Massively Parallel Lattice Boltzmann Simulations of Fully Resolved Particulate Flows

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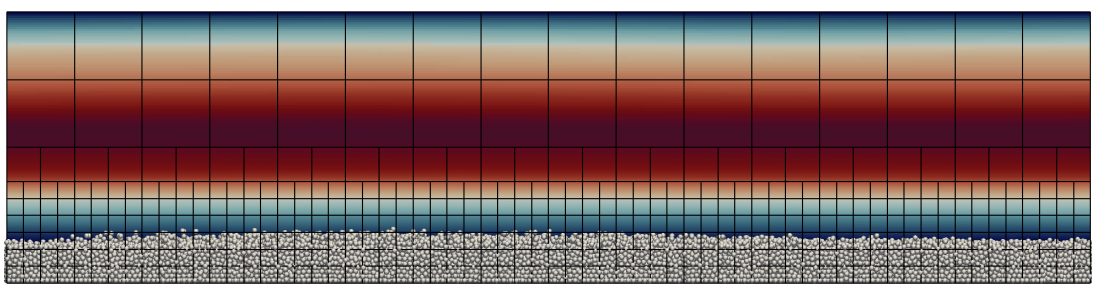
ABSTRACT

The direct numerical simulation of particulate flows is based on fluid-structure coupling mechanisms that transfer momentum from the particulate to the fluid phase and vice versa. In this talk we will focus on particles that are geometrically fully resolved to enable accurate predictions from first principles [1]. The fluid dynamics are represented by the lattice Boltzmann method with the collision model from [2]. The interaction between particles is modeled by a non-smooth granular dynamics method [3]. We will discuss suitable fluid-solid coupling algorithms with special emphasis on their suitability for massively parallel execution. In combination with grid refinement techniques [4], large scale simulations of particulate flows can be realized efficiently featuring several thousand particles interacting with the fluid flow. Illustrating examples from environmental engineering will be presented, such as the dynamics of sediment beds as visualized below. The generality and flexibility of the approach can be used to investigate the influence of particle shapes and size distributions on such systems.



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