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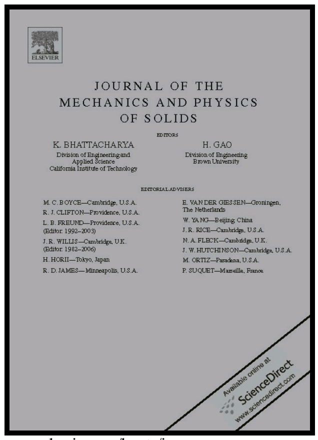

The micromechanical nature of stresses in triphasic granular media with interfaces

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The micromechanical nature of stresses in triphasic granular media with interfaces

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Abstract

The total stress tensor as the average stress within a triphasic granular medium is formally derived from micromechanics where internal forces associated with the solid phase, the two immiscible fluid phases and the associated three interfaces are explicitly accounted for. It is demonstrated that for rigid solid particles, the contributions of all local solid-fluid surface tensions to the total stress are eventually zero. The present work gives the total stress expression as a function of a solid-phase specific stress tensor and a fluid mixture stress contribution that is related to the material's microstructure. A generally non-spherical fluid mixture stress is obtained in contrast to an averaged hydrostatic fluid pressure usually associated with standard thermodynamics. The tensorial nature of this fluid mixture stress contribution is highlighted through numerical experiments pertaining to an idealized granular material in the pendular regime at low wetting saturations. Numerical simulations providing full access to microstructural information are conducted using the Discrete Element Method (DEM), which describes internal forces using resultant forces that clearly deviate from the distributed nature of internal forces in triphasic granular media, *e.g.*, fluid pressures. Nevertheless, this micro-scale representation is demonstrated to be indeed valid for macro-scale stress description in the pendular regime.

Keywords: granular material, microstructure, stress, unsaturated conditions, interfaces