

Summary

The Discrete Element Method (DEM) is a numerical method which allows simulating the behavior of granular materials. By calculating the individual behavior of each particle in the granular solid system step by step, the complex behavior of the bulk solid during a certain time can be computed. The present computational power of computers has made it possible to use the DEM on large problems up to 1 million particles, making the DEM a tool that can be used in the design of bulk handling equipment.

Before the DEM should be applied, the user of the DEM should know the theory, possibilities and shortcomings of the DEM. Also of importance is the accurateness of the predictions made by the DEM.

At each timestep, based on the position of particles, contact points between particles or particles and equipment are identified, using a contact detection algorithm. As particles are allowed to overlap, this overlap is used to calculate the interaction forces. Several models, such as the linear spring and the Hertz-Mindlin contact model are available for calculating these interaction forces but there is no consensus on which model is the best. From these interaction forces, the net forces acting on a particle are calculated. Newton and Euler equations are used to compute the accelerations of each particle. Using an integration scheme, new velocities and positions are calculated, with these new positions new contact points have to be identified and the process starts at the beginning.

A realistic representation of the particle geometry is still difficult and requires large computing times, making some simplifications on the shape necessary. Other particle parameters that need to be defined are: Particle stiffness, damping coefficient and friction coefficients. Reducing the particle stiffness with a factor of 100 has no great impact on the results, but reduces the computing time significantly.

The DEM offers possibilities to revolutionize the design of bulk handling equipment. However, the DEM should be used with caution as an inaccurate model leads to inaccurate results. Besides a substantiated model the initial state of the particles is of importance. A validation experiment is recommended to guarantee the predictions made by the DEM. Only then bulk equipment designs optimized with the DEM can be used to redesign bulk handling equipment.