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An Adaptively Stabilized Finite Element Formulation for Monolithic Thermo-hydro-mechanical Simulations at Finite Strain

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Abstract

An adaptively stabilized monolithic finite element scheme is proposed for a thermo-hydro-mechanical problem in non-isothermal fluid-infiltrating porous solids at finite strain. We first present the derivation of the thermo-hydro-mechanics model in large deformation. By exploiting assumed deformation gradient techniques, we develop a numerical procedure capable of simultaneously curing the multiple locking phenomena related to shear failure, incompressibility imposed by pore-fluid and/or incompressible solid skeleton, and yet produce solutions that satisfy the inf-sup condition and enable equal-order discretization. Methods for estimating optimal value for stabilization parameters are discussed. The template based generic programming and automatic differentiation techniques used to implement the stabilized model are also highlighted. Finally, numerical examples are given to show the versatility and efficiency of this model.

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