# MULTISCALE SIMULATION VIA DIRECT SUBSTITUTION OF PORE-SCALE MODELS FOR DARCY-SCALE GRIDS NEAR WELLS

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A limitation of existing continuum-scale reservoir simulators is the inherent inaccuracy of macroscopic properties, because constant, average values are used to describe the heterogeneous media. Improved accuracy in these properties can often be obtained through pore-scale modeling by solving the fundamental momentum equations in media imaged from real rock samples. Typically, the pore-scale models are used as stand-alone tools and arbitrary boundary conditions are imposed in order to back-calculate properties such as permeability and relative permeability. Inaccuracies can arise by implementing this approach because the imposed boundary conditions do not reflect transport behavior in the surrounding media.

In this work, we perform a more rigorous multiscale approach in which pore-scale models are directly substituted for Darcy-scale models in selected regions of the reservoir. We demonstrate the multiscale approach in a near-well region where hundreds of pore-scale, network models are substituted near the wellbore. The pore-scale region is then coupled to macro-(Darcy-)scale grids to provide outer boundary conditions. By modeling flow and transport in a thin film (decimeters beyond the well and decimeters in the vertical direction) at the fundamental pore scale, more accurate physics are captured in this dynamic region. Finite-element mortars are used to ensure continuity of pressures and fluxes between the pore-scale models as well as the pore-scale region to the outer, macro-scale region.

Important applications of the work include reactive flow in the near-well region, for example acid injection for the purpose of improving permeability. Reactive transport is an inherently pore-scale process; modeling the formation of wormholes is difficult (or impossible) at the macro-scale. The multiscale simulator developed in this work allows for modeling wormhole creation in pore-scale models. Since these wormholes often extend beyond one network model length, it is necessary to couple many together near the well to simulate the formation of the resulting preferential pathways. If necessary, upscaling can then be performed a posteriori so that the defined permeability field matches results obtained in the multiscale approach.