Accelerated granular matter simulation

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Akademisk avhandling

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Abstract

Modeling and simulation of granular matter has important applications in both natural science and industry. One widely used method is the discrete element method (DEM). It can be used for simulating granular matter in the gaseous, liquid as well as solid regime whereas alternative methods are in general applicable to only one. Discrete element analysis of large systems is, however, limited by long computational time. A number of solutions to radically improve the computational efficiency of DEM simulations are developed and analysed. These include treating the material as a nonsmooth dynamical system and methods for reducing the computational effort for solving the complementarity problem that arise from implicit treatment of the contact laws. This allow for large time-step integration and ultimately more and faster simulation studies or analysis of more complex systems. Acceleration methods that can reduce the computational complexity and degrees of freedom have been invented. These solutions are investigated in numerical experiments, validated using experimental data and applied for design exploration of iron ore pelletising systems.

Keywords

discrete element method, nonsmooth contact dynamics, multibody dynamics, granular media, simulation, projected Gauss–Seidel, validation, iron ore pellets, pelletising balling circuit, model reduction, design optimization