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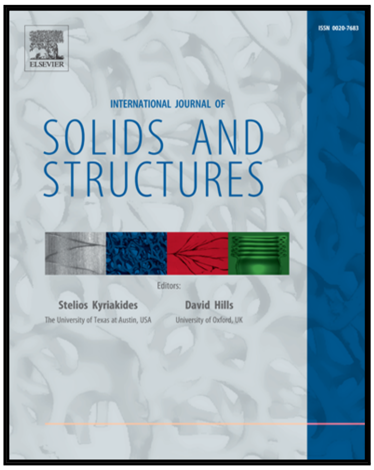

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On Elastic Deformations and Decomposition of Strain in Granular Media

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Abstract

The origin of global deformations in granular media stems from various concurrent mechanisms at the microscopic scale. Recent micromechanical studies have pointed out inadequacies of traditional elasto-plastic theories with elastic nucleus to describe such materials. In addition, the fundamentals of additive decomposition of global strain into mechanism-specific contributions have also been questioned from a multiscale point of view due to appearance of emergent nonlinearities in the global response. The current study addresses the decomposability of strain and the existence of an elastic zone by systematically scrutinizing the energy aspects of granular deformation under quasi-static loading regime. The results show that the assumption of an exclusively elastic nucleus can potentially introduce non-negligible errors, even at strain ranges below 10^{-4}. By relaxing commonly used assumptions which are often restrictive, a new constitutive model for elastic deformations in granular materials is developed to capture material response as a function of microstructure of the granular assembly. After verification through comparisons with discrete elements simulations, the model has been used to investigate the decomposability of strain. The results demonstrate that the elastic strain component can only be extracted through numerical simulations where the dissipative mechanisms are "artificially" prohibited, which relegates the strain decomposition to an abstract concept.

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