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Improved Watershed-based Pore Space Partitioning Algorithm for Pore Network Modelling

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In recent years, watershed-based methods mimicking basin flooding have been adopted for the partitioning the pore space in 2D and 3D images into pores regions as a basis for pore network modelling. However, due to the noisy nature of tomographic images and the neglection of both the convergent and divergent features in different locations in the pore space, watershed-based partitioning algorithms often result in an excessively large numbers of pores, referred to as over-segmentation. Many of these pore regions are redundant with respect to the topology of the pore space and do not notably improve the geometrical characterisation required for, in particular, multi-phase flow simulations. Although some recent algorithms employ additional, usually post-processing, rules to reduce the over-segmentation these still preserve too many unnecessary pores, thus significantly prolonging fluid flow simulations. In this work, we propose a new algorithm to minimise the number of so-called seeds from which the regions grow. Using an efficient region-growing procedure, the algorithm then determines the locally narrowest pore space constrictions separating the pore regions, which in turn map onto the network bonds and nodes, respectively. We combine this new algorithm with an existing medial-axis-based pore network extraction technique (Jiang et al,. 2007) facilitating accurate determination of node and bond flow properties, such as capillary entry pressures and conductances. The proposed partitioning algorithm is convincingly validated in terms of pore-by-pore fluid occupancy, as determined by capillary entry pressures, against phase distributions of two-phase flow experiments, visualised directly in a micromodel and in a carbonate rock through synchrotron X-ray micro-tomographic imaging. This demonstrates that the algorithm facilitates highly accurate and highly efficient pore-network simulations.

Time Block Preference

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

References

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