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A MULTISCALE EIGENEROSION METHOD FOR PROPAGATING FRACTURES IN FLUID-INFILTRATING POROUS MEDIA

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A multiscale model is proposed to simulate hydro-fracture of porous media at the brittle region. By coupling discrete element simulations with a flow network simulator at the pore scale, the microstructural evolutions of the grain assemblies and seepage flow are explicitly simulated at representative elementary volumes (REV). These pore-scale simulations are then linked to a macroscopic mixed finite element model that includes the displacement jump as a priori unknown. A computational homogenization scheme for discrete-continuum coupling problems previously established in Liu et al. 2015 and Wang & Sun (2016) are extended to retrieves the characteristic length, orientation and magnitude of the jump from grain scale simulations to propagate macroscopic fractures in the macroscopic domain. Using a variant of eigenerosion scheme, the macroscopic hydro-mechanical finite element may erode when the homogenized microscopic responses at corresponding REVs exhibit material failure. Numerical examples will be compared with analytical solution and benchmark problems to illustrate the versatility and robustness of the proposed method. The interplays between micro-damage and the onset and propagation of macroscopic fracture are analyzed.

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