The Development of Advanced DEM-based Hybrid Models for Particulate Systems

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Abstract

Particulate systems are ubiquitous in nature and in chemical processing industries, and may products are manufactured using particulate materials. Mechanical behaviour of particulate systems during the manufacturing process are complex, as the particle systems behave either as a collection of loose packed one, whose interactions with neighbouring particles and surrounding fluids (e.g. air) dominate the process where the deformation of individual particles are negligible, or solid-like materials, where significant particle deformation, even fragmentation, can take place. To model complex behaviour of particulate systems, it is challenging to rely on the discrete element method (DEM) alone. In this paper, an overview on how DEM can be hybridized with computational fluid dynamics (CFD), the finite element method (FEM) and the population balance model (PBM) to model the complex mechanical behavior of particulate system will be presented. For each hybrid model, the principle will be introduced and some case studies will be given to demonstrate the robustness of these models. It is shown that these hybrid models provide an useful alternative numerical tool that can be used to predict the mechanical behaviour of particulate systems.

Keywords: DEM, DEM-CFD, DEM-FEM, DEM-PBM, Particle systems