Public Abstract

First Name:Raihan
Middle Name:
Last Name:Tayeb
Adviser's First Name:Yuwen
Adviser's Last Name:Zhang
Co-Adviser's First Name:
Co-Adviser's Last Name:

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Title:STUDY OF MICRO-SIZED PARTICLE DEPOSITION USING DEM, CFD-DEM AND SPH APPROACH

Self-assembly and packing of colloids and micro or nano scale particles has become a subject of great interest due to widespread advancement of micro-scale technologies. A complete numerical analysis of packing phenomena in particle laden multiple phase systems can be of great importance by providing deeper understanding of the packing process. In this thesis, several numerical analyses are performed to study the packing or self-assembly of micro-sized particles under dry or wet condition. Part one of the thesis is concerned with DEM simulation of micro-sized cohesive granular particles using two history dependent contact models. DEM stands for Discrete Element Method. History dependent means that the force that arises due to collision between two particles depends on collision history. The simulation results showed that the particles with Gaussian size distribution always have the lowest packing density. For cohesive particles, size distributions result in the same tendency of packing density but has much less variation with particle size. In the second part a coupled Computational Fluid Dynamics (CFD) and DEM method is used to simulate self-assembly of micro-sized particles induced by evaporation. The problem involves interaction between solid and fluid as well as interaction between fluids. The problem also involves phase change.In the simulation liquid water film evaporates and leaves the particles at the container alone. Interesting patterns (self-assembly) are seen to emerge as the liquid water film evaporates. In the third part of the thesis low velocity SPH method is used to simulate jamming transition in granular system under cyclic compression. The jamming of granular materials indicates how disordered particle systems change from mechanically unstable to stable states. The results obtained show that the average coordination number varies with packing fraction during jamming. Stress relaxation is seen to occur after several compression cycles which is marked by a decrease in coordination number and global pressure. Force distribution shows similar exponential behavior as the average force on the system is increased. The results obtained from the thesis can be of great importance to people working or researching in the field of micro or nano technology. This thesis provides information on packing properties of micro scale particles and how these properties change due to external mechanical influence. Fabrication of micro-scale structures which is essential for many industrial applications such as optics, catalysis and printing technology can be achieved by assembling micro-sized particles.