Computational Challenges in Multiscale Poromechanics

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ABSTRACT

We consider the problem of coupled fluid flow-solid deformation in the unsaturated range and address the computational challenges of accommodating the multiscale and multiphysical nature of this problem. To this end, we present a general mathematical framework for unsaturated poromechanics in the finite deformation range and identify energy-conjugate variables relevant for constitutive modeling [1,2]. The framework relies on classic mixed finite element formulation with solid displacements and fluid pressures as independent degrees of freedom. Theoretical and computational issues addressed include material heterogeneity at the mesoscale level, formulation of the problem in the finite deformation range, development of solution algorithms based on iterative linear solvers, shear band triggering, double porosity modelling and simulations, and stabilized mixed finite element formulations. We also present a generalized continuum model to propagate a persistent shear beyond the peak response and well into the softening regime.

REFERENCES

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