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VISCOPLASTIC REGULARIZATION OF STRAIN LOCALIZATION IN FLUID-SATURATED POROUS MEDIA

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Strain softening in geomaterials is usually accompanied by localized deformation and lead to ill-posedness of the boundary value problem when a Cauchy continuum is used. From the numerical point of view, ill-posedness is manifested by excessive pathological sensitivity of the results to the size of finite elements. As first pointed by Needleman (1988) and used in (Loret and Prevost, 1991; Sluys, 1992; Oka et al., 1994) rate dependency may help avoiding this ill-posedness introducing implicitly a characteristic length, which prevents strains from localizing into infinitely narrow bands when the mesh is refined.

In this work viscoplasticity is adopted as regularization technique in strain localization simulation of multiphase geomaterials in quasi-static and isothermal conditions. In particular, the variably saturated porous medium is treated as a multiphase system where the voids of the skeleton are filled partially with liquid water and partly with gas assumed to behave as an ideal mixture of dry air and water vapour. The mechanical behaviour of the soil skeleton is described by an elasto-viscoplastic constitutive model of Perzyna type (Perzyna, 1966) with Drucker-Prager (with linear isotropic hardening/softening and non-associated flow rule) yield surface for simplicity.

The regularizing effect of the developed viscoplastic model is illustrated by finite element simulation in Comes-Geo code (Gawin and Schrefler, 1996; Lewis and Schrefler, 1998; Sanavia et al., 2006, Sanavia et al., 2008) of an undrained plane strain biaxial compression test on water saturated dense sand inspired by Mokni and Desrues, 1998 following Sanavia et al., 2006. Mesh sensitivity is examined by using different spatial discretization and the results denote the crucial influence of the loading velocity on the viscous regularization of quasi-static process.

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