Multiscale Modelling of Granular Chute Flows

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ABSTRACT

There are many applications for granular flow, from large-scale snow, rock or debris avalanches to small-scale material transport in industrial processes. Here, we consider the flow of granular material down an inclined chute. The flow is described by a macroscopic model with the exception of the basal friction coefficient, which requires microscopic modelling with a shorter spatial and temporal step size.

We investigate modelling the flow with a Heterogeneous Multiscale Method [1]. The macroscopic behaviour is described by a Discontinuous Galerkin discretization of the shallow water equations with unknown bottom friction coefficient. A Discrete Particle Model [2] is used to compute the undetermined basal friction coefficient and hence close the model. The microscopic model requires a short time scale, but is assumed to relax rapidly in time. The results presented here were implemented in hpGEM [3].

The model is tested against the Pouliquen-Jenkins flow rule [4] for rapid granular flow along an inclined chute with rough base. We simulate granular flows through a contraction and show speed comparisons with the microscopic model to demonstrate the effectiveness of the algorithm.

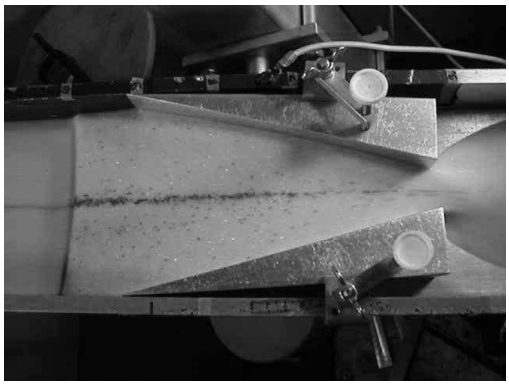

Figure 1: Granular flow through a contraction [5].

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