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Single-scale heterogeneous pore network modelling with microporosity upscaling.

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One of the longstanding challenges of the oil and gas industry is the problem of scale and hence, the term "upscaling"is used frequently in literature. In this work, we investigate the ways to represent connected regions with substantially different pore sizes. For this purpose, pore-scale simulations are combined with conventional continuum scale models. Our primary objective is to run sensitivity analysis considering topology changes for the pore space above and below a given resolution. Inspired by conventional upscaling practices, we assign upscaled flow properties to a group of pores and throats that are smaller than a given resolution. We show if the back calculated upscaled properties are solely a function of the pore space topologies at smaller scale. To make our study more general, we also investigate different pore-to-pore connections at larger scales. First, we start by considering the simplest case where two macro-pores connected through cuboidal regular lattice network of micro-pores that represents microporous region. Calculating upscaled properties of the cuboidal lattice, we compare results from both conventional pore-scale and hybrid upscaled models. Consequently, we vary pore space connectivities within the cuboidal lattice as well as the connectivity with macro-pores to study a wide range of possible scenarios for these two different scales of pores. The results could provide insight to our understanding of multiphase flow in rocks with different scales of importance and upscaling large pore networks to speed up pore-scale simulations.

References

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Primary authors: Mr HAKIMOV, Nijat (University of Kansas); Dr ZOLFAGHARI, Arsalan (TORP/University of Kansas); Prof. KALANTARI-DAHAGHI, Amirmasoud (TORP/University of Kansas); Prof. NEGAHBAN, Shahin (TORP/University of Kansas); Dr AGHAEI, Arash (Thermo Fisher Scientific)

Presenter: Mr HAKIMOV, Nijat (University of Kansas)

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