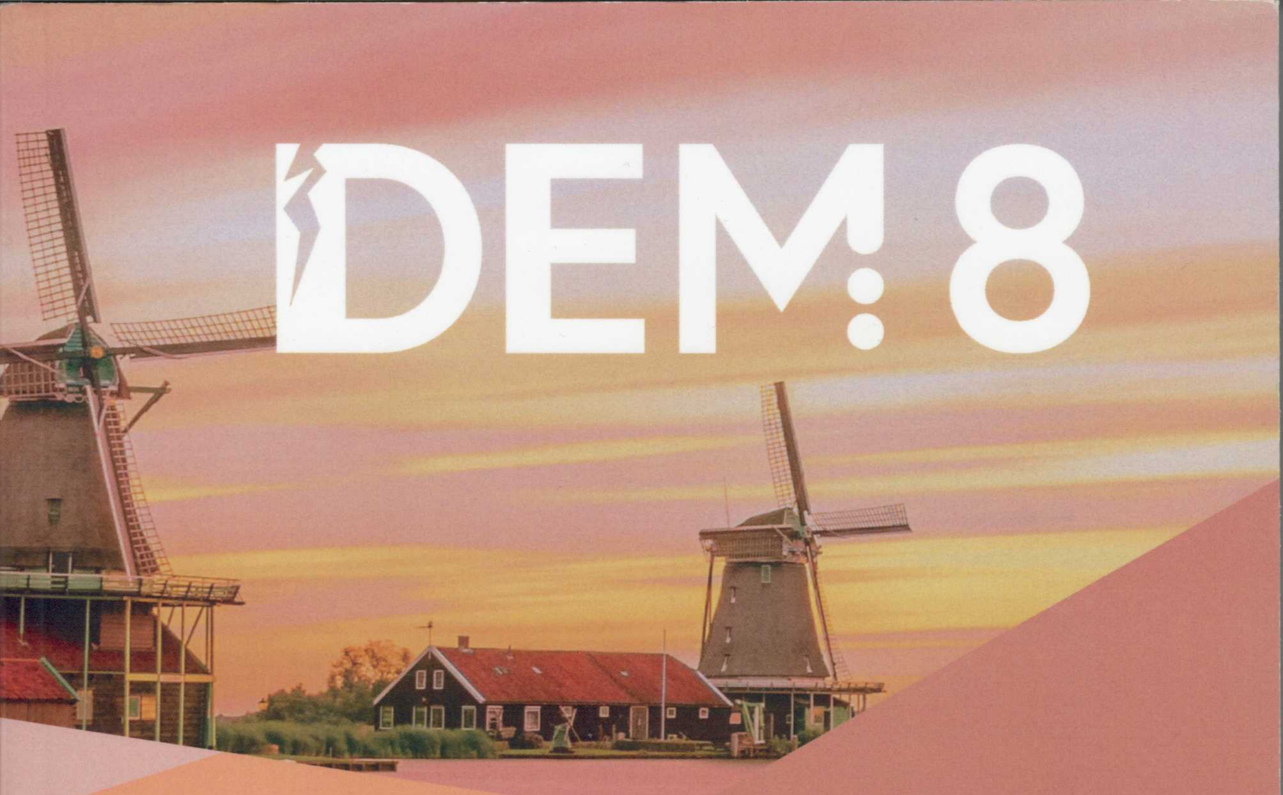

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180: Enhanced modelling capabilities of the discrete element method with deformable particles

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Keywords deformable particles, micro-macro relationships, Poisson's ratio, elastic wave propagation

Abstract An original concept of the discrete element method accounting for deformability of cylindrical or spherical particles will be presented. The deformability of the particles in the new method, called the deformable discrete element method (DDEM) is taken into account in a simplified way which does not increase the computational cost of the DEM too much.

It is assumed that the particle deformation is composed of the global and local deformation modes. The global deformation mode is evaluated assuming a uniform strain in the particle induced by the volume-averaged stress derived in terms of the contact forces acting on the particle. The particle strains are obtained via the inverse constitutive relationship from the averaged particle stress. The linear elastic material model is assumed for the particle global deformation mode. The deformed shape (global deformation) of the particle is obtained by an integration of the particle strain. The local deformation modes are assumed at contact zones, and they are represented by the overlaps of the globally deformed particles. The normal contact forces are determined as functions of the overlaps.

It has been shown that the proposed method enhances the modelling capabilities of the discrete element method. Deformability of particle 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, which is important, for instance in problems of wave propagation.

The performance of the DDEM will be demonstrated by simulations of the uniaxial compression of a cohesive material modelled with bonded particles. These simulations have been used to determine the relationships between the macroscopic effective elastic moduli and microscopic parameters of the new DEM. The DDEM model will be used to simulate elastic wave propagation. It will be shown that the new method allows us to reproduce better the ratio of compressional to shear wave speed.

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