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Random Emulation of Large-Scale Natural Pore Networks

Tuesday, 1 June 2021 14:55 (15 minutes)

Over the past years, tomographic scanning techniques like micro-CT have enabled the acquisition of high-fidelity void-space geometries of natural porous media [e.g., Raeini, Bijeljic, and Blunt, Physical Review E, 96, 1 (2017)]. There are, however, experimental/computational limitations in the sample size, respectively level of detail or voxel count, that can be acquired [Section 2.3 in Cnudde and Boone, Earth-Science Reviews, 123 (2013)]. Moreover, limitations both in computing time and memory prohibit direct numerical simulation (DNS) of flow and transport in large resp. detailed sample geometries. Pore networks derived from scans alleviate this second limitation or computational burden, but introduce model assumptions and still necessitate a methodology to extrapolate to larger samples. Such a methodology is needed, especially for relatively inhomogeneous rocks like carbonates, as the scales of representative elementary volumes (REV) for flow and transport theories are often larger than the sample sizes that are currently scanned/post-processed [Meyer and Bijeljic, Physical Review E, 94, 1 (2016)].

In this work, we address this need by presenting a new pore network generation algorithm. While emulating from an existing base network new networks of equal or larger sizes, the new algorithm scales approximately linearly with the pore count and maintains (1) pore coordination-number statistics, (2) geometrical pore/throat properties, as well as (3) the potentially inhomogeneous spatial clustering of pores. While existing methods address the first two properties [Idowu, Pore-Scale Modeling: Stochastic Network Generator and Modeling of Rate Effects in Waterflooding, Imperial College London (2009)], the third point is crucial to match flow/transport properties such as the permeability in inhomogeneous media.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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