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FLOWING CHARACTERISTICS OF SPHERICAL PARTICLES WITH RESTRAINED ROTATION

Behzad Soltanbeigi[1], Thomas Weinhart[2], Stefanos-A. Papanicolopulos[1], Stefan Luding[2], and Jin Y. Ooi[1]

[1] Institute for Infrastructure and Environment, School of Engineering, University of Edinburgh, EH9 3JL, Edinburgh, UK, j.ooi@ed.ac.uk , www.t-mappp.eu *
[2] Multiscale Mechanics (ET & MESA +), University of Twente, P.O. Box 217, 7500AE Enschede, The Netherlands, s.luding@utwente.nl, and www.mercurydpm.org

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Real particles are mainly non-spherical and have surface irregularities. The irregular shape results in geometric interlocking between particles at the micro-scale, which hinders the motion of the particles and therefore affects directly the rheology at the macro-scale. Spheres, however, are the most frequently used shape in Discrete Element Modelling (DEM) simulations. For spheres, the mechanical interlocking is missing and the motion of the individual particles is restricted merely by frictional forces. Meanwhile, it has already been suggested that controlling the rotational freedom can overcome the inherent deficiency of the spheres in providing geometric interlocking [1, 2]. However, a comprehensive investigation, which clarifies the effect of such an implementation on flowing characteristics of spherical particles, is missing. In this regard, a systematic study, which incorporates two popular rolling friction models (Model A and C according to the classification suggested by Ai et al. [3]), has been conducted using a flat-bottom silo.

Furthermore, to conduct multi-scale analyses, the obtained micro-scale DEM data are coarse-grained to obtain the bulk response of the considered granular assembly. This enhanced understanding the effect of rolling resistance on the flow profiles, the invariants of the stress tensor and other microscopic quantities. The preliminary results suggest that flow rate, velocity profiles and stress distribution are directly dependent on the magnitude of the applied rotational constraint. Further investigations are carried out to verify the differences of both rolling resistance models at the single particle level and relate these features to the respective macro responses. Consequently, the current study aims to provide the fundamental characteristics of both models and enlighten other researchers about the effect of incorporating such models in DEM simulations.

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