Localization phenomena occur as a result of local concentrations of plastic deformations in small bands of finite width (shear bands). Porous materials, as, for instance, soil, rock, concrete and sinter materials as well as polymeric and metallic foams exhibit a strong tendency towards shear banding caused by plastic dilatation in the brittle deformation range. This kind of behaviour is of great practical importance in engineering design, for example in the study and computation of failure mechanisms in soil mechanics (base failure, slope failure, etc.). From the mathematical point of view, the computation of localization phenomena, for example within the framework of the finite element method (FEM), yields an ill-posed problem, since each mesh refinement leads to smaller shear bands until one obtains (ideally) a singular surface. Following this, regularization mechanisms should be introduced to obtain reliable and robust results. In the present article, two natural regularization mechanisms for liquid-saturated and empty granular porous materials are discussed. These mechanisms are (1) the inclusion of additional independent degrees of freedom in the sense of the Cosserat brothers for the granular porous solid and (2) the inclusion of pore-fluid viscosity in the saturated case.
saturated and empty materials; elasto-plastic skeleton; micro polarity; viscous pore-fluid; shear band localization