COSSERAT AND NON-LOCAL CONTINUA FOR GRANULATE MATERIALS

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We consider granulate materials consisting of rigid grains with elastic contacts resisting both displacements and rotations. The latter play an important role in the process of deformation. When the microstructural size is much smaller than the problem dimension, it is advantageous to model the granulate material as a continuum. The possibility of grain rotations necessitates the use of Cosserat continuum every point of which possesses three rotational degrees of freedom on top of the conventional translational ones. The homogenisation procedure is a cornerstone of deriving such continua. The homogenisation strategies by differential expansions and integral transformations are considered and the results are compared for simple 1D realisations. The homogenisation by differential expansions is shown to provide a healthy balance between the accuracy and simplicity, while the homogenisation by integral transformations produces a non-local continuum yielding a one-to-one correspondence with the full discrete description of the original microstructure. The homogenisation by differential expansions is then generalised for 3D statistically homogeneous particle arrangements. The non-standard (Cosserat) elastic moduli are expressed through the contact stiffnesses, averaged particle size, volume fraction and contact distribution function.

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