Granular flows in inclined channels with linear constrictions

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Study of granular flows down inclined channels is essential in understanding the dynamics of natural phenomena such as landslides and snow avalanches. As a stepping stone, monodisperse dry granular flows in an inclined channel with a localised constriction is investigated both theoretically and numerically. By utilising the depth-averaged shallow granular equations of motion [1] with a friction law obtained from particle simulations of steady monodisperse flows [2], we will present a novel one-dimensional granular model [3, 4]. The one-dimensional (1D) model is obtained by width-averaging the closed two-dimensional (2D) shallow granular model, which is also an extension of the one for water flows through contraction [5].

For steady flows, this extended 1D granular hydraulic theory predicts multiple flow regimes, like smooth flows without jumps or steady jumps/shocks in the contraction, which for supercritical and subcritical flows is verified by solving the two-dimensional (only depth-averaged) shallow granular equations using the discontinuous Galerkin finite element method. Despite the strong flow inhomogeneities in the contraction region, the one- and two-dimensional solutions (averaged across the channel width) match for, both, supercritical and subcritical flows.

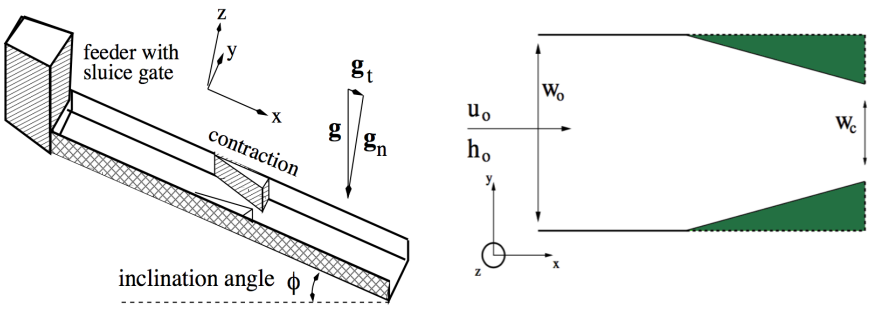

Figure 1: Illustrates an inclined channel with linear constrictions (left) and its top view (right).

Keywords: Shallow granular flows

References

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