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Avalanche impact force on a rigid wall in presence of a granular jump

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The prediction of the magnitude of impact forces snow avalanches can exert on rigid walls is of utmost importance in order to design efficient protection dams and safe buildings able to withdraw the impact of snow avalanches. When a free-surface gravity-driven granular flow meets a rigid wall without any possible overflow downstream of that wall, the material gradually piles up against the wall and a propagating jump is formed at the (moving) frontier between the incoming flow and the material that comes to rest behind the wall. An analytical solution was recently proposed to describe the impact force on a rigid wall when such a complicated physics comes into into play and the proposed formulation was shown to give reasonable results when it was compared to extended discrete numerical simulations of the granular flow-wall impact problem (Albaba et al., 2018). This analytical solution can still be improved but already provides a number of ingredients that are essential when considering complex materials, such as granular materials and snow. In particular, it is possible to consider the compressibility of the material and a couple of processes associated with friction. The present study proposes to explore the theoretical predictions of the analytical solution considering a wide range of the different ranges of input parameters for the analytical solution. Case studies are also considered. This work allows demonstrating the richness of the analytical solution compared to more straightforward formula that are traditionally used in avalanche engineering.

Albaba A, Lambert S, Faug T. (2018). Dry granular avalanche impact force on a rigid wall: Analytic shock solution versus discrete element simulations. Physical Review E, 97, 052903.