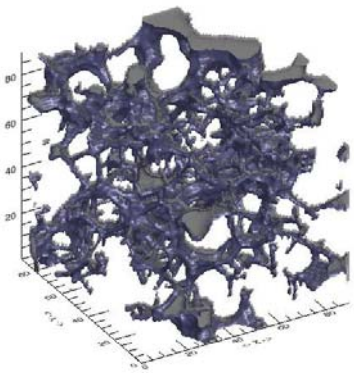

Fig. 1

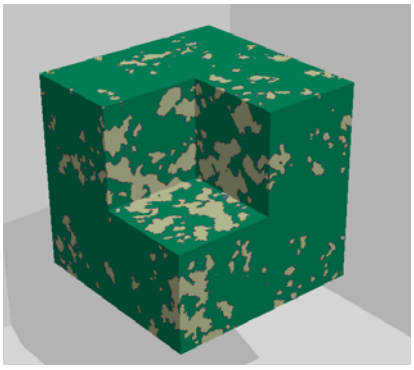

Fig. 2