Pore-scale modelling of grain-fluid mixtures applied to dense suspensions

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The plane shear flow of a dense fluid-grain mixture is simulated using a new hydromechanical coupled model combining the Discrete Element Method (DEM) for the solid phase with a Pore-scale Finite Volume (PFV) formulation for the fluid phase. This model, based on a regular triangulation of the particles and its dual Voronoi graph, couples the isotropic part of the strain field with the fluid flow [2,3]. In order to study sheared suspensions, we further improved the previous model: including the deviatoric part of the stress tensor on the basis of the lubrication theory[4], and extending the solver to periodic boundary conditions. Simulations of a granular media saturated by an incompressible fluid and submitted to a plane shear at imposed vertical stress are presented. The shear stress is decomposed in different contributions which can be examined separately: contact forces, lubrication forces, and drag forces associated to the poromechanical couplings [2]. The proposed numerical model is able to describe the behavior of the dense suspension. The friction and dilatancy laws predicted by the present model is compared with the experiments and rheological models found in previous works (e.g. Boyer et al. [5]).

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