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Abstract

Mechanics of homogenized micro-structured materials via Cosserat elasticity

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Particle composites include materials like ceramic, metal composites, poly-crystals, and masonry. Due to the presence of different heterogeneities (rigid or soft inclusions, voids, microcracks, etc.) whose size may have an important impact on their behavior at the macroscopic scale, mechanical modelling is a challenging task.
Non-local theories offer a solution to this problem while maintaining memory of the microstructure, especially the internal length. Differently to local classical models, non-local models (micropolar/Cosserat might be considered non-local continua of implicit type) can account for internal lengths in the field equations, which are significant in many cases.
The aim of this work is the mechanical characterization of anisotropic composites made of rigid particles and thin elastic interfaces at different level scale for investigating both statical and dynamical behavior. To find the anisotropic constitutive properties of those materials, a homogenization technique based on an energy equivalence criterion between a discrete model of the material and a continuum one is adopted. Two continuum model descriptions, one micropolar and the other classical, are compared to the discrete system, assumed as benchmark. Different material symmetry classes, both centrosymmetric and non-centrosymmetric, are considered and the advantages of micropolar modelling are highlighted.