4th Polish Congress of Mechanics and
23rd International Conference on Computer Methods in Mechanics
PCM-CMM-2019, Kraków, Poland, September 8-12, 2019

THE DISCRETE ELEMENT METHOD WITH DEFORMABLE PARTICLES

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Keywords: *Discrete Element Method, Deformable Particles, Macroscopic Properties*

An original concept of the discrete element method accounting for deformability of cylindrical or spherical particles proposed in [1] 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 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 Poissons ratio which can be reproduced in the DEM, which is important in many practical applications.

The performance of the DDEM will be demonstrated by simulations of the uniaxial compression of a cohesive material modelled with bonded particles. The relationships between the macroscopic effective elastic moduli and microscopic parameters of the DDEM will be determined. Numerical properties of the DDEM have been studied extensively in [2].

Acknowledgement. This work has been financed from the funds of the National Science Centre (NCN) awarded by the decision number DEC-2015/19/B/ST8/03983.

References

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