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Particle simulations on the GPU using the Blaze-DEM code

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Abstract content
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Numerical simulation of particulate materials is required in many industrial processes with applications ranging from ball mills in mining to powder mixers in pharmaceuticals. While the discrete element method (DEM) has become the defacto standard for numerical simulation of particulate materials , the large computational cost associated with the method limits the number of particles that can be simulated in a realistic time frame on a typical computer to less than a million. Simulations of millions of particles are only possible on expensive clusters which are typically not accessible to the majority of users. However, the computational architecture plays a significant role on the performance that can be realized. In the last few years the trend of increasing Central Processing Unit (CPU) clock speed resulting in more computations being performed in the same time period has stopped due to the physical limits on the materials used in the manufacturing of computer hardware. While computational power still scales with Moore's Law, this scaling is now achieved through increasing the number of computing cores on a single chip as opposed to make a single core faster. Leading this evolution from multi core to many core processing chips is the Graphical Processor Unit (GPU) that can perform billions arithmetic operations in parallel (7.52 TFLOPS). In this paper we present the GPU based code Blaze-DEM that allows for tens of millions of particles to be simulated on a single pc. We will look at the GPU specific algorithms for DEM as well some experimental and simulation results for industrial processes such as silos , ball mills and pulp lifters.

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