InterPore2021



Contribution ID: 487

Type: Oral Presentation

Towards Unified Pore-Scale Imaging and Modelling: Comparison of the Generalized Network Model with Direct Numerical Simulation

Thursday, 3 June 2021 11:15 (15 minutes)

A thorough understanding of pore-scale modelling techniques is essential to flow through permeable media research. We compare two phase-flow simulations from the generalised network model (GNM) [Raeini et al, 2017, 2018] with a recently developed lattice-Boltzmann model (LBM) [Akai et al, 2018, 2020] for drainage and waterflooding in two samples -- a synthetic beadpack and a micro-CT imaged Bentheimer sandstone -for water-wet, mixed-wet and oil-wet states. We further compare the GNM to a volume-of-fluid method [Shams et al. 2018] for two-phase flow in a synthetic two-pore system. An analysis of macroscopic capillary pressure shows a large discrepancy between the GNM and both direct numerical simulations, with volumeof-fluid simulations highlighting the need for accurate pore-space geometry in network modelling. Pore-bypore comparison between the GNM and LBM reveals a good agreement for oil and water-wet media. The comparison for mixed-wet media, however, shows greater differences. We suggest that the dependence of displacement on wettability in the mixed-wet state is responsible for this discrepancy. Compared to the LBM, the GNM can reach lower initial water saturations and captures the effect of layer flow -a prohibitively expensive task for LBMs -by achieving a lower residual oil saturation after waterflooding in altered wetting states. Overall, we present a workflow for the comparison of porenetwork models with direct numerical simulation of multi-phase flow. We demonstrate their strengths and shortcomings through an analysis of local and macroscopic parameters while showing how high-fidelity approaches can be used to facilitate future network model development.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

Raeini, A. Q., Bijeljic, B., and Blunt, M. J. (2017). Generalized network modeling: Network extraction as a coarse-scale discretization of the void space of porous media. Physical Review E, 96(1):1–17

Raeini, A. Q., Bijeljic, B., and Blunt, M. J. (2018). Generalized network modeling of capillary-dominated two-phase flow. Physical Review E, 97(2):1–20

Akai, T., Lin, Q., Bijeljic, B., and Blunt, M. J. (2018). Wetting boundary condition for the color-gradient lattice Boltzmann method: Validation with analytical and experimental data. Advances in Water Resources, 116:56– 66

Akai, T., Lin, Q., Bijeljic, B., and Blunt, M. J. (2020). Using energy balance to determine pore-scale wettability. Journal of Colloid and Interface Science, 576:486–495

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Session Classification: MS9

Track Classification: (MS9) Pore-scale modelling