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Simulation of multiphase porous media flow in acid stimulation formations with an adaptive mesh refinement strategy

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In our previous work, we investigated the fingering behavior in acid stimulation formations and found that the dissolution patterns in acid stimulation region have an influence on the injection performance. A detailed characterization of the highly heterogeneous wormholes could introduce a large number of gridblocks and subsequently increase the computational burden drastically. In this work, an adaptive mesh refinement strategy is proposed for a computationally efficient simulation of multiphase porous media flow in acid stimulation formations. As a preprocessing step, we construct multiple tiers of grids containing the heterogeneous features in the vicinity of the wellbore and ascertain their topology. The saturation is taken as a criteria during simulation to switch the grids locally. When the saturation of the injected phase is lower than a threshold value, a fine grid is used to capture the fingering behavior. When the value is surpassed, a coarse grid is used instead. With respect to the switch, the upscaling is achieved using a volume weighted approach, while the downscaling is achieved using a basis function interpolation method. A number of scenarios are used to evaluate the technique, and the results demonstrate its feasibility, strong computational performance, and accuracy.

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Primary author: Dr LI, Longlong (Institute of Mechanics, Chinese Academy of Sciences)

Co-author: JIA, Cunqi (The University of Texas at Austin)

Presenter: Dr LI, Longlong (Institute of Mechanics, Chinese Academy of Sciences)

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