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# Assessment of the Effectiveness of 2.5D Pore-Scale Modeling

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Digital rock physics (DRP) is an emerging technique that integrates advanced imaging and computational modeling to characterize rock microstructures. The flow transport properties such as absolute permeability, velocity, and relative permeability can be quantified using numerical simulations based on high-resolution three-dimensional (3D) digital rock models. However, the acquisition and simulation of 3D models are often expensive and computationally demanding. Two-dimensional (2D) models are more accessible alternatives and are frequently utilized in microfluidic experiments but those models commonly fall short in capturing pore-scale trapping phenomena or relative permeability curves. As another alternative, 2.5D models[1] have been introduced to bridge the gap. In 2.5D models, the etching depth of each void (pore) pixel in a 2D image depends on its distance from the nearest solid (grain) pixel, enhancing the geometric representation of pore throats. The etching depth or shape were still limited because they were devised for micromodel experiments. In this study, we generated digital 2D and 2.5D models for a range of parameters including the slice number of a 3D rock image, etching depth, and etching shape. We compared their transport properties such as relative permeability versus saturation, as well as quantifying the topology of the trapped non-wetting phase, to those of the original 3D model using the open-source Lattice-Boltzmann simulator OPM/LBPM. The quantitative and qualitative results demonstrate the capabilities of 2D and 2.5D models to replicate essential transport properties of 3D porous media they represent.

## Country

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## References

[1] Xu, K., Liang, T., Zhu, P., Qi, P., Lu, J., Huh, C., & Balhoff, M. (2017). A 2.5-D glass micromodel for investigation of multi-phase flow in porous media. Lab on a Chip, 17(4), 640–646. https://doi.org/10.1039/C6LC01476C

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