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Plug size pore network extraction with pore scale resolution

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When dealing with pore scale simulation, two main methods are generally used: direct numerical simulation (DNS) and Pore Network Modeling (PNM). The former can use different formalism like Lattice-Boltzmann, Navier-Stokes or Smoth-Particule-Hydrodynamics. While DNS can provide more precise results than PNM, it cannot get reliable results on multiphase flow on images exceeding 500^3 voxels. On the other hand, PNM allows to reach much wider volumes at the cost of precision.
Lately, Raeini et al. (2017) have proposed a hybrid solution that can get profit from both DNS and upscaling through a Pore Network Model where properties of the network are determined from DNS by solving Stokes equation on the segmented image.
However, the extraction code that can produce such a network is limited by the memory of the machine, especially when dealing with large volumes (network extraction from a two billion voxels 3D image needs more than 128Gb of memory). To overcome this limitation, a stitching process has been developed on networks extracted from overlapping sub-volumes of a given image. Then, simulations on the large extracted network are held by the TOTAL's pore-scale network simulator DynaPNM (Regaieg et al. 2021).
In this talk, the stitching method is first presented. Then, a validation process for both qualitative and quantitative evaluation of the discrepancy introduced by the stitching process, for both single and two phase flow, is proposed. Guidelines on the input parameter choice for stitching are exposed, justified by a sensitivity study. Three rock-types are used as source materials for these studies (one outcrop and two reservoir rocks). Moreover, strategies to get a cubic pore network from a source image with a large aspect ratio are discussed. Finally, the application on centimeter long rock samples is presented on an extracted pore network representing a rock volume up to 46cm^3 (equivalent to a large 10000x8000x8000 voxel image scan at a voxel resolution of 4µm).

Time Block Preference

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

References

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