Contribution ID: **651**

Type: **Oral Presentation**

Bridging the Gap: Connecting Pore-Scale and Continuum-Scale Simulations for Immiscible Multiphase Flow in Porous Media

Wednesday, 15 May 2024 14:45 (15 minutes)

Our work aims to bridge length scales in immiscible multiphase flow simulation by connecting pore-scale and continuum-scale simulations through a novel validation framework. We employ Niessner and Hassnaizadeh's (2008) continuum-scale model for multiphase flow in porous media, combined with McClure et al.'s (2020) geometric equation of state, to provide a complete set of geometrical measures. Pore-scale fluid configurations simulated with the Lattice-Boltzmann method are used to validate the continuum-scale results. We propose a mapping from the continuum-scale to pore-scale utilizing a Generalized Additive Model to predict non-wetting phase Euler characteristics during imbibition, effectively bridging the continuum-to-pore length scale gap. Other continuum-scale simulated measures of specific interfacial area, saturation, and capillary pressure are directly compared to up-scaled pore-scale simulation results. Overall, the proposed framework provides reasonable front profiles for saturation, capillary pressure, specific interfacial area, and Euler characteristic for an imbibition process.

The described workflow advances the modelling of immiscible multiphase flow by establishing a transparent connection between pore-scale and continuum-scale simulations, supported by fundamental thermodynamic and geometrical principles. Furthermore, the generated results for the Lattice-Boltzmann simulations demonstrate that utilizing the fluid configurations obtained from the outcomes of pore-scale simulations not only offers analytical references for validating the continuum-scale simulations but also serves as an interface to compare pore-scale and continuum-scale simulations. Future work remains for evaluating the extended multiphase flow model and our proposed framework for flow reversal processes such as drainage followed by imbibition.

Acceptance of the Terms & Conditions

Click here to agree

Student Awards

Country

Australia

Porous Media & Biology Focused Abstracts

References

Conference Proceedings

I am interested in having my paper published in the proceedings.

Primary author: EBADI, Mohammad (University of New South Wales)

Co-authors: MCCLURE, James (Virginia Tech); MOSTAGHIMI, Peyman; ARMSTRONG, Ryan

Presenter: EBADI, Mohammad (University of New South Wales)

Session Classification: MS23

Track Classification: (MS23) Interfaces, interfaces everywhere…a special session in honor of Prof. Dorthe Wildenschild