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A NOVEL FORMULATION OF THE DISCRETE ELEMENT METHOD WITH DEFORMABLE PARTICLES

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ABSTRACT

A new original formulation of the discrete element method (DEM) with deformable spherical particles will be presented. The DEM is a modelling technique, wherein the material is represented by an assembly of rigid particles (discrete elements) interacting with one another by contact forces. Now, it is a commonly accepted modelling method for a wide range of materials, both particulate and non-particulate ones, such as powders, granular materials, soils, rocks, concrete and various others. The standard DEM, however, has certain difficulties in a proper representation of material behaviour, for instance, the maximum value of Poisson's ratio that can be obtained with discrete element model is 0.25 for bonded spherical elements and 0.33 for bonded disc elements.

In order to mitigate these limitations, a novel formulation of the discrete element method, called the deformable discrete element method (DDEM) was proposed in [1]. The deformability of the particles in the DDEM is taken into account in a simplified way which does not increase the computational cost of the DEM too much [2]. Particle deformation is evaluated assuming uniform strain in the particle induced by the volume-averaged stress derived in terms of the contact forces acting on the particle.

Deformability of particles yields a nonlocal contact model, it leads to the formation of new contacts, it changes the distribution of contact forces in the particle assembly and affects the macroscopic response of the particulate material, in particular it allows to extend the range of the Poisson's ratio which can be reproduced in the DEM. The performance of the DDEM will be demonstrated by simulations of the uniaxial compression and wave propagation in an elastic body.

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