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Random Emulation of Large-Scale Natural Pore Networks

DANIEL MEYER, Institute of Fluid Dynamics, ETH Zurich — Over the past years, tomographic scanning techniques like micro-CT have become popular for the acquisition of high-fidelity void-space geometries of natural porous media [e.g., Raeini, Bijeljic, and Blunt, Physical Review E, 96, 1 (2017)]. Limitations both in computing time and memory prohibit, however, direct numerical simulation (DNS) of flow and transport in large resp. detailed sample geometries. Pore networks derived from scans alleviate this limitation, but still necessitate a methodology to extrapolate to larger samples. In this work, we present 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 [e.g., 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.

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